**Safety Evaluation Report With Open Items for the U.S. EPR**

**Chapter 16, "Technical Specifications"**

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# 16 TECHNICAL SPECIFICATIONS

## 16.1 Introduction

The U.S. EPR Generic Technical Specifications (GTS) were provided by AREVA NP, Inc., (hereafter AREVA or the applicant) for U.S. Nuclear Regulatory Commission (NRC) staff review in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.36(a) (10 CFR 50.36(a)), "Technical Specifications (TS)," 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors," and 10 CFR 52.47(a)(11), "Standard Design Certification: Content of application: Technical information." In its application, the applicant stated that the GTS was derived from the analyses and evaluations in the U.S. EPR Final Safety Analysis Report (FSAR). The applicant also informed the NRC that the GTS were developed utilizing Revision 3.1 of the Standard Technical Specifications (STS), NRC NUREG-1430, "Standard Technical Specifications − Babcock and Wilcox Plants," NUREG-1431, "Standard Technical Specifications − Westinghouse Plants," NUREG-1432, "Standard Technical Specifications Combustion Engineering (CE) Plants," and NUREG-1434, "Standard Technical Specifications − General Electric Plants (BWR/6)," as deemed appropriate to the U.S. EPR design. The staff determined that the GTS is modeled primarily after the Standard Technical Specifications (STS) referenced in NUREG-1431 and, to a lesser extent, NUREG-1432. The remaining two NUREGs referenced by the applicant were only used in very limited applications.

In accordance with 10 CFR 50.36(a), the applicant also provided a "Bases" document, Chapter 16B, that included a summary statement of the bases or reasons for such technical specifications. Consistent with this requirement, bases information 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, the applicant also stated that the FSAR was prepared using the guidance in NUREG-0800, "Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants − LWR Edition," (hereafter referred to as NUREG-0800 or the SRP) and, to the extent applicable for design certification, the applicant used Regulatory Guide (RG) 1.206, Revision 0, "Combined License (COL) Applications for Nuclear Power Plants (LWR Edition)," as a guide for format and content. In March 2007, NUREG-0800 was revised to be consistent with the guidance provided in RG 1.206, to facilitate an effective and efficient review of the FSAR for design certification and combined license applications submitted in accordance with 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

This safety-evaluation report documents the staff's review of the GTS and Bases with regard to NRC requirements and guidance, and consistency with the related portions of the U.S. EPR design certification document.

## 16.2 Summary of Application

**FSAR Tier 1**: FSAR Tier 1 information does not include the GTS or Bases. However, as part of the GTS and Bases review, some FSAR Tier 1 information has been reviewed to ensure that the information in the GTS and Bases is consistent with the corresponding portions of the U.S. EPR design certification documentation found in the FSAR Tier 1 portion of the FSAR.

**FSAR Tier 2**: The applicant provided the GTS and Bases as part of its application in FSAR Tier 2, Chapter 16, "Technical Specifications."

**ITAAC**: There are no ITAAC items associated with the U.S. EPR GTS and Bases.

**Technical Specifications**: The GTS and Bases are provided in the FSAR Tier 2 portion of the FSAR, Chapter 16, and are the subject of this safety evaluation. The GTS and Bases are summarized herein as follows:

In accordance with 10 CFR 50.36(c), TS shall include "safety limits (SLs), limiting safety-system settings, and limiting control settings." Safety limits for nuclear reactors are the limits placed upon important process variables that are necessary to reasonably protect the physical barriers that guard against the uncontrolled release of radioactive material. If any of these limits are exceeded, the reactor must be shut down. Limiting safety-system settings are settings for automatic protective devices related to those variables having significant safety functions. These settings are so chosen to allow automatic protective devices to correct an abnormality before a safety limit is exceeded. Limiting control settings apply to fuel reprocessing plants and are not applicable to this review.

The GTS contains: "Limiting Conditions for Operation" (LCO), "Applicability," determination, remedial "Actions," and "Surveillance Requirements" (SRs). "LCO" specify the lowest functional capability or performance levels of equipment required for safe operation of a nuclear facility. If these conditions are not met, the licensee is required to take remedial actions permitted by the TS or shutdown. "Applicability" identifies when an LCO is in effect and has to be met, usually in terms of Mode(s) of Operation and thermal power. "Actions" include the "Condition(s)" that defines the anticipated method(s) in which the requirements of the LCO cannot be met. Specified with each of these identified conditions are "Required Actions," the actions that must be taken in response to the corresponding condition; and the "Completion Time," (CT) the time limit to complete the required action. Each "SR" is described and has a specified frequency in which the surveillance must be satisfactorily performed. The design features in GTS Section 4 are discussed in the appropriate technical sections of this report. The administrative controls in GTS Section 5 contain descriptions of the minimum program requirements. Detailed evaluation of the proposed administrative controls is discussed in the appropriate sections of this report.

In addition to the GTS, the FSAR, Chapter 16B, the "Bases," contain summary statements of the bases or reasons for such specifications, as applicable, and include background information, applicable safety analyses, LCO, applicability, actions, SRs, and references. In accordance with 10 CFR 52.47(a)(2), "Contents of applications; technical information," the descriptions provided in the Bases document shall be sufficient to permit an understanding of the system design and its relationship to the safety evaluations. Such items as the reactor core, reactor coolant system, instrumentation and control (I&C) systems, electrical systems, containment system, other engineered safety features (ESFs), auxiliary and emergency systems, power conversion systems, radioactive waste handling systems, and fuel handling systems shall be discussed insofar as they are pertinent.

## 16.3 Regulatory Basis

The relevant requirements of NRC regulations for TS and Bases reviews, and the associated acceptance criteria, are given in NUREG-0800, Chapter 16 and are summarized below. Review interfaces with other SRP sections also can be found in NUREG-0800, Chapter 16.

1. 10 CFR 50.36, establishes NRC regulatory requirements relating to the content of TS.

2. 10 CFR 50.36(c) requires that TS contain (1) safety limits and limiting safety-system settings, (2) limiting conditions for operation, (3) SRs, (4) design features, and (5) administrative controls.

3. 10 CFR 50.36(c)(2)(ii) requires that an 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 DBA 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

4. General Design Criteria (GDC) 17, “Electric Power Systems,” as they are related to meeting single failure criteria in safety-related system design

5. GDC 21, “Protection System Reliability and Testability,” as they are related to meeting single failure criteria in safety-related system design

6. GDC 34, “Residual Heat Removal,” as they are related to meeting single failure criteria in safety-related system design

7. GDC 35, “Emergency Core Cooling,” as they are related to meeting single failure criteria in safety-related system design

8. GDC 38, “Containment Heat Removal,” as they are related to meeting single failure criteria in safety-related system design

9. GDC 41, “Containment Atmosphere Cleanup,” as they are related to meeting single failure criteria in safety-related system design

10. GDC 44, “Cooling Water,” as they are related to meeting single failure criteria in safety-related system design

Acceptance criteria adequate to meet the above requirements are included in the STS documents. The STS for pressurized water reactors 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 safety limits, limiting safety system settings, limiting

conditions for operation, and associated actions and surveillance requirements. The documents applicable to the U.S. EPR include:

1. NUREG-1430, “Standard Technical Specifications - Babcock and Wilcox Plants”

2. NUREG-1431, “Standard Technical Specifications - Westinghouse Plants”

3. NUREG-1432, “Standard Technical Specifications - Combustion Engineering (CE) Plants”

These STS documents reflect the detailed effort used to apply the four criteria of 10 CFR 50.36(c)(2)(ii) 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 consistent application of TS criteria and the TS Writer's Guide would consistently provide 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 Federal Register (FR) 39132) on standardization of TS expressing the view that satisfying the guidance in the policy statement also satisfies Section 182a. of the Atomic Energy Act 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 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 design certification should use STS and applicable Bases to the extent possible, not withstanding design-specific characteristics. As is appropriate, deviation from the STS, as well as design-specific characteristics, shall be technically justified by an applicant and reviewed in detail by the NRC.

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 plant-specific technical specifications (PTS):

- TSTF-448-A, Revision 3, “Control Room Habitability”

- TSTF-449-A, Revision 4, “Steam Generator (SG) 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, “Codes and Standards”

- 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”

## 16.4 Technical Evaluation

### 16.4.1 General

The staff has reviewed and evaluated the GTS and Bases to verify their accuracy and completeness. The staff has also reviewed the GTS to confirm the appropriateness of the restrictions imposed by the GTS to ensure that an operating U.S. EPR will operate within its safety limits and limiting safety system settings, as described in the FSAR. The GTS must ensure that a plant designed and constructed in accordance with the U.S. EPR 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 U.S. EPR licensee to take specified actions, up to and including shutting down the plant, if one or more systems, structures, or components (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 Standard Technical Specifications (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 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 Pressurized Water Reactor (PWR), a 2 Loop PWR, a 2 Loop PWR with once through Steam Generators, 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 − Babcock and 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 U.S. EPR 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 U.S. EPR design is a 4 Loop PWR, it is most similar to the Westinghouse design. The Westinghouse and US EPR designs have SSCs with similar names and functions. The U.S. EPR was developed from existing Framatome designs, which, in turn, were developed from Westinghouse designs. Both the U.S. EPR design and the Westinghouse design for which the STS provide a model set of standard TS use systems with 100 percent trains: The U.S. EPR design provides additional redundancy for key safety systems and some U.S. EPR unique design features. However, the U.S. EPR is sufficiently similar to the Westinghouse design, in view of its 4 Loop PWR design, the similarity of the design and function of many of its SSCs to the SSCs of a Westinghouse 4 Loop design, and its use of 100 percent trains, so that the Westinghouse STS in NUREG-1431 can be applied as guidance in evaluating most of the GTS. With the exception of U.S. EPR Tier 2, Section 16.3.2, which used the Combustion Engineering STS, the preponderance of the GTS were based on the Westinghouse GTS.

Based on the similarity in design and function of some U.S. EPR SSCs to those of the Combustion Engineering design to which the model STS in NUREG-1432 apply, the staff also determined that some of the STS in NUREG-1432 could be applied as guidance in evaluating the GTS applicable to those SSCs. For similar reasons, in some limited applications, the STS in NUREG-1430 and NUREG-1434 could also be applied as guidance in evaluating the GTS. As described below throughout this chapter, some U.S. EPR SSCs are unique to the design, and the STS were of limited use as guidance in the staff evaluation of these SSCs.

In some instances, detailed site-specific design information, equipment selection, instrumentation settings, or other information are needed to establish the information to be included in the plant-specific TS. Locations for this site-specific information are signified by “square brackets” to indicate where combined license applicants, that reference the U.S. EPR design certification, must provide plant-specific values. COL applicants must also include in their application, technical justification for the site-specific information provided. This is COL Information Item 16.0-1.

In addition, the GTS and Bases contains Reviewer’s Notes stating conditions that an applicant (or licensee) must address in order to adopt a particular TS provision, for example, incorporation of an NRC-approved methodology into a plant’s licensing basis or a staff determination that a licensee’s probabilistic risk assessment program is of adequate quality.

An evaluation of the GTS and Bases was performed by the NRC and the results documented in Sections 16.4.2 through 16.4.15 of this report.

## 16.4.2 Use and Application

### Introduction

GTS Section 1.0, “Use and Application,” provides the definitions for terms, explains the logic connectors, establishes the Completion Time convention, and defines the proper use and application of frequency requirements utilized throughout the GTS.

**Evaluation**

In general, GTS Section 1.0 is modeled after NUREG-1431, Section 1.0, "Use and Application." Although GTS Section 1.0, closely models the STS in format and content, the staff noted differences that require technical justification and clarification beyond what was given in GTS Section 1.0.

In FSAR Tier 2, GTS Section 1.1, "Definition of Terms," the applicant identified two new terms, "Division Operational Test," and "Sensor Operational Test (SOT)," to be used in place of the existing STS term, "Channel Operational Test (COT)," to reflect the unique U.S. EPR control system design. In addition, the applicant introduced other new terms that directly or equivalently replace existing terms in the STS without an explanation for the changes. Finally, the applicant omitted some existing STS definitions including, "Engineering Safety Feature," "Response Time," and "Reactor Trip System (RTS) Response Time," again without an explanation. In Request for Additional Information (RAI) 122, Question 16-243, the staff requested that the applicant provide justifications for these changes. In a March 19, 2009, response to RAI 122, Question 16-243, the applicant addressed each difference from the Westinghouse STS, and proposed to remove the definition for the term, "Division Operational Test," and to add a new term, "Protection System Response Time," to replace the two old terms, "Engineering Safety Feature Response Time," and "Reactor Trip System Response Time." The staff found that the applicant adequately addressed these differences because they reflect unique features in the U.S. EPR design, especially the integrated digital Instrumentation and Control system. The complete scope of the newly defined tests was evaluated as part of their applications throughout the GTS (see Section 16.4.7 of this report for further details). The staff has confirmed that Revision 1 of the U.S. EPR FSAR, Tier 2, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 122, Question 16-243 is resolved.

In GTS Sections 1.3, "Completion Times," and 1.4, "Frequency," the applicant proposed a new term, "Division," to replace "Train" and "Channel," the terms currently used in Westinghouse STS. The staff determined that these changes do not add any value. The new term did not enhance the understanding of the examples used to illustrate completion times in the GTS action statements or frequencies in the GTS surveillance requirements. Moreover, the terms, "Train" and "Channel," are still being used throughout the GTS. In RAI 122, Questions 16-245 and 16-246, the staff requested that the applicant provide a justification for these changes or to adopt the original texts of the STS. In a December 18, 2008, response to RAI 122, Questions 16-245 and 16-246, the applicant agreed to revise GTS Section 1.3 and GTS Section 1.4, to reinstate the original texts of the Westinghouse STS. The staff has confirmed that Revision 1 of the U.S. EPR FSAR, Tier 2, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 122, Questions 16-245 and 16-246 are resolved.

Also in RAI 122, Question 16-244 and RAI 122, Question 16-256, the staff requested that the applicant correct editorial errors found in GTS Section 1.0. In a December 18, 2008, response to RAI 122, Question 16-244 and RAI 122, Question 16-256, the applicant agreed to revise the GTS to reflect these corrections. The staff has confirmed that Revision 1 of the U.S. EPR FSAR, Tier 2, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 122, Questions 16-244 and 16-256 are resolved.

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

**Conclusion**

The applicant adhered to the guidance for definitions for terms, logic connectors, conventions for Completion Time, and frequency requirements as referenced in the Westinghouse STS, with exceptions as discussed above. In addition, GTS Section 1.0 does not contain any bracketed information or Reviewer's Notes. Therefore, the staff finds GTS Section 1.0 acceptable.

## 16.4.3 Safety Limits

**Introduction**

GTS Section 2.0 and Bases include the requirements for safety limits. Safety limits are used to ensure that the fuel design limits and the reactor coolant system (RCS) boundary pressure limits are not exceeded during steady state conditions, normal operating transients and anticipated operational occurrences.

**Evaluation**

In general, GTS Section 2.0, "Safety Limits," is modeled after Westinghouse STS, Section 2.0, with some differences to reflect the U.S. EPR design.

In RAI 102, Question 16-125, the staff requested that the applicant explain discrepancies that were noted regarding the Departure for Nucleate Boiling Ratio (DNBR). The staff noted the following discrepancies: (1) The reactor core SL for the DNBR ratio were listed based upon use of either the ACH-2 or BWU-N correlations (ratios are 1.246 and 1.21 respectively); (2) in response to RAI 5 in Chapter 4 of this report on the ACH-2 review (ANP-10269P-A), it was stated that the DNBR Technical Specification would be identified with a design limit of 1.30; and (3) the DNBR limit calculated using the BWU-N correlation did not match the value provided in corresponding Topical Report BAW-10199P-A.

In an October 24, 2008, response, the applicant stated that the DNBR for the ACH-2 correlation in Section 2.1.1.1 of the Safety Limits will be revised from "≥ 1.246" to "≥ 1.25." The applicant indicated that the response to RAI 5 (which includes the 1.30 value) was submitted in May 2007, prior to the addition of ANP-10269P, Revision 0, Supplement (August 2007), and has been superseded. The applicant noted that Section 4.0 of the staff's safety evaluation report (SER) for ANP-10269P-A states that the approved DNBR limit for the ACH-2 correlation is ≥ 1.25. The applicant also noted that the staff's SER for BAW-10199P-A stated that the DNBR limit for the BWU-N correlation for pressures above 1500 psia is 1.21. This value is consistent with TS Section 2.1.1.1. In an October 24, 2008, response, the applicant included marked-up pages of the changes that would be made to Section 2.1.1.1.

In RAI 102, Question 16-127, the staff requested that the wording of Safety Limits Bases Section B 2.1.1 be modified so that the peak fuel centerline temperature would correspond to the absolute fuel temperature limit, instead of steady state peak linear heating rate.

In an October 24, 2008, response, the applicant stated that TS Section 2.1.1 Bases would be revised to indicate that the overheating of the fuel is prevented by maintaining the peak linear heat rate (LHR) below the level that would cause the fuel centerline temperature to reach the

fuel rod melt temperature limit. In an October 24, 2008, response, the applicant included marked-up pages of the changes that would be made to Bases Section B 2.1.1.

In RAI 110, Question 16-241, the staff requested that the applicant provide a rationale for omitting Core Operating Limits Report (COLR) limitations on the combination of Thermal Power, RCS highest loop average temperature and pressurizer pressure from GTS Section 2.1.1.

In an October 28, 2008, response, the applicant stated that the information presented in the Applicable Safety Analyses and Safety Limits portions of the FSAR TS Bases Section B 2.1.1 has been updated and is consistent with the U.S. EPR incore trip setpoint and transient methodology topical report submitted November 27, 2007. This methodology is the basis for the calculation and dynamic confirmation of the incore setpoints which are designed to protect against violation of the specified safety limits during normal operation and anticipated operational occurrences. In an October 28, 2008, response, the applicant included marked-up pages of the changes that would be made to Bases Section B 2.1.1.

The staff evaluated the proposed changes as a result of the responses and finds the proposed changes acceptable both in content and format. In addition, the staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, accurately reflects the changes committed to in the above stated question responses. The staff evaluation of the acceptability of the values of these safety limits is set forth in Chapter 15 of this report.

Based upon the above evaluation, the staff finds that the RAIs listed for FSAR Tier 2, Chapter 16, Section 2.0 are resolved.

The remaining portions of GTS Section 2.0 are similar to the applicable STS such that the staff finds them acceptable.

**Conclusion**

The Safety Limits specifications provided in FSAR Tier 2, Section 2.0, which include the Reactor Core Safety Limits and the Reactor Coolant System Pressure Safety Limit, conform to the STS. In addition, the GTS Section 2.0 and its Bases do not contain any bracketed information or Reviewer's Notes. Therefore, the staff finds GTS Section 2.0 and its bases acceptable.

## 16.4.4 Limiting Condition for Operation and Surveillance Requirement Applicability

**Introduction**

The GTS and Section 3.0, "Limiting Condition for Operation Applicability," and "Surveillance Requirement Applicability," includes the general provisions regarding determination of equipment operability and performance of SRs used throughout GTS Sections 3.1 through 3.9.

### Evaluation

In general, GTS Section 3.0 is modeled after STS Section 3.0 for Westinghouse plants with some differences to reflect U.S. EPR-unique design features. Although GTS Section 3.0, closely models the STS in format and content, the staff noted differences between the two that warranted clarification beyond what was given in GTS Section 3.0 and its applicable bases.

In RAI 110, Question 16-242, the staff requested that the applicant provide examples, similar to those provided in the Westinghouse STS, regarding determination of loss of system functions in a supported system due to inoperable equipment in the supporting system. In a December 18, 2008, response to RAI 110, Question 16-242, the applicant stated that, since most of U.S. EPR systems have four redundant trains, versus the two-train design in the Westinghouse STS, similar examples for the four-train design would cause more confusion rather than enhance the understanding of LCO 3.0.6 requirements. The staff finds the stated position that similar examples are not beneficial for the U.S. EPR design acceptable; therefore, RAI 110, Question 16-242 is resolved.

Also in RAI 110, Question 16-247, the staff requested that the applicant correct editorial errors found in GTS Section 3.0. In a December 18, 2008, response to RAI 110, Question 16-247, the applicant agreed to revise the GTS to reflect these corrections. The staff has confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 110, Question 16-247 is resolved.

The remaining portions of GTS Section 3.0 are similar to the applicable STS such that the staff finds them acceptable.

### Conclusion

The applicant adhered to the model LCO and SR applicability TS as provided in the Westinghouse STS, with some differences to reflect U.S. EPR-unique design features. In addition, GTS Section 3.0 and its Bases do not contain any bracketed information or Reviewer's Notes. Therefore, the staff finds GTS Section 3.0 and Bases Section B 3.0 acceptable.

## 16.4.5 Reactivity Control Systems

### Introduction

GTS Section 3.1 and Bases, "Reactivity Control Systems," includes requirements for the reactivity control systems, which are designed to reliably control reactivity changes and maintain the capability to cool the core under postulated accident (PA) conditions.

### Evaluation

In general, GTS Section 3.1 is modeled after Westinghouse STS, Section 3.1 with differences to reflect the U.S. EPR-unique design features. GTS Section 3.1 corresponds to the Westinghouse STS in the following manner:

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.1.1* | 3.1.1 | SHUTDOWN MARGIN (*Same) |
| 3.1.2* | 3.1.2 | Core Reactivity (*Same) |
| 3.1.3* | 3.1.3 | Moderator Temperature Coefficient (*Same) |
| 3.1.4* | 3.1.4 | Rod Control Cluster Assembly (RCCA) Group Alignment Limits (*Rod Group Alignment Limits) |
| 3.1.5* | 3.1.5 | Shutdown Bank Insertion Limits (*Same) |
| 3.1.6* | 3.1.6 | Control Bank Insertion Limits (*Same) |
| 3.1.7* | 3.1.7 | RCCA Position Indication (*Rod Position Indication) |
| N/A | 3.1.8 | Boron Dilution Protection (BDP) |
| 3.1.8* | 3.1.9 | PHYSICS TESTS Exceptions – MODE 2 (*Same) |

In RAI 122, Question 16-257, the staff requested that the applicant include the applicability requirement of "MODE 2 with Keff < 1.0" to the Applicability for LCO 3.1.1 Shutdown Margin (SDM) or provide technical justification for its omission. This addition is needed in order to be consistent with the Background section of the Bases for TS 3.1.1. In a December 5, 2008, response, the applicant stated that the applicability requirement would be added to LCO 3.1.1 and provided mark-ups of the resulting changes. The staff finds this response acceptable because it eliminates the inconsistency between the specification and the bases.

In RAI 122, Question 16-259, the staff requested that the applicant resolve a discrepancy between LCO 3.1.3b which states "…a maximum MTC equal to 0 pcm/oF when…." and the Background section of the Bases 3.1.3 which states "beginning of cycle (BOC) MTC is less than zero when…." This information is needed to ensure the accuracy and consistency between the GTS and the Bases. In a December 5, 2008, response, the applicant stated that the Bases would be revised to state "…beginning of cycle (BOC) MTC is less than or equal to zero when…." The applicant also provided markups of the resulting change to the Bases. The staff finds this response acceptable because it eliminates the inconsistency between the specification and the bases.

In RAI 122, Question 16-261, the staff requested that the applicant clarify the number of steps a Rod Control Cluster Assembly must be moved during a Surveillance Requirement. This information is needed to ensure the accuracy and consistency between the GTS and the Bases. In a December 5, 2008, response, the applicant stated that the TS, SR 3.1.4.2 and Bases will be modified to reflect a range of 16 to 20 steps. The applicant also provided markups of the resulting change to the Specifications and Bases. The staff finds this response acceptable because it clarifies the number of steps required to correctly perform the SR and aligns with the corresponding Bases.

In RAI 122, Question 16-263, the staff requested that the applicant justify the interpretation of the "Note" in the Applicability Section of LCO 3.1.6 as it pertains to partial trips. This information is needed to clarify the Applicability Section and ensure that no further technical justification is required. In a December 5, 2008, response, the applicant stated that the note in TS Bases Section 3.1.6 pertaining to a partial trip will be deleted, because partial trips have not been

evaluated and are not in the U. S. EPR requirements. The applicant also provided markups of the resulting change to the Bases. The staff finds this response acceptable because it clarifies LCO 3.1.6 and is consistent with the STS.

In RAI 122, Question 16-265, the staff requested that the applicant clarify a discrepancy in LCO 3.1.7. One statement within the section states that the RCCA position will be performed with the Self-Powered Neutron Detectors (SPNDs) while another states the performance will be done by use of the Aeroball Measurement System (AMS). This clarification is needed so the correct system for this function can be identified. In a December 5, 2008, response, the applicant stated that all areas of LCO 3.1.7 would be revised to state that the AMS would be used to verify RCCA position. The applicant also provided markups of the resulting change to the Bases. The staff finds this response acceptable because it is consistent with the stated uses of the AMS.

In RAI 122, Question 16-266, the staff requested that the applicant provide a justification for not requiring verification of RCCA position under LCO 3.1.7, Condition B, with "one or more banks with two or more analog RCCA position indicators inoperable" using incore instrumentation to verify RCCA position. This justification is needed to ensure accuracy and completeness of the GTS. In a December 5, 2008, response, the applicant stated that when "one or more banks with two or more analog RCCA position indicators inoperable" exist, it is the intent of the Bases that the actions of Section 3.1.7, Required Actions for Condition A, be implemented in addition to the Required Actions for Condition B and that the actions occur within their intended time-frames. A Required Action will be added for Section 3.1.7 Condition B to implement the Required Actions for Condition A. The applicant also provided markups of the resulting changes. The staff finds this response acceptable because it removes the inaccuracies and inconsistencies regarding the Required Actions.

In RAI 122, Question 16-268, the staff requested that the applicant provide a justification for not including an additional Required Action for LCO 3.1.8 to restore the Operability of the Volume Control Tank (VCT) and letdown isolation valves. This justification is needed to ensure accuracy and completeness of the GTS. In a December 5, 2008, response, the applicant stated that TS Section 3.1.8 and Bases will be revised to add an additional Required Action for restoring the operability of the VCT and letdown isolation valves. The applicant also provided markups of the resulting changes. The staff finds this response acceptable because it aligns the GTS with the STS.

In RAI 122, Question 16-270, the staff requested that the applicant provide a justification for not including a Surveillance Requirement specifically linked to physics testing under SR 3.1.9 requiring the performance of an Operability verification of the intermediate range and power range channels. This justification is needed to ensure accuracy and completeness of the GTS. In a December 5, 2008, response, the applicant stated that the U.S. EPR uses a Sensor Operability Test for the power and intermediate range divisions that are primarily composed of digital components. In this response, Technical Specifications SR 3.1.9.3, "Perform a Sensor Operational Test on power range and intermediate range divisions," was added. The applicant also provided markups of the resulting changes. The staff finds this response acceptable because it removes the inaccuracies and inconsistencies regarding the required Surveillance Requirements.

In RAI 122, Question 16-272, the staff requested that the applicant provide a justification for LCO 3.1.9 not allowing the suspension of LCO 3.4.2, "RCS Minimum Temperature for

Criticality," during the performance of Physics Tests. The Bases for LCO 3.1.9, Background section, states that the "performance of this test could challenge LCO 3.4.2, RCS Minimum Temperature for Criticality. This justification is needed to ensure accuracy and completeness of the Physics Test program under LCO 3.1.9. In a December 5, 2008, response, the applicant stated that the Bases Section 3.1.9 will be revised to indicate that performance of this test should not challenge LCO 3.4.2. The revision of the Background section of LCO 3.1.9 included the cooldown figures to support this conclusion. The applicant also provided mark-ups of the resulting changes. The staff finds this response acceptable because it removes the inaccuracies and inconsistencies regarding the required LCO suspensions during Physics Testing.

The staff evaluated the proposed changes as a result of the responses and finds the proposed changes acceptable both in content and format. In addition, the staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, accurately reflects the changes committed to in the above stated question responses.

Based upon the above evaluation, the staff finds that the RAIs for FSAR Tier 2, Chapter 16, Section 3.1 are resolved.

The remaining portions of GTS Section 3.1 are similar to the applicable STS such that the staff finds them acceptable.

**Conclusion**

The applicant adhered to the model Reactivity Control Systems TS as provided in the Westinghouse STS, with differences to reflect the U.S. EPR-unique design features. In addition, GTS Section 3.1 and its Bases do not contain any bracketed information or Reviewer's Notes. Therefore, the staff finds GTS Section 3.1 and Bases Section B 3.1 acceptable.

## 16.4.6 Power Distribution Limits

**Introduction**

GTS and Bases B 3.2, "Power Distribution Limits," includes requirements for the Power Distribution Limits, which are designed to reliably adhere to core thermal limits and achieve core power distribution consistent with the design safety analysis.

**Evaluation**

In general, GTS Section 3.2 models after STS Section 3.2 for Combustion Engineering plants, with some differences to reflect U.S. EPR-unique design features. GTS Section 3.2 corresponds to the Combustion Engineering STS in the following manner:

| STS | U.S. EPR GTS | U.S EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.2.1* | 3.2.1 | Linear Power Density (*Linear Heat Rate) |
| 3.2.2* | 3.2.2 | Nuclear Enthalpy Rise Hot Channel Factor (*Planar Radial Peaking Factors (Fxy)) |
| 3.2.4* | 3.2.3 | Departure from Nucleate Boiling Ratio (*Same) |
| 3.2.5* | 3.2.4 | Axial Offset (*Axial Shape Index) |
| 3.2.3* | 3.2.5 | Azimuthal Power Imbalance (*Azimuthal Power Tilt (Tq)) |

In RAI 122, Question 16-273, the staff requested that the applicant clarify the description of instrumentation used in the Bases in Section 3.2.1. The instrumentation is referred to as both Self-Powered Neutron Detectors and, "fixed incore instrumentation," which may or may not be referring to the same system. This clarification is needed to ensure accuracy and completeness of the Bases portion of Section 3.2.1. In a December 5, 2008, response, the applicant stated that the phrase, "and fixed incore instrumentation," would be removed for clarification. The applicant also provided mark-ups of the resulting changes. The staff finds this response acceptable because it clarifies the instrumentation nomenclature.

In RAI 122, Question 16-275, the staff requested that the applicant clarify a discrepancy regarding the Rated Thermal Power (RTP) level contained in LCO 3.2.1. LCO 3.2.1, Action B.1 states "≤ 10 % RTP," while the Bases Section 3.2.1 states, "< 10 % RTP." This clarification is needed to ensure accuracy and completeness of TS and Bases portions of Section 3.2.1. In a December 5, 2008, response, the applicant stated the Bases Section 3.2.1, Action B.1 will be changed from "<" to "≤" for consistency. The applicant also provided mark-ups of the resulting changes. The staff finds this response acceptable because it aligns the LCO and Bases with regard to RTP level.

In RAI 122, Question 16-276, the staff requested that the applicant justify the 12-hour surveillance frequency for SR 3.2.1.1 with the RCSL and its associated alarm not in service. The corresponding Bases section does not contain sufficient information to support the 12 hour frequency and there is history to show that a shorter frequency is warranted (NUREG 1432 requires a 2 hour frequency for the same application). This information is needed to ensure that power distribution limits will not be exceeded. In a December 5, 2008, response, the applicant stated that the SR will be modified to be met within an hour of the RCSL being declared inoperable and occur once per hour thereafter until the RCSL System is back in service. The applicant also provided mark-ups of the resulting changes. The staff finds this response acceptable because it aligns the GTS with operating history and provides a conservative approach to ensuring that power distribution limits will not be exceeded.

In RAI 122, Question 16-278, the staff requested that the applicant clarify the purpose for LCO 3.2.2 regarding FΔHN. Various statements in the Bases for 3.2.2 appear inconsistent relative to the types of design bases events that are covered by the FΔHN LCO. The Bases for 3.2.2, Background Section, states that, "operation outside the LCO limits may produce unacceptable consequences if an anticipated operational occurrence (AOO) or other postulated accident occurs," and the Applicable Safety Analyses section states that the FΔHN LCO, "limits the scope of power distributions from which an accident may be initiated for all FSAR Chapter 15 events." The 3.2.2 Bases, Applicability Section, state that, "this LCO applies only to

Loss of Coolant Accident (LOCA) analyses." This clarification is needed to ensure accuracy and completeness of the TS and Bases portions of LCO 3.2.2. In a December 5, 2008, response, the applicant stated that the Bases Section 3.2.2, Applicable Safety Analysis Note b states the FΔHN LCO is used to, "Limit the scope of power distributions from which an accident may be initiated for all FSAR Chapter 15 events." This includes all of Mode 1 operation. To be consistent with the FSAR Tier 2, Chapter 15 analyses, the Applicability section of TS Sections 3.2.2 and B.3.2.2 will be revised to include Mode 1 operation. The SR will be updated from 15 Effective Full Power Days (EFPD) to 31 EFPD to be consistent with SR 3.2.4.2. A frequency of 31 EFPD is acceptable because the power distribution changes only slightly with the amount of fuel burnup. The FΔHN is first determined after each fuel loading when the Thermal Power is greater than 40 percent of RTP, but prior to exceeding 70 percent RTP, verifying that the core is properly loaded. The applicant also provided markups of the resulting changes. The staff finds this response acceptable because it removes inconsistencies in the Bases for LCO 3.2.2 and SR frequencies.

In RAI 122, Question 16-279, the staff requested that the applicant justify the 12-hour surveillance frequency for SR 3.2.3.1 with the RCSL and its associated alarm not in service. The corresponding Bases Section 3.2.3 states that the 12 hour frequency is based on the ability to identify trends that could result in an approach to the DNBR limits. This statement, in itself, is not a sufficient justification for the 12 hour frequency and there is operating history from current plant designs that show that limits can be exceeded in a shorter time frame. This information is needed to ensure that DNBR limits will not be exceeded. In a December 5, 2008, response, the applicant stated that the SR will be modified to be met within an hour of the RCSL being declared inoperable and occur once per hour thereafter until the RCSL System is back in service. If the DNBR is not within limits and the RCSL System is out of service, the operator is required to take immediate action to reduce power until the most limiting DNBR is within limits. The applicant also provided markups of the resulting changes. The staff finds this response acceptable because it aligns with operating history and provides a conservative approach to ensuring that power distribution limits will not be exceeded.

In RAI 122, Question 16-282, the staff requested that the applicant justify the 12-hour surveillance frequency for SR 3.2.4.1 with the RCSL and its associated alarm not in service. The corresponding Bases section 3.2.4 states that the 12 hour frequency is based on the ability to identify trends that could result in an approach to the Axial Offset (AO) limits. This statement, in itself, is not a sufficient justification for the 12 hour frequency and there is operating history from current plant designs that show that limits can be exceeded in a shorter time frame. This information is needed to ensure that AO limits will not be exceeded. In a December 5, 2008, response, the applicant stated that the SR will be modified to be met within an hour of the RCSL being declared inoperable and occur once per hour thereafter until the RCSL System is back in service. If the AO is not within limits and the RCSL System is out of service, the operator is required to take immediate action to reduce power until the most limiting AO is within AO limits. The applicant further stated that TS Section 3.2.4 and Bases will be revised by adding an action statement and a SR to address this issue. The applicant also provided mark-ups of the resulting changes. The staff finds this response acceptable because it aligns with operating history and provides a conservative approach to ensuring that power distribution limits will not be exceeded.

In RAI 122, Question 16-284, the staff requested that the applicant provide additional information to verify the accuracy of information presented in Bases Section B 3.2.1. The Applicability Section of Bases Section B 3.2.1 states that, "power distribution is a concern any

time the reactor is critical." The power distribution LCOs, however, are only applicable in MODE 1 above 10 percent RTP. This LCO is not a concern below 10 percent RTP because the core is operating well below its thermal limits. This clarification is needed to ensure accuracy and completeness of TS Bases Section B 3.2.1. In a December 5, 2008, response, the applicant stated that the Bases Section B 3.2.1 will be revised to clarify that the LCO is applicable for power above 10 percent of RTP. The applicant also provided mark-ups of the resulting changes. The staff finds this response acceptable because it eliminates inconsistencies within Bases Section B 3.2.1.

In RAI 122, Question 16-286, the staff requested that the applicant justify information presented in the Bases Section B 3.2.1. The Background section of B 3.2.1 states that, "after calibration, all 12 SPNDs within the same axial slice, therefore provide the same value, which corresponds to the maximum linear power density value for that axial slice." This justification is needed to ensure completeness and accuracy of Bases Section B 3.2.1. In a December 5, 2008, response, the applicant stated that at the time of calibration, each of the SPND within the same axial elevation are adjusted by a unique calibration factor to indicate the maximum power density within the axial slice as determined by the 3-D power distribution. The applicant further stated that Bases Section 3.2.1 would be revised by modifying existing statements to clarify this issue. The applicant also provided markups of the resulting changes. The staff finds this response acceptable because it clarifies the SPND calibration process within Bases Section B 3.2.1.

The staff evaluated the proposed changes as a result of the responses and finds the proposed changes acceptable both in content and format. In addition, the staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, accurately reflects the changes committed to in the above stated question responses.

Based upon the above evaluation, the staff finds that the RAIs for FSAR Tier 2, Chapter 16, Section 3.2 are resolved.

The remaining portions of GTS Section 3.2 are similar to the applicable STS such that the staff finds them acceptable.

**Conclusion**

The applicant adhered to the model Power Distribution Limits TS as provided in the Combustion Engineering STS, with differences to reflect the U.S. EPR unique-design features. In addition, GTS Section 3.2 and its Bases do not contain any bracketed information or Reviewer's Notes. Therefore, the staff finds GTS Section 3.2 and Bases Section B 3.2 acceptable.

## 16.4.7 Instrumentation

**Introduction**

GTS Section 3.3, "Instrumentation," and Bases B 3.3, "Instrumentation," include requirements for instrumentation systems that (1) initiate reactor trip (RT) and engineered safety-features actuations, (2) provide information required by operators to perform manual actions specified in Emergency Operating Procedures (EOPs), and (3) provide operators with the capability to place and maintain the plant in a safe-shutdown condition from a location outside the control room. GTS Section 3.3 corresponds to the Westinghouse STS in the following manner:

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.3.1* | 3.3.1 | Protection System (*Reactor Trip System Instrumentation) |
| 3.3.2* | --- | Protection System (*Engineered Safety Feature Actuation System (ESFAS) Instrumentation) |
| 3.3.3* | 3.3.2 | Post-Accident Monitoring (PAM) Instrumentation (*same) |
| 3.3.4* | 3.3.3 | Remote Shutdown System (*same) |
| 3.3.5* | --- | Protection System (*Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation) |
| 3.3.6* | None | N/A (*Containment Purge and Exhaust Isolation Instrumentation) |
| 3.3.7* | --- | Protection System (*Control Room Emergency Filtration System (CREFS) Actuation Instrumentation) |
| 3.3.8* | None | N/A (*Fuel Building Air Cleanup System (FBACS) Actuation Instrumentation) |
| 3.3.9* | --- | Protection System (*Boron Dilution Protection System (BDPS)) |

STS 3.3.2, STS 3.3.5, STS 3.3.7, and STS 3.3.9 are included in GTS 3.3.1. STS 3.3.6 and STS 3.3.8 are not relevant to the GTS.

**Evaluation**

Although GTS Section 3.3 is modeled after STS Section 3.3 for Westinghouse plants to the greatest extent possible, significant differences exist, primarily with respect to the digital-based U.S. EPR Protection System (PS), requiring technical justification and clarification beyond what is given in GTS Section 3.3 and its Bases.

The U.S. EPR Protection System is an integrated digital Reactor Protection System (RPS) and ESFAS. The PS detects plant conditions that indicate the occurrence of AOOs and postulated events, and actuates safety-related process systems required to mitigate the event. In contrast, the Westinghouse STS Instrumentation Systems are representative of a conventional design approach that does not employ the use of an integrated system, digital I&C platform. Nonetheless, wherever correlations existed between the GTS and Bases, and the Westinghouse STS and Bases, these correlations were used to evaluate the accuracy and completeness of those portions of the GTS and Bases. Where correlations between the GTS and the applicable STS do not exist, detailed technical reviews were performed to determine the accuracy and completeness of those portions of the GTS and Bases.

Additional information has been requested for each of the following items in order to evaluate the adequacy and completeness of GTS Section 3.3, and Bases B 3.3. Details regarding the responses associated with RAI 103, Questions 16-128 through 16-209 and RAI 110, Questions 16-210 through 16-235 are described below.

- In RAI 103, Question 16-128, the staff requested that the applicant identify and include the Acquisition and Processing Unit (APU) functional assignments in the GTS. In a

November 26, 2008, response to RAI 103, Question 16-128, the applicant stated that functional assignments for APUs will be completed later in the design process in a way that maximizes functional diversity. Technical Specifications conservatively assume that the failure of any APU in a division renders all functions performed by the APUs in that division to be inoperable. This assumption is based on the Failure Modes and Effects Analysis (FMEA) which bounds all cases of specific APU single failures by considering the effect on every function of the system. In addition, APU functional assignments are considered design information, which is typically not included in the Technical Specifications. The staff finds the response acceptable; therefore, RAI 103, Question 16-128 is resolved.

- In RAI 103, Question 16-129, the staff requested that the applicant provide an explanation regarding the effects of placing the different types of signal processing components in "Lockout." In a November 26, 2008, response, the applicant provided incomplete information in that it did not address either the Remote Acquisition Units (RAUs) or the Rod Cluster Control Assembly Units (RCCAUs). Furthermore, the Bases discussion in the associated FSAR markup did not make a clear distinction between the Acquisition and Processing Units and the Actuation Logic Units (ALUs) when describing the Lockout function. In an audit on July 30-31, 2009, the applicant acknowledged the deficiencies and agreed to make the necessary changes to the Bases. In addition, the following issues were also identified:

    - LCO 3.3.1, Condition C, Required Action C.2, direction to "Place the Trip/Actuation Function in the associated APU in lockout" is misleading. Individual Trip/Actuation Functions do not have Lockout capability. Only the APU to which the Trip/Actuation Functions are assigned can be "Locked Out." In an audit on July 30-31, 2009, the applicant acknowledged the deficiency and agreed to make the necessary changes to the GTS and Bases.

    - LCO 3.3.1, Condition C, Required Action C.2, provides insufficient guidance depending on the number of Limiting Trip Setpoints (LTSPs) that are affected. For example, if a LTSP problem is common to all four divisions of a given Trip/Actuation Function, the action to place each of the four associated divisional APUs in Lockout is not the intention. In an audit on July 30-31, 2009, the applicant acknowledged the deficiency and agreed to make the necessary changes to the GTS and Bases.

    - Bases B 3.3.1, Background, Signal Processors, Page B 3.3.1-9, third paragraph of the June 30, 2009, FSAR markup, references to "division" are inaccurate. "Division" should be replaced by "subsystem." In an audit on July 30-31, 2009, the applicant acknowledged the inaccuracies and agreed to make the necessary changes to the Bases.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-130, the staff requested that the applicant provide an explanation regarding the impact on Protection System Trip/Actuation functions when APUs are declared inoperable under Conditions D and F of LCO 3.3.1. In a November 26, 2008, response to RAI 103, Question 16-130, the applicant described single-failures upstream of the ALU layer that could result in invalid signals being used in

Reactor Trip and Engineered Safety Features actuations. The staff agreed with the applicant's response with the exception of editorial errors associated with multiple misspellings of the word "actuation" in the FSAR markup for Bases B 3.3.1. In an audit on July 30-31, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes to the Bases. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-131, the staff requested that the applicant provide an explanation regarding the impact on Protection System Trip/Actuation functions when ALUs are declared inoperable under Conditions D and F of LCO 3.3.1. In a November 26, 2008, response to RAI 103, Question 16-131, the applicant specified additional ALU Conditions in GTS Table 3.3.1-1, "Protection System Sensors, Manual Actuation Switches, Signal Processors, and Actuation Devices," along with Bases revisions describing the consequences of ALU failures on reactor trip outputs and ESF actuation signals. These additional ALU Conditions and Bases revisions were directly affected by the June 30, 2009, response to RAI 103, Question 16-138, regarding the omission of permissive signals from LCO 3.3.1. The subsequent incorporation of permissives and the inclusion of new ESF functions resulted in new and revised Required Actions. The Conditions and Required Actions for inoperable ALUs were re-evaluated and revised accordingly, and are reflected in the FSAR markup associated with the June 30, 2009, response. (Note that due to the number of changes stemming from the response to RAI 103, Question 16-138, the FSAR Tier 2, Chapter 16, TS Section 3.3.1 and Bases B 3.3.1 were replaced in their entirety.) The following issues were identified based on evaluation of the June 30, 2009, FSAR markup:

  - LCO 3.3.1, Condition V, Required Action V.2, provides insufficient guidance depending on the number of divisions affected. For example, if there were less than the minimum required operable ALUs in only one division, opening of all reactor trip breakers would not be warranted. In an audit on July 30-31, 2009, the applicant acknowledged the deficiency and agreed to make the necessary changes to the GTS and Bases.

  - Bases B 3.3.1, Actions, Section V.1 and V.2, does not make the distinction that the functions on the associated ALUs are to be declared inoperable. The Bases simply state that the ALUs must be declared inoperable. In an audit on July 30-31, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes to the Bases.

  - LCO 3.3.1, Condition U, is specified for both the Rod Cluster Control Assembly Bottom Position Indicators and the RCCA Units in Mode 1, with Permissive P2 validated (LCO Table 3.3.1-1). Condition U is also specified for Permissive P8 in Modes 3 and 4, with Permissive P7 inhibited (FSAR Tier 2, Table 3.3.1-2, "Acquisition and Processing Unit Requirements Referenced from FSAR Tier 2, Table 3.3.1-1"). Required Action U.2 is associated with RCCA Position Indication, not RCCA Bottom Position Indication. RCCA Bottom Position Indication is not used in the Low Departure from Nucleate Boiling (DNB) function and is, therefore, not required in Mode 1 with Permissive P2 validated. In addition, the RCCA Position Indicators are not included in either LCO Table 3.3.1-1 or the Bases. In an audit on July 30-31, 2009, the applicant

acknowledged the discrepancies and agreed to make the necessary changes to the GTS and Bases.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-133, the staff requested that the applicant provide clarification regarding the implementation of Required Action F.1 for inoperable APUs and ALUs. In a November 26, 2008, response to RAI 103, Question 16-133, the applicant adequately addressed the fact that multiple Condition entries may warrant simultaneous entry into multiple LCOs and the implementation of Required Actions whose requirements are different and may conflict. In addition, Condition requirements associated with ALUs were identified and addressed in response to RAI 103, Question 16-131. The staff has confirmed that Revision 1 of FSAR Tier 2, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue. Therefore, RAI 103, Question 16-133 is closed.

- In RAI 103, Question 16-137, the staff requested that the applicant provide a technical justification regarding the omission of safety-related RT signals in FSAR Tier 2, Table 3.3.1-2, Section A. FSAR Tier 2, Section 7.2.1.2, "Reactor Trip Functional Description," identifies the Safety Injection System (SIS) Actuation, Emergency Feedwater System (EFWS) Actuation, and the Manual RT signals from the Safety Information and Control System (SICS), as safety-related RT initiation signals. In a March 19, 2009, response to RAI 103, Question 16-137, the applicant concluded that these RT initiation signals should not be included in TS on the basis that (1) they are not credited in the U.S. EPR safety analysis as implied by their absence from FSAR Tier 2, Chapter 15, "Transient and Accident Analyses," FSAR Tier 2, Tables 15.0-7 and 15.0-8, and (2) they do not satisfy Criterion 3 of 10 CFR 50.36 with regard to being part of the primary success path of a safety-sequence analysis. NUREG-1431 includes both the Manual RT and the SIS Actuation initiation signals in comparable LCO 3.3.1, Reactor Trip System Instrumentation. The Manual RT initiation ensures that the control room operator has the capability to initiate a reactor trip at any time. This capability is critical whenever a parameter is rapidly trending toward its Trip Setpoint. Regarding the SIS Actuation, NUREG-1431, Bases B 3.3.1 specifically states that initiation of a reactor trip upon any signal that initiates a safety injection is a condition of acceptability for the loss-of-coolant accident (LOCA). The EFWS Actuation is the primary success path, which functions to mitigate the effects of a loss of Main Feedwater (MFW) event, providing a safety classified means to remove residual heat via the steam generators. FSAR Tier 2, Section 7.3.1.2.2, "Emergency Feedwater System Actuation," identifies a number of failure mechanisms that can result in a loss of MFW, including a loss of offsite power, which is a highly credible event. In addition, it remains unclear how the applicant intends to ensure that surveillance testing requirements associated with the referenced safety-related trip signals will be met if they are not included in the TS. The staff determined that the response does not provide the requisite technical justification to warrant exclusion of the safety-related RT initiation signals from TS. The staff issued a follow-up RAI 315, Question 16-318 to address this concern. **RAI 315, Question 16-318 is being tracked as an open item.**

- In RAI 103, Question 16-138, the staff requested that the applicant provide a technical justification regarding the omission of permissive signals from LCO 3.3.1, "Protection

System." In a June 30, 2009, response to RAI 103, Question 16-138, the applicant proposed to revise the GTS to include permissives that enable RT and ESF functions credited in the safety analysis, along with Permissive P16, which is implicitly credited by virtue of the fact that it enables alignment of the safety injection system from cold leg injection to hot leg injection. The response was determined to be acceptable with the exception of numerous discrepancies associated with Bases discussions describing permissive signal capabilities. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes to the Bases. In addition, the following issues were also identified based on evaluation of the response:

- Description inaccuracies associated with Functions B.11.b, B.11.c, and B.11.d in Tables 16-138-1 and 16-138-2 of the response. The referenced functions do not isolate the chemical and volume control system (CVCS) charging line. In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracies and agreed to make the necessary changes.

- Discrepancy between the specified conditions for Reactor Trip Functions A.8 and A.9 in LCO Table 3.3.1-2, and the permissive bypass associated with these functions. Footnote (i) in Table 3.3.1-2 states, "Below 10 percent RTP [rated thermal power]"; whereas, the description for Permissive P6 in FSAR Tier 2, Section 7.2.1.3.4, "P6 Permissive," states, "P6 permissive is representative of core thermal power above a low-power setpoint value (10 percent power) corresponding to the boundary between the operating ranges of the IRDs and the PRDs." In an audit on August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes.

- LCO 3.3.1, Condition K, provides insufficient guidance with respect to Function B.1, Turbine Trip on Reactor Trip, in LCO Table 3.3.1-2. If Function B.1 was determined to be inoperable in Mode 1 at a power level that could not support turbine operation (Turbine off-line), placing the Unit in Mode 3 and opening the reactor trip breakers may be undesirable. In an audit on August 13-14, 2009, the applicant acknowledged the deficiency and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-141, the staff requested that the applicant provide an explanation regarding the three values that make up the variable low setpoint specified for Steam Generator Pressure Drop Function A.14 in FSAR Tier 2, Table 3.3.1-2. The staff also requested the same information for the variable low setpoints associated with main steam isolation valve (MSIV) isolation on SG Pressure Drop (All SGs) Function B.8.a (RAI 103, Question 16-166), and startup and shutdown feedwater isolation on SG Pressure Drop (Affected SGs) Function B.2.c (RAI 103, Question 16-167). In a November 26, 2008, response to RAI 103, Questions 16-141, 16-166, and 16-167, the applicant revised the Bases for each of the referenced functions to include the requested information. The changes, however, resulted in inconsistencies amongst the individual Bases sections, as well as the inclusion of unnecessary setpoint

algorithm specifics. In addition, a discrepancy was noted in the FSAR markup provided with the June 30, 2009, response, between the Bases for Function A.14 and FSAR Tier 2, Section 7.2.1.2.14, "Reactor Trip on Steam Generator Pressure Drop," regarding inconsistencies associated with postulated accident and AOO information. In an audit on July 30-31, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes to both the Bases and the FSAR. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-144, the staff requested that the applicant provide an explanation regarding the mode applicability associated with Hot Leg Temperature Wide Range (WR) instrumentation. In a June 30, 2009, response to RAI 103, Question 16-144, the applicant sufficiently describes how the mode requirements for the Hot Leg Temperature WR sensors have been chosen to envelope the required modes of the functions and permissives they support. Although the response was found to be acceptable, the staff noted that the assignment of Condition O in U.S. FSAR Tier 2, Table 3.3.1-1 to Modes 1 through 4 for Sensor A.12 was questionable considering the Conditions specified for the remaining components in the table. With the exception of Sensor A.18, "Radiation Monitor - Control Room HVAC Intake Activity," Condition N is specified for all components in FSAR Tier 2, Table 3.3.1-1, where the applicable modes are separately grouped as 1 through 4. In an audit on July 30-31, 2009, the applicant indicated that Condition N should have been specified and agreed to make the necessary changes. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-145, the staff requested that the applicant provide an explanation regarding the mode applicability for P6 Permissive instrumentation with respect to Reactor Trip Function A.8, High-Neutron Flux - Intermediate Range, as well as validation of the ≤15 percent rated thermal power (RTP) Limiting Trip Setpoint value. In a June 30, 2009, response to RAI 103, Question 16-145, the applicant sufficiently described how the mode requirements for the P6 Permissive sensors were chosen to envelope the required modes of the functions and permissives they support. However, there was no discussion pertaining to the LTSP for A.8. In an audit on August 13-14, 2009, the applicant explained that, because P6 Permissive validation is manual, the ≤15 percent RTP LTSP would remain active above the 10 percent RTP operability requirement specified in FSAR Tier 2, Table 3.3.1-2, until the permissive was manually validated by the operator. The staff agreed with the clarification provided during the audit. The RAI response needs to be updated with this information in order to ensure its completeness and accuracy. In addition, the following issues were also identified based on evaluation of the response:

    - The P6 Permissive Bases discussion on Page B 3.3.1-62 of the FSAR markup provided with the June 30, 2009, response (last paragraph), contains superfluous information pertaining to operability as it relates to 10 CFR 50.36, Criterion 3. In an audit on August 13-14, 2009, the applicant acknowledged that the information adds little value and agreed to make the necessary changes to the Bases.

    - The P16 Permissive Bases discussion on Page B 3.3.1-68 of the FSAR markup provided with the June 30, 2009, response (first paragraph), inaccurately

describes reactor coolant pump (RCP) operational requirements as they relate to the permissive. In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracy and agreed to make the necessary changes to the Bases.

- The P16 Permissive Bases discussion on Page B 3.3.1-67 of the FSAR markup provided with the June 30, 2009, response (last paragraph), does not include the RCP Current sensors. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes to the Bases.

- The applicable modes specified for the Intermediate Range sensors (A.13) in LCO Table 3.3.1-1 of the FSAR markup provided with the June 30, 2009, response and the associated Bases, are 1, 2, and 3 with the RCSL system capable of withdrawing an RCCA or one or more RCCA's not fully inserted. The staff questioned the Mode 1 applicability requirement on the basis that Intermediate Range sensor operability typically only extends up to 10 or 15 percent RTP. The Mode 1 requirement appears to be due to the fact that these sensors support Permissive P5 as well, which is utilized in both the High-Core Power Level and the Low Saturation Margin Reactor Trip functions. Permissive P5, Flux (Intermediate Range) Measurement Higher than Threshold, is representative of Intermediate Range Detector neutron flux measurements above a low-power setpoint value (approximately $10^{-5}$ percent) which corresponds to the boundary between the operating ranges of the Source Range and Intermediate Range detectors. In an audit on August 13-14, 2009, the applicant acknowledged the staff's concerns and agreed to resolve any potential discrepancies.

- The Bases discussions for Functions B.9.c, B.9.d, B.10.a, B.10.b, B.12.a, B.12.b, and B.13 in the FSAR markup provided with the June 30, 2009, response include statements that identify the Limiting Safety System Setting (LSSS) setpoint values associated with these functions as LSSSs related to variables having significant safety functions, but which do not protect Safety Limits. 10 CFR 50.36(c)(1)(ii)(A) requires that the TSs include LSSSs for variables that have significant safety functions. For variables on which a Safety Limit has been placed, the LSSS must be chosen to initiate automatic protective action to correct abnormal situations before the SL is exceeded. 10 CFR 50.36(c)(1)(ii)(A) also contains requirements for a general class of LSSSs; LSSSs related to variables having significant safety functions but which do not protect SLs. All plant operating licenses have TSs for LSSSs that are not related to SLs. For these LSSSs, 10 CFR 50.36(c)(1)(ii)(A) also requires that a licensee take appropriate action if it is determined that the automatic safety system does not function as required. The use of Bases statements to distinguish between SL-LSSS and non-SL-LSSS functions is unnecessary. The distinctions add little value and the classification of U.S. EPR Protection System instrumentation setpoints as either SL-LSSS or non-SL-LSSS is not clearly understood for all functions. In an audit on August 13-14, 2009, the applicant acknowledged the staff's concerns and agreed to review the issue.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-146, the staff requested that the applicant provide an explanation regarding the mode applicability for P6 Permissive instrumentation with respect to Reactor Trip Function A.9, "Low Doubling Time - Intermediate Range." This issue is identified and addressed under RAI 103, Question 16-145. Therefore, RAI 103, Question 16-146 is closed.

- In RAI 103, Question 16-147, the staff requested that the applicant provide an explanation regarding the mode applicability for Pressurizer Pressure Narrow Range (NR) instrumentation with respect to Reactor Trip Function A.13, "Low Hot Leg Pressure." In a June 30, 2009, response to RAI 301, Question 16-147, the applicant described how the mode requirements for the Pressurizer Pressure NR sensors have been chosen to envelope the required modes of the functions and permissives they support. However, the response does not adequately address the capabilities of the instrumentation to support Permissive P12 (Pressurizer Pressure Lower Than Threshold) or ESFAS Function B.3.b (SIS Actuation on Low Delta $P_{sat}$), in Mode 4 with Permissive P15 inhibited. Pressurizer Pressure NR sensor mode applicability specified in LCO Table 3.3.1-1 is 1, 2, 3, and $4^{(h)}$, where (h) states, "with Permissive P15 inhibited." The P15 validation pressure setpoint is 3.199 MPa (464 psia). Pressurizer Pressure NR instrument range is 11.135 – 17.340 MPa (1,615 – 2,515 psia). The applicant stated that the instrument range of 11.135 – 17.340 MPa (1,615 – 2,515 psia) is adequate to support the referenced functions on the basis of a design feature that allows the input signals to the permissive to remain at the lowest range of the instrument after the instrument drops off scale. The applicant maintains that this is acceptable for this application, since the actual Pressurizer Pressure is not necessary for the proper functioning of the permissive, and that validation of Permissive P12 is only dependent on Pressurizer Pressure being above or below the setpoint. The staff questions the applicant's position on the basis that (1) sensor operability is questionable beyond the calibrated range of the instrument, and (2) Pressurizer Pressure NR sensors are required to be operable in Mode 4 with Permissive P15 inhibited (validation pressure setpoint of 3.199 MPa (464 psia)) as specified in FSAR Tier 2, Table 3.3.1-1 for Component A.16 and LCO Table 3.3.1-2 for Function B.3.b and Permissive P12. The requirements for Pressurizer Pressure operability in Mode 4 with P15 inhibited extend to Function B.9.b (Containment Isolation (Stage 1) on SIS Actuation) as well, due to its reliance upon the SIS Actuation on Low Delta $P_{sat}$. In an audit on August 13-14, 2009, the applicant acknowledged the staff's concerns and agreed to resolve any discrepancies. In addition, the following issues were also identified based on the staff's evaluation of the response:

    - The Pressurizer Pressure NR Bases discussion on Page B 3.3.1-74 of the FSAR markup provided with the June 30, 2009, response (last paragraph), inaccurately describes the Mode 4 conditions associated with sensor operability. In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracy and agreed to make the necessary changes to the Bases.

    - The P12 Permissive Bases discussion on Page B 3.3.1-65 of the FSAR markup provided with the June 30, 2009, response (first paragraph), inaccurately

describes the Mode 4 conditions associated with P12 operability. In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracy and agreed to make the necessary changes to the Bases.

- The P12 Permissive Bases discussion on Page B 3.3.1-65 of the FSAR markup provided with the June 30, 2009, response (third paragraph), inaccurately describes the capability of the permissive with respect to the cooling functions accomplished via Main Steam Bypass or the Main Steam Relief Train (MSRT). In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracy and agreed to make the necessary changes to the Bases.

- The P12 Permissive Bases discussion on Page B 3.3.1-65 of the FSAR markup provided with the June 30, 2009, response (second paragraph), only makes reference to the, "Low SG Pressure," and, "Low Hot Leg Pressure," Reactor Trip functions when describing functions that are automatically activated when Pressurizer Pressure rises above the P12 Permissive value. Functions A.12, B.2.d, B.3.a, B.7.b, and B.8.b in LCO Table 3.3.1-2, also become automatically activated above the P12 value. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes to the Bases.

- The Low DNBR Bases discussion on Page B 3.3.1-17 of the FSAR markup provided with the June 30, 2009, response (third paragraph), includes the "Increase in reactor coolant inventory" event as one of five anticipated operational occurrences for which protection is provided. It is unclear how the Low DNBR Trip function protects against an "increase in reactor coolant inventory." In an audit on August 13-14, 2009, the applicant agreed to review the referenced AOO for applicability, provide the necessary clarification, and resolve any potential discrepancies associated with the Bases.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-148, the staff requested that the applicant provide an explanation regarding the mode applicability for Pressurizer Pressure Narrow Range instrumentation with respect to Reactor Trip Function A.15, "Low SG Pressure." This issue is identified and addressed under RAI 103, Question 16-147. Therefore, RAI 103, Question 16-148 is closed.

- In RAI 103, Question 16-149, the staff requested that the applicant provide a technical justification regarding omission of the SIS Actuation Signal on RCS Loop Low Level function from LCO 3.3.1, Protection System. In a June 30, 2009, response to RAI 103, Question 16-149, the applicant stated that the SIS Actuation on RCS Loop Low Level function and its associated sensor (RCS Loop Level) would be included in LCO 3.3.1 and the Bases. However, the staff noted that the footnote assignments corresponding to the applicable modes for Sensor A.23 in LCO Table 3.3.1-1 and Function B.3.c in LCO Table 3.3.1-2 were questionable on the basis that (1) Permissive P15 may not be validated (i.e., RCP in operation) below Mode 4, and (2) footnotes have been specified for each applicable mode associated with Functions B.11.b, B.11.c, and Permissives P7, P8 in LCO Table 3.3.1-2 with respect to the operational status of RCPs (P7 either validated or inhibited). In addition, the staff noted that the assignment of Footnote (s) in

Mode 6 for Function B.11.b and Permissive P7 was also questionable because of applicant information that RCPs would not be running in Mode 6. In an audit on August 13-14, 2009, the applicant acknowledged the staff's concerns and agreed to make any necessary changes. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-150, the staff requested that the applicant provide an explanation regarding inconsistencies between LCO Table 3.3.1-1, LCO Table 3.3.1-2, and the Bases associated with the mode applicability specified for ESFAS Function B.3.b (SIS Actuation on Low Delta $P_{sat}$) and its sensors, including P12 and P15 Permissive instrumentation. In a June 30, 2009, response to RAI 103, Question 16-150, the applicant sufficiently described how the mode requirements for the individual sensors have been chosen to envelope the required modes of the functions and permissives they support. However, the response did not adequately address the Bases discrepancies associated with the references to Cold Shutdown. The Low Delta $P_{sat}$ function Bases discussions (FSAR markup provided with the June 30, 2009, response) on Page B 3.3.1-40 (last paragraph) and Page B 3.3.1-41 (third paragraph), both state that the function ensures SIS actuation in the Hot and Cold Shutdown conditions with Low Head Safety Injection/Residual Heat Removal (LHSI/RHR) in operation and at least one RCP operating. Hot and Cold Shutdown conditions are Modes 4 and 5, respectively. The modes specified in LCO Table 3.3.1-2 for Function B.3.b are $3^{(m)}$ and $4^{(n)}$ (Hot Standby and Hot Shutdown). In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes to the Bases. In addition, the following issues were also identified based on the staff's evaluation of the response:

    - The second bulleted item of the response to RAI 103, Question 16-150 on Page 20 of 63, inaccurately describes the Mode 4 conditions (Permissive P15 inhibited logic) associated with Function B.3.b operability. In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracy and agreed to make the necessary changes.

    - The Low Delta $P_{sat}$ function Bases discussion on Page B 3.3.1-41 of the FSAR markup provided with the June 30, 2009, response (first paragraph), deletes three anticipated operational occurrences that are categorized as overcooling events. In an audit on August 13-14, 2009, the applicant indicated that overcooling events are no longer credited for this function and that FSAR Tier 2, Section 7.3.1.2.1, "Safety Injection System Actuation," would be updated to reflect this fact.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-151, the staff requested that the applicant provide an explanation regarding inconsistencies between the Bases and FSAR Tier 2 logic drawings 7.2-34 (Permissive P15) and 7.3-2 (SIS Actuation) with respect to ESFAS Function B.3.b (SIS Actuation on Low Delta $P_{sat}$). In a June 30, 2009, response to RAI 103, Question 16-151 the applicant stated that the staff's interpretation of the

functions depicted in the referenced figures was correct. However, the staff noted the following discrepancies in the associated FSAR markup and the response to RAI 103, Question 16-151:

- The Low Delta $P_{sat}$ function Bases discussion on Page B 3.3.1-41 of the FSAR markup provided with the June 30, 2009, response (second paragraph), inaccurately describes the Mode 4 conditions (Permissive P15 inhibited logic) associated with sensor and processor operability. In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracy and agreed to make the necessary changes to the Bases.

- The Low Delta $P_{sat}$ function Bases discussion on Page B 3.3.1-41 of the FSAR markup provided with the June 30, 2009, response (last paragraph), uses the word "automatically" to describe the capability of Permissive P15 to disable Function B.3.b. P15 is manual with respect to validation. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes to the Bases.

- The second paragraph of the June 30, 2009, response to RAI 103, Question 16-151 on Page 22 of 63, uses the word "automatically" to describe the capability of Permissive P15 to disable Function B.3.b. P15 is manual with respect to validation. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-153, the staff requested that the applicant provide an explanation regarding the mode applicability for sensors associated with ESFAS Function B.9.b (Containment Isolation (Stage 1) on SIS Actuation), including P12 and P15 Permissive instrumentation. In a June 30, 2009, response to RAI 103, Question 16-153, the applicant sufficiently described how the mode requirements for Function B.9.b sensor instrumentation have been chosen to envelope the required modes of the functions and permissives they support. However, the staff identified the following issue based on evaluation of the response:

  - The Containment Isolation (Stage1) on SIS Actuation Function Bases discussion on Page B 3.3.1-51 of the FSAR markup provided with the June 30, 2009, response (third paragraph), states that, "Safeguards Building HVAC is also reconfigured to process air through HEPA filters to ensure 10 CFR 50.34, 'Contents of Applications; Technical Information' and 10 CFR 100.21, 'Revocation, Suspension, Modification of Licenses, Permits, and Approvals for Cause' limits are not exceeded." There are no references to Safeguards Building Heating, Ventilation, and Air Conditioning (HVAC) reconfiguration on the Stage 1 Containment Isolation signal, either in FSAR Tier 2, Section 7.3.1.2.9 (Containment Isolation) or FSAR Tier 2, Section 7.3.1.2.16 (Main Control Room Air Conditioning System (CRACS) Isolation and Filtering). Also, there are no Safeguards Building HVAC functions depicted in associated FSAR Tier 2 logic Figures 7.3-20 (Containment Isolation) or 7.3-28 (MCR Isolation and Filtering). The same statement appears in the Bases discussion for Function B.9.a on Page

B 3.3.1-50 (fifth paragraph) as well. In an audit on August 13-14, 2009, the applicant indicated that FSAR Tier 2, Section 7.3.1.2.9 would be revised to address inconsistencies between the FSAR and the Bases with respect to Safeguards Building HVAC and the Containment Isolation functions.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-154, the staff requested that the applicant specify the appropriate range for the Containment Service Compartment Pressure sensors in the Bases for ESFAS Function B.9.a (Containment Isolation (Stage 1) on High-Containment Pressure). In a June 30, 2009, response to RAI 103, Question 16-154, the Bases was revised to include the Wide Range designation for the sensors. The staff questions the applicant's response to Question 16-154 on Page 25 of 63 regarding the statement, "The Containment Service Compartment Pressure (Wide Range) sensors provide input to the Containment Isolation (Stage 1) on High-Containment Pressure function and the Containment Isolation (Stage 2) on High-High-Containment Pressure function." While the Containment Service Compartment WR sensors do provide input into the Containment Isolation (Stage 1) on High-Containment Pressure function, the actuation setpoint associated with this input is Max2p, not the Max1p setpoint specified for Function B.9.a in LCO Table 3.3.1-2 and FSAR Tier 2, Section 7.3.1.2.9. The inputs associated with the Max1p setpoint are provided by the Containment Equipment Compartment Pressure and Containment Service Compartment Pressure Narrow Range sensors that input into the High-Containment Pressure Reactor Trip function (A.19). The RT signal on High-Containment Pressure (> Max1p) is what actually provides the input resulting in the actuation of Function B.9.a. The mode applicability currently specified for both the Equipment Compartment Pressure sensors and Containment Service Compartment Pressure NR sensors in LCO Table 3.3.1-1 (Modes 1, 2, and 3 $^{(g)}$), does not align with the mode requirements specified for Function B.9.a in LCO Table 3.3.1-2 (Modes 1, 2, 3, and 4). Simply stated, it does not appear that the operability requirements for the containment pressure sensors necessary to support Function B.9.a in Modes 3 (other than 3$^{(g)}$) and 4 have been specified. In an audit on August 13-14, 2009, the applicant acknowledged the staff's concerns and agreed to resolve any discrepancies. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-159, the staff requested that the applicant provide an explanation regarding the mode applicability for Hot Leg Temperature Wide Range instrumentation with respect to ESFAS Function B.6.a, Emergency Feedwater System Actuation on Low-Low SG Level (Affected SG). This issue is identified and addressed under RAI 103, Question 16-144. Therefore, RAI 103, Question 16-159 is closed.

- In RAI 103, Question 16-160, the staff requested that the applicant provide an explanation regarding the mode applicability for Hot Leg Temperature Wide Range instrumentation with respect to ESFAS Function B.6.c, "Emergency Feedwater System Isolation on High-SG Level (Affected SGs)." Although this issue is identified and addressed under RAI 103, Question 16-144, the staff questions the applicant's removal of the EFWS Isolation on High-SG Level function from Technical Specifications as

indicated in the response to RAI 103, Question 16-160 on Page 30 of 63. In a June 30, 2009, response to RAI 103, Question 16-160, the applicant concluded that ESFAS Function B.6.c should not be included in TS on the basis that (1) the function is no longer credited in FSAR Tier 2, Table 15.0-8, "Engineered Safety Features Functions Used in the Accident Analysis," and (2) Manual operator action is assumed to mitigate a steam generator tube rupture (SGTR) event with no automatic actions. The EFWS Isolation function automatically mitigates the effects of a SGTR. The EFWS is isolated at a high-level setpoint to avoid an uncontrolled SG level increase, subsequent SG overfill, and potential radioactive water discharge via the main steam relief train. If the EFWS system is actuated to mitigate the effects of a loss of Main Feedwater event, then isolation of the EFWS system is considered the primary success path for mitigating a SGTR. In addition, it remains unclear how the applicant intends to ensure that surveillance testing requirements associated with the EFWS Isolation function will be met if they are not included in the TS. Exclusion from FSAR Tier 2, Table 15.0-8 and reliance upon manual operator action to avoid an uncontrolled SG level increase and potential radioactive discharge do not necessarily warrant exclusion of the EFWS Isolation function from the Technical Specifications. The staff issued a follow-up RAI 315, Question 16-319 to address this concern. **RAI 315, Question16-319 is being tracked as an open item.**

- In RAI 103, Question 16-162, the staff requested that the applicant provide an explanation regarding the mode applicability for sensors associated with ESFAS Function B.5 (Partial Cooldown Actuation on SIS Actuation), including P12 and P15 Permissive instrumentation. In a June 30, 2009, response to RAI 103, Question 16-162, the applicant sufficiently described how the mode requirements for Function B.5 sensor instrumentation have been chosen to envelope the required modes of the functions and permissives they support. In addition, the staff identified the following issues based on evaluation of the response:

    - The Partial Cooldown Actuation on SIS Actuation function Bases discussion on Page B 3.3.1-44 of the FSAR markup provided with the June 30, 2009, response (second paragraph), incorrectly references Function B.3.c (SIS Actuation on Low RCS Loop Level) when identifying the applicable SIS Actuation signals. Function B.5 is required to be operable in Modes 1, 2, and 3. Function B.3.c is required in Modes $4^{(o)}$, 5, and 6. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes to the Bases.

    - The Partial Cooldown Actuation on SIS Actuation function Bases discussion on Page B 3.3.1-44 of the FSAR markup provided with the June 30, 2009, response (third paragraph), uses the word "automatically" to describe the capability of Permissive P14 to activate Function B.5. P14 is manual with respect to both validation and inhibition. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes to the Bases.

    - The Partial Cooldown Actuation on SIS Actuation function Bases discussion on Page B 3.3.1-44 of the FSAR markup provided with the June 30, 2009, response (third paragraph), inaccurately describes the specific plant conditions necessary to support P14 activation of Function B.5. In an audit on August 13-14, 2009, the

applicant acknowledged the inaccuracy and agreed to make the necessary changes to the Bases.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-164, the staff requested that the applicant provide an explanation regarding the mode applicability for Hot Leg Temperature Wide Range instrumentation with respect to ESFAS Function B.7.a, "Main Steam Relief Train Actuation on High-SG Pressure (Affected SGs)." This issue is identified and addressed under RAI 103, Question 16-144. Therefore, RAI 103, Question 16-164 is closed.

- In RAI 103, Question 16-165, the staff requested that the applicant provide an explanation regarding the mode applicability for Pressurizer Pressure Narrow Range instrumentation with respect to ESFAS Function B.7.b, "MSRT Isolation on Low SG Pressure (Affected SGs)." This issue is identified and addressed under RAI 103, Question 16-147. Therefore, RAI 103, Question 16-165 is closed.

- In RAI 103, Question 16-168, the staff requested that the applicant provide an explanation regarding the mode applicability for Pressurizer Pressure Narrow Range instrumentation with respect to ESFAS Function B.8.b, "Main Steam Isolation Valve Isolation on Low SG Pressure (All SGs)." This issue is identified and addressed under RAI 103, Question 16-147. Therefore, RAI 103, Question 16-168 is closed.

- In RAI 103, Question 16-169, the staff requested that the applicant provide an explanation regarding the mode applicability associated with the Reactor Trip Circuit Breaker (RTCB) Position Indication sensors. In a June 30, 2009, response to RAI 103, Question 16-169, the applicant sufficiently describes how the mode requirements for the sensors have been chosen to envelope the required modes of the functions they support. However, the staff identified the following issues based on evaluation of the response:

    - The RTCB Position Indication Bases discussion on Page B 3.3.1-77 of the FSAR markup provided with the June 30, 2009, response, inaccurately describes the conditions specified by Footnote (k) in LCO Table 3.3.1-1 with respect to sensor operability requirements in Modes 2 and 3. The reference to "low load" lines is missing from the discussion. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes to the Bases.

    - Bases discussion pertaining to the postulated accidents mitigated by Function B.2.c (Startup and Shutdown Feedwater Isolation on SG Pressure Drop (Affected SGs)), on Pages B 3.3.1-35 and B 3.3.1-36 of the FSAR markup provided with the June 30, 2009, response, lacks clarity and consistency with respect to the placement of information. In an audit on August 13-14, 2009, the applicant acknowledged the need for clarification and agreed to make the necessary changes to the Bases.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-172, the staff requested that the applicant provide an explanation regarding the mode applicability for Hot Leg Temperature Wide Range instrumentation with respect to ESFAS Function B.2.b, "Main Feedwater Full Load Isolation on High-SG Level (Affected SGs)." This issue is identified and addressed under RAI 103, Question 16-144. Therefore, RAI 103, Question 16-172 is closed.

- In RAI 103, Question 16-174, the staff requested that the applicant provide an explanation regarding the reference to "full load isolation valves" in the Bases for Function B.2.c, "Startup and Shutdown System (SSS) Feedwater Isolation on SG Pressure Drop (Affected SGs)." In a November 26, 2008, response to RAI 103, Question 16-174, the applicant submitted changes that were subsequently affected by the June 30, 2009, response to RAI 103, Question 16-138, regarding the omission of permissive signals from LCO 3.3.1. The June 30, 2009, response revises Bases Section B.2.c and associated Footnote (l) in LCO Table 3.3.1-2 to reflect the fact that that the SSS Feedwater Isolation includes closure of the MFW isolation valve, which prevents full load as well as SSS Feedwater flow. The staff finds the applicant's clarification regarding the SSS Feedwater Isolation function acceptable. In addition, the staff identified the following issues based on evaluation of the original response received on November 26, 2009:

    - The FSAR markup for RAI 103, Question 16-174 resulted in Bases inconsistencies regarding use of the word, "Feedwater," when referring to the "SSS Feedwater Isolation on SG Pressure Drop (Affected SGs)" function. In an audit on July 30-31, 2009, the applicant acknowledged the inconsistencies and agreed to make the necessary changes to the Bases.

    - The FSAR markup (RAI block identifier) for RAI 103, Question 16-174 includes references to both RAI 103, Questions 16-171 and 16-174. The reference to RAI 103, Question 16-171 is incorrect. In an audit on July 30-31, 2009, the applicant acknowledged the discrepancy and agreed to update the response.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-175, the staff requested that the applicant provide an explanation regarding the mode applicability for Pressurizer Pressure Narrow Range instrumentation with respect to ESFAS Function B.2.d, "Startup and Shutdown System Feedwater Isolation on Low SG Pressure (Affected SGs)." This issue is identified and addressed under RAI 103, Question 16-147. Therefore, Question 16-175 is closed.

- In RAI 103, Question 16-177, the staff requested that the applicant provide an explanation regarding the mode applicability for Hot Leg Temperature Wide Range instrumentation with respect to ESFAS Function B.2.e, "Startup and Shutdown System Feedwater Isolation on High-SG Level for a Period of Time (Affected SGs)." This issue is identified and addressed under RAI 103, Question 16-144. Therefore, RAI 103, Question 16-177 is closed.

- In RAI 103, Question 16-180, the staff requested that the applicant provide an explanation regarding the mode applicability for Cold Leg Temperature Wide Range instrumentation with respect to ESFAS Function B.11.a, "Chemical and Volume Control System Charging Line Isolation on High-High-Pressurizer Level." In a June 30, 2009, response to RAI 103, Question 16-180, the applicant sufficiently described how the mode requirements for the Cold Leg Temperature WR sensors have been chosen to envelope the required modes of the functions and permissives they support. However, the same information is not accurately reflected in the changes incorporated in the FSAR markup provided with the June 30, 2009, response for Sensor A.6 in LCO Table 3.3.1-1. Footnote presentation is inconsistent. Footnote (f) for example, is used to represent a stand-alone condition in conjunction with Modes 1 through 4, and as a superscript in Mode 5. In addition, Sensor A.6 mode applicability does not align with the mode requirements specified for Permissive P17 in LCO Table 3.3.1-2. Cold Leg Temperature WR sensors provide inputs to Permissive P17 which supports Low Temperature Overpressure Protection (LTOP) and is required to be operable when required by LCO 3.4.11. P17 modes of applicability are $4^{(u)}$, $5^{(u)}$, and $6^{(u)}$. Mode 6 is not specified for Sensor A.6 in LCO Table 3.3.1-1. Also, the staff noted that the description for Function B.11.c in the fourth bullet of the response to RAI 103, Question 16-180 on Page 46 of 63 was inaccurate. The CVCS Charging Line does not isolate on CVCS Anti-Dilution Mitigation (ADM). In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-182, the staff requested that the applicant provide a technical justification regarding omission of the CVCS Isolation on Anti-Dilution Mitigation at Power Operation function from LCO 3.3.1, Protection System. In a June 30, 2009, response to RAI 103, Question 16-182, the applicant incorporated the function, designated as B.11.d, in LCO Table 3.3.1-2, with appropriate changes to the Bases and mode applicability information for associated sensor instrumentation in LCO Table 3.3.1-1. However, the staff identified the following issues based on evaluation of the response:

    - The descriptions associated with CVCS Isolation on ADM Functions B.11.b, B.11.c, and B.11.d in LCO Table 3.3.1-2 and the Bases are inaccurate. The CVCS Charging Line does not isolate on Anti-Dilution Mitigation. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes.

    - The placement associated with Footnotes (b) and (c) in LCO Table 3.3.1-2 for Functions A.1.a, A.1.b, A.1.c, A.1.d, A.1.e, A.2, B.11.c, and B.11.d is incorrect. The footnotes should appear as superscripts for the referenced functions. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes.

    - The CVCS Isolation on ADM at Shutdown Conditions (RCP not operating) function Bases discussion on Page B 3.3.1-56 in the FSAR markup provided with the June 30, 2009, response (fourth paragraph), inaccurately describes the RCP operational conditions required for validation of the P7 Permissive. In an audit on

August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-185, the staff requested that the applicant provide an explanation regarding the LTSP values specified for ESFAS Functions B.11.b and B.11.c. In a March 19, 2009, response to RAI 103, Question 16-185, the applicant stated that the LTSP for Function B.11.b, CVCS Isolation on ADM at Shutdown Conditions (RCP not operating), is a fixed value. The staff questioned the applicant's position on the basis that a departure item associated with this issue had initially been identified in Revision 0 of the Bell Bend COL Application referencing the U.S. EPR design certification, with a justification stating that (1) the change corrects an error in the GTS, (2) the values associated with the LTSP are cycle-specific parameter values, and (3) consistent with the LTSP specified in the GTS Table 3.3.1-2, for Function B.11.c, CVCS Isolation on ADM at Standard Shutdown Conditions, it is appropriate for the LTSP for Function B.11.b to also be specified in the COLR. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-190, the staff requested that the applicant provide an explanation regarding inconsistencies associated with Bases Table B 3.3.1-1, Protection System Functional Dependencies. In a June 30, 2009, response to RAI 103, Question 16-190, the applicant adequately addressed items a, b, e, and f. However, it did not adequately address Items c and d. FSAR Tier 2, Bases Table B 3.3.1-1, "Protection System Functional Dependencies," identifies functions and permissives that could be impacted by the cumulative failures of different sensors or signal processors within individual divisions and explicitly notes those functions that do not have four divisions of ALUs. The table may be used as an aid to assess divisional operability in applying GTS Table 3.3.1-2 Footnote (a), which states, "A division is OPERABLE provided: a) The minimum sensors required for functional capability for all sensors providing input to the Trip/Actuation Function/Permissive are OPERABLE; and b) the associated signal processors are OPERABLE." Item c identifies ambiguities associated with RCS Loop Flow instrumentation requirements. LCO Table 3.3.1-1 and Bases Table B 3.3.1-1 were revised by the FSAR markup provided with the June 30, 2009, response to specify a minimum requirement of three RCS Loop Flow sensors "per division and per loop." If two sensors within the same division (different loops) were to become inoperable, a shutdown would be required in accordance with Condition J, even though the minimum requirements for loop operability remained satisfied. Bases Table B 3.3.1-1 guidance does not appear to consider the fact that the, "Low RCS Flow," and "Low-Low RCS Flow," reactor trips both employ four divisions of two-out-of-four voting logic that receive RCS Loop Flow sensor information from the other divisions as well. Item d identifies ambiguities associated with RCP Current instrumentation requirements. LCO Table 3.3.1-1 specifies a minimum requirement of two RCP current sensors per pump. Bases Table B 3.3.1-1 was revised by the FSAR markup provided with the June 30, 2009, response to define which RCP current sensors are acquired by each division without apparently specifying any minimum requirements for divisional operability. It is unclear how to interpret the revised RCP current sensor information in

Bases Table B 3.3.1-1 in terms of evaluating divisional operability with respect to Function B.4 and Permissive P15. The changes made under the FSAR markup provided with the June 30, 2009, response did not adequately address the staff's concerns regarding the RCP current sensor minimum divisional requirement information specified in previous revisions of the GTS. In Revision 1, for example, if two sensors within the same division (different pumps) became inoperable, the division would be declared inoperable, with the minimum requirements for pump operability still satisfied. Bases Table B 3.3.1-1 guidance does not appear to consider the fact that ESFAS Function B.4, "RCP Trip on Low Delta Pressure with SIS Actuation," and Permissive P15 both employ four divisions of two-out-of-three voting logic that receive RCP Current sensor information from the other divisions as well. In an audit on August 13-14, 2009, the applicant acknowledged the ambiguities and agreed to make the necessary changes. In addition, the following issues were also identified based on evaluation of the response:

- Bases Table B 3.3.1 of the FSAR markup provided with the June 30, 2009, response (Page B 3.3.1-100), does not specify the correct values for the minimum number of RCCA Position Indicators per division for Function A.1, Low DNBR. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes.

- Bases Table B 3.3.1 of the FSAR markup provided with the June 30, 2009, response (Page B 3.3.1-107), does not specify any values for the minimum number of RCCA Bottom Position Indicators per division for Permissive P8. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes.

- Bases Table B 3.3.1 of the FSAR markup provided with the June 30, 2009, response (Page B 3.3.1-107), does not specify the correct values for the minimum number of RCCA Units per division for Permissive P8. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes.

- The Low Saturation Margin Bases discussion on Page B 3.3.1-21 of the FSAR markup provided with the June 30, 2009, response (first paragraph), does not clearly describe the reason for the Low Saturation Margin Reactor Trip. The Bases states that the function "assures" that the High-Core Power Level trip function remains valid. FSAR Tier 2, Section 7.2.1.2.4, "Reactor Trip on High Core Power Level or Low Saturation Margin," states the "RT on low saturation margin is introduced because, in case of saturation occurring in a hot leg, the thermal power level calculation becomes invalid." The High-Core Power Level trip uses an enthalpy balance to calculate core thermal power. In an audit on August 13-14, 2009, the applicant acknowledged the need for clarification and agreed to make the necessary changes.

- The Bases discussion on Page B 3.3.1-2 of the FSAR markup provided with the June 30, 2009, response (second full paragraph), inaccurately states that, "when a sensor becomes inoperable, the Acquisition and Processing Unit that receives the signal from the sensor declares the functions supported by that sensor to be invalid." Single-failures upstream of the ALUs that could result in an invalid

signal being used in a reactor trip or ESF actuation, are accommodated by modifying the vote at the ALU layer. The function is not invalidated by the APU. In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracy and agreed to make the necessary changes.

- Similarly, the first paragraph of the response to RAI 103, Question 16-190 on Page 58 of 63, inaccurately states that, "when a sensor becomes inoperable, the Acquisition and Processing Unit that receives the signal from the sensor declares the functions or permissives supported by that sensor to be invalid." Single-failures upstream of the ALUs that could result in an invalid signal being used in a reactor trip or ESF actuation, are accommodated by modifying the vote at the ALU layer. Neither the function or the permissive are invalidated by the APU. In an audit on August 13-14, 2009, the applicant acknowledged the inaccuracy and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-191, the staff requested that the applicant provide a technical justification regarding inconsistencies identified in LCO Tables 3.3.1-1 and 3.3.1-2 of the GTS. In a June 30, 2009, response to RAI 103, Question 16-191, the applicant adequately addressed items a through g; however, the FSAR markup changes associated with item g for the Reactor Trip Contactors (D.3) in LCO Table 3.3.1-1 are incorrect. The Reactor Trip Contactors are required to be operable in Modes 1 and 2, and in Modes 3, 4, and 5 with the RCSL System capable of withdrawing an RCCA or one or more RCCAs not fully inserted. Footnote (m) was incorrectly specified for Actuation Device D.3 in Modes 3, 4, and 5. In an audit on August 13-14, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes. In addition, the following issues were also identified based on evaluation of the response:

  - The first sentence of the Bases discussion for Action Q.1 on Page B 3.3.1-88 of the FSAR markup provided with the June 30, 2009, response, is ambiguous because it does not clearly convey that entry into Condition Q is the direct result of inoperable instrumentation relied upon to automatically mitigate dilution events. In an audit on August 13-14, 2009, the applicant acknowledged the need for clarification and agreed to make the necessary changes.

  - The first sentence of the Bases discussion for Action R.1 on Page B 3.3.1-88 of the FSAR markup provided with the June 30, 2009, response, is ambiguous because it does not clearly convey that entry into Condition R is the direct result of inoperable instrumentation relied upon to automatically mitigate events in Modes 5 and 6 that could lead to a decrease in RCS inventory. In an audit on August 13-14, 2009, the applicant acknowledged the need for clarification and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-192, the staff requested that the applicant clarify LCO 3.3.1 Required Action guidance associated with Conditions O, P, Q, R and T of Revision 0 of the GTS. In a November 26, 2008, response to RAI 103, Question 16-192, the applicant revised the referenced Conditions to provide the additional guidance necessary. However, the response was directly affected by the June 30, 2009, response to RAI 103, Question 16-138, regarding the omission of permissive signals from LCO 3.3.1. The subsequent incorporation of permissives and the inclusion of new ESF functions resulted in new and revised Required Actions. The Required Actions for Conditions O, P, Q, R and T were re-evaluated and revised accordingly, and are reflected in the FSAR markup provided with the June 30, 2009, response under comparable Conditions P, O/Q, S, T and V, respectively. (Note that due to the number of changes stemming from the response to RAI 103, Question 16-138, the FSAR Tier 2, TS Section 3.3.1, and Bases Section B 3.3.1 were replaced in their entirety.) The staff found the revisions acceptable because they provide Required Action guidance that is clear and relevant. Verification that the referenced changes are properly incorporated into the FSAR is necessary. **RAI 103, Question 16-192, is being tracked as a confirmatory item.**

- In RAI 103, Question 16-193, the staff requested that the applicant provide an explanation regarding the overall approach to surveillance requirement testing for U.S. EPR PS instrumentation, and how that approach ensures that all RT and ESFAS functions specified in LCO 3.3.1 are adequately tested. The following issues were identified based on evaluation of: (1) The March 19, 2009, response to RAI 103, Question 16-193, including review of the accompanying Figure 16-193-1, "Summary of Protection System Testing," which provides a correlation between specific sections of Siemens Topical Report EMF-2341P, "Generic Strategy for Periodic Surveillance Testing of TELEPERM XS Systems in U.S. Nuclear Generating Stations," Revision 1, and the surveillance testing specified in TS Section 3.3.1, and (2) the FSAR markup provided with the June 30, 2009, response.

    - LCO 3.3.1 SRs are only specified for the components (Sensors, Manual Actuation Switches, Signal Processors, and Actuation Devices) listed in LCO Table 3.3.1-1. There are no SRs associated with any of the functions or permissives in LCO Table 3.3.1-2. This approach deviates from the established convention for function-based surveillance testing in the STS and all TS issued for operating plants. The applicant maintains that (1) there is no fundamental difference between a function-based surveillance testing approach and a component-based approach, and (2) since a function is performed by components, a component-based approach specifies an additional level of detail by defining which specific surveillances apply to which specific components. The digitally-based U.S. EPR Protection System combines signals between all four divisions (Divisional versus Channelized concept where protective action signals are shared and processed by voting logic computers within each division). In many cases the PS design relies upon a single sensing device to provide the input signals to multiple functions and permissives. It is unclear how SR testing specified at the component level ensures that each of the Reactor Trip functions, ESFAS functions, and permissives are properly tested. The applicant does not address how the performance of CALIBRATION surveillances for designated components listed in LCO Table 3.3.1-1, verifies the Limiting Safety System Setting values for each of the functions in LCO Table 3.3.1-2, especially in cases

where the PS logic for certain functions depends upon the acquisition of input signals from more than one sensor.

- Differences between NUREG-1431 and GTS surveillance definitions reflect the fact that the digitally-based U.S. EPR PS design uses a fundamentally different approach from the analog reactor trip and ESF actuation systems used in existing facilities. The TELEPERM XS Digital Protection System includes continuous self-monitoring and online diagnostics to verify proper functioning of digital systems and to ensure integrity of the installed application and system software. FSAR Tier 2 credits these features as a means of ensuring partial compliance with established surveillance testing requirements for reactor protection systems, including the justification for deletion of both the Channel Check and Actuation Logic Test (ALT) surveillances.. The applicant maintains that Channel Checks are no longer necessary on the basis that the digital PS (1) provides continual online monitoring of each input signal in each division, (2) performs software limit checking (signal online validation) against required acceptance criteria, (3) provides hardware functional validation so that a division check is continuously being performed, and (4) generates an alarm signal in the Control Room if redundantly measured analog signals exceed pre-established deviation criteria or are identified to be in a failure status. The applicant also maintains that the ALT is not required on the basis that (1) reactor trip and ESF actuation decisions are performed by software that does not physically degrade, (2) the adequacy of the PS software is based on the software development methodology, including verification and validation (V&V), (3) the PS has the ability to continuously verify that the software has not been corrupted, (4) Extended Self Tests are performed that also verify software integrity, and (5) it is neither practical or necessary to perform a surveillance test for “each possible” combination of sensor inputs and function responses that could result in a reactor trip or ESF actuation. Continuous self-testing and online diagnostic monitoring capabilities are being evaluated in Chapter 7 of this report (RAI 75, Questions 07.02-1 and 07.02-17, and RAI 60, Question 07.03-2) to determine the extent to which these features may be credited towards surveillance testing. U.S. EPR Instrumentation surveillance requirements are being evaluated in Chapter 7 of this report with respect to Siemens Topical Report EMF-2341P and testing conducted on the TELEPERM XS System through the Office of Nuclear Regulatory Research.

- SR 3.3.1.10, PS Response Time, Bases discussion on Pages B 3.3.1-97 and B 3.3.1-98 of the FSAR markup provided with the June 30, 2009, response, describes allocations for sensor, signal processing and actuation logic response times. Comparable Bases discussions for SR 3.3.1.16 (RTS Response Time) and SR 3.3.2.10 (ESFAS Response Times) in NUREG-1431 cite two topical reports, one that provides the basis and methodology for using allocated sensor response times (Westinghouse Commercial Atomic Power (WCAP-13632-P-A, Revision 2, "Elimination of Pressure Sensor Response Time Testing Requirements," January 1996), and one that provides the basis and methodology for using allocated signal conditioning and actuation logic response times (WCAP-14036-P, Revision 1, "Elimination of Periodic Protection Channel Response Time Tests," December 1995). The staff questions the applicant’s position regarding response time allocations for PS Instrumentation on the basis

that (1) all technical references associated with the STS appear to have been removed without providing comparable replacement references, (2) differences in the methods used by the GTS and STS have not been clearly delineated, and (3) the definition for PS Response Time in GTS Definitions Section 1.1 states that, "In lieu of measurement, response time may be verified for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC." In an audit on August 13-14, 2009, the applicant acknowledged the staff's concerns and indicated that response time allocation issues would be appropriately addressed.

- SR 3.3.1.5, Sensor Operational Test, Bases discussion on Page B 3.3.1-96 of the FSAR markup provided with the June 30, 2009, response, incorrectly states, "required for division OPERABILITY," instead of, "required for sensor OPERABILITY." In an audit on July 30-31, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes to the Bases.

- SR 3.3.1.6, Calibration, Bases discussion on Page B 3.3.1-96 of the FSAR markup provided with the June 30, 2009, response, incorrectly states, "parameter that the sensor monitors," instead of, "parameter that the division monitors." In an audit on July 30-31, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes to the Bases.

- SR 3.3.1.8, Actuating Device Operational Test (ADOT) is listed for Sensors A.24 and A.25, and Manual Actuation Switch B.1 in Table 3.3.1-1 of the FSAR markup provided with the June 30, 2009, response. Assignment of SR 3.3.1.8 to sensors A.24 and A.25 is questionable considering the description of ADOT in Definitions Section 1.1 of the GTS. Assignment of SR 3.3.1.8 to Manual Actuation Switch B.1 (Reactor Trip) is also questionable considering that SR 3.3.1.3, Actuation Device Operational Test, which verifies the operability of the Reactor Trip Circuit Breakers and Reactor Trip Contactors every 31 days, has not been specified for component B.1. In an audit on July 30-31, 2009, the applicant agreed to review the assignments associated with SRs 3.3.1.8 and 3.3.1.3 and make any necessary changes.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-194, the staff requested an explanation regarding setpoint relationships, references to Sensor Operational Test, and use of the word "channel" in the Bases. In a March 19, 2009, response to RAI 103, Question 16-194, the applicant adequately addressed each of these issues; however, the staff noted inconsistencies throughout Bases B 3.3.1 regarding use of the terms "channel" and "division." In an audit on July 30-31, 2009, the applicant acknowledged the inconsistencies and agreed to make the necessary changes. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-195, the staff requested that the applicant provide an explanation regarding the, "Minimum Required for Functional Capability," value specified for the SPNDs in LCO, Table 3.3.1-1. In a March 19, 2009, response to RAI 103, Question 16-195, the applicant proposed to revise the GTS and Bases to specify a

minimum required value of 67 SPNDs. However, the FSAR markup (RAI block identifiers) associated with changes to both the SPNDs and Remote Acquisition Units, in LCO, Table 3.3.1-1 are incorrect. The identifiers should reference RAI 103, Question 16-195, instead of 16-193. In an audit on July 30-31, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary change. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-197, the staff requested that the applicant provide a technical justification for omission of the Channel Check surveillance requirement from LCO 3.3.2, "Post-Accident Monitoring Instrumentation." In a November 26, 2008, response to RAI 103, Question 16-197, the applicant stated that The TELEPERM XS Digital Protection System includes continuous self-monitoring and online diagnostics to verify proper functioning of digital systems and to ensure integrity of the installed application and system software. FSAR Tier 2 credits these features as a means to justify elimination of the Channel Check surveillance. The applicant maintains that Channel Checks are no longer necessary on the basis that the digital PS (1) provides continual online monitoring of each input signal in each division, (2) performs software limit checking (signal on-line validation) against required acceptance criteria, (3) provides hardware functional validation so that a division check is continuously being performed, and (4) generates an alarm signal in the Control Room if redundantly measured analog signals exceed pre-established deviation criteria or are identified to be in a failure status. Continuous self-testing and online diagnostic monitoring capabilities are evaluated in Chapter 7 of this report (RAI 75, Question 07.02-1 and 07.02-17, and RAI 60, Question 07.03-2) to determine the extent to which these features may be credited towards surveillance testing. **RAI 103, Question 16-197 is being tracked as an open item to address the staff's concerns regarding the PAM instrumentation Channel Check surveillance requirement.**

- In RAI 103, Question 16-198, the staff requested that the applicant provide a technical justification for omission of the Channel Check surveillance requirement from LCO 3.3.3, Remote Shutdown System. In a March 19, 2009, response to RAI 103, Question 16-198, the applicant stated that the TELEPERM XS Digital PS includes continuous self-monitoring and online diagnostics to verify proper functioning of digital systems and to ensure integrity of the installed application and system software. FSAR Tier 2 credits these features as a means to justify elimination of the Remote Shutdown System Channel Check surveillance. The applicant maintains that Channel Checks are no longer necessary on the basis that the digital PS (1) provides continual on-line monitoring of each input signal in each division, (2) performs software limit checking (signal on-line validation) against required acceptance criteria, (3) provides hardware functional validation so that a division check is continuously being performed, and (4) generates an alarm signal in the Control Room if redundantly measured analog signals exceed pre-established deviation criteria or are identified to be in a failure status. Continuous self-testing and online diagnostic monitoring capabilities are being evaluated in Chapter 7 of this report (RAI 75, Questions 07.02-1 and 07.02-17, and RAI 60, Question 07.03-2) to determine the extent to which these features may be credited towards surveillance testing. The applicant also maintains that Channel Checks are no longer necessary on the basis of its June 30, 2009, response to RAI 110, Question 16-215, which is used to support the claim that there are no separate and

unique analog instruments located at the "Remote Shutdown Station," which require a surveillance. In a June 30, 2009, response to RAI 110, Question 16-215, the applicant proposes to revise its design and regulatory approach with regards to the Remote Shutdown System and its associated TS. Instead of specifying the required Remote Shutdown System functions in TS Bases B 3.3.3, the Bases will be revised to state that the displays and controls at the "Remote Shutdown Station" are functionally the same as the displays and controls normally used by the operator to achieve and maintain Mode 3 from the main control room. Note that **RAI 315, Question 16-320, which is a follow-up to RAI 110, Question 16-215, is being tracked as a separate open item by the staff.** In addition, the following issue was also identified based on evaluation of the response:

- The first two paragraphs of the March 19, 2009, response to RAI 103, Question 16-198, on Page 14 of 21, contain RAI reference errors. The first paragraph should reference RAI 103 instead of RAI 110. The second paragraph is missing the reference to RAI 110. In an audit on July 30-31, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-199, the staff requested that the applicant provide an explanation regarding the implementation of Condition C with respect to PAM Instrumentation Functions 1, 4, 5, 7, 8, 9, and 15 in the GTS Table 3.3.2-1 (Revision 0). In a November 26, 2008, response to RAI 103, Question 16-199, the applicant provided clarifying information about the U.S. EPR design that prompted the need for additional information regarding the divisional (versus channelized) approach to surveillance testing, as it relates to the implementation of Condition C for PAM Instrumentation variables/functions that are specified on a per component basis. Note that the response to RAI 110, Question 16-212 removed the current list of PAM Instrumentation (including all references to LCO Table 3.3.2-1) and associated discussions from FSAR Tier 2, Chapter 16, TS 3.3.2, "Post Accident Monitoring Instrumentation," and FSAR Tier 2, Chapter 16, TS Bases B 3.3.2, "Post Accident Monitoring Instrumentation," on the basis that PAM variable selection criteria in RG 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," June 2006, depend on prior development of Emergency Procedure Guidelines (EPGs), Emergency Operating Procedures (EOPs), and Abnormal Operating Procedures (AOPs) (procedures that cannot be completed prior to COL issuance). **RAI 300, Question 16-315, which is a follow-up to RAI 110, Question 16-212, is being tracked as a separate open item by the staff to address this issue.** The staff issued a follow-up RAI 300, Question 16-311 to obtain the additional information necessary for the staff to understand and evaluate LCO 3.3.2, Condition C, implementation specifics. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-200, the staff requested that the applicant provide an explanation regarding the disparity between the 24-month Surveillance Frequency specified for SR 3.3.1.8 in the GTS, and the 31-day Surveillance Frequency stated in the associated Bases section. In a November 26, 2008, response to RAI 103, Question 16-200, the applicant revised the Bases to clarify the scope of SR 3.3.1.8 and changed the 31-day reference to 24 months to align with the GTS. In addition, the staff

noted that the surveillance descriptions for SR 3.3.1.3 and SR 3.3.1.8 in the GTS were inaccurate. The word ACTUATION should be changed to ACTUATING to ensure consistency with the surveillance description provided in GTS Section 1.1, "Definitions." In an audit on July 30-31, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-201, the staff requested that the applicant provide an explanation regarding the adequacy of compensatory actions provided by LCO 3.4.9, Pressurizer, when Chemical and Volume Control System isolation functions are declared inoperable and entry into Condition P is required (U.S. EPR GTS, Revision 0). The November 26, 2008, response to RAI 103, Question 16-201 was directly affected by the June 30, 2009, RAI 103, Question 16-138 response regarding the omission of permissive signals from LCO 3.3.1. The subsequent incorporation of permissives and the inclusion of new ESF functions resulted in revisions to the TS requiring the unit to be brought to Mode 5, and to immediately suspend operations involving positive reactivity additions that could result in the loss of required shutdown margin or boron concentration. Entry into LCO 3.4.9 is no longer required. Therefore, the staff finds that RAI 103, Question 16-201 is resolved.

- In RAI 103, Question 16-203, the staff requested that the applicant provide a technical justification regarding omission of the Source Range Neutron Flux Reactor Trip function from LCO 3.3.1. In accordance with NUREG-1431, the Source Range Neutron Flux Reactor Trip function ensures protection against an uncontrolled RCCA bank withdrawal accident from a subcritical condition during startup. The applicable modes are Modes 2(d), 3(a), 4(a), and 5(a), where (d) is, "Below the P-6 (Intermediate Range Neutron Flux) interlocks," and (a) is "With Rod Control System capable of rod withdrawal or one or more rods not fully inserted." In the GTS LCO 3.3.1, PS Reactor Trip functions, "High-Neutron Flux (Intermediate Range)," and "Low Doubling Time (Intermediate Range)," both protect against excessive reactivity additions during reactor startup from a subcritical or low power startup condition. Applicable modes associated with both of these functions in the FSAR markup provided with the June 30, 2009, response are Modes 1(i), 2, 3(f), where (i) is "Below 10 percent RTP," and (f) is "With the Reactor Control, Surveillance and Limitation System capable of withdrawing an RCCA or one or more RCCAs not fully inserted." Although the Reactor Trip Functions are similar between NUREG-1431 and the GTS, the mode applicability is different. The U.S. EPR Protection System does not provide protection against excessive reactivity additions from RCCA withdrawal events from subcritical conditions in Modes 4 and 5. In a March 19, 2009, response to RAI 103, Question 16-203, the applicant stated that in Modes 4 and 5, RCCA withdrawal events are controlled by (1) plant procedures that will restrict RCCAs from being capable of being withdrawn below a minimum temperature for criticality 298 °C (568 °F), and (2) RCS boration, by plant procedure, to a value greater than the all rods out (ARO) critical boron concentration, if RCCAs are required to be exercised below 298 °C (568 °F). The staff questions the applicant's position on the basis that the applicant appears to be relying solely upon administrative controls to provide protection against uncontrolled RCCA withdrawal events from subcritical conditions in Modes 4 and 5. This issue has been identified as an open item. In addition, the staff identified the following issue based on evaluation of the response:

- The Boron Dilution Events section of the March 19, 2009, response to RAI 103, Question 16-203, on Page 17 of 21, inaccurately states that, "Boron dilution events are protected by the Chemical and Volume Control System charging line isolation function of the Anti-Dilution Mitigation System." The CVCS Charging Line does not isolate on Anti-Dilution Mitigation. In an audit on July 30-31, 2009, the applicant acknowledged the discrepancy and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-204, the staff requested that the applicant provide a technical justification regarding omission of the Overtemperature $\Delta$T Reactor Trip function from LCO 3.3.1. As identified in NUREG-1431, the Overtemperature $\Delta$T Reactor Trip function ensures that the design limit DNBR is met. The applicable modes are Modes 1 and 2. The GTS LCO 3.3.1, Protection System Reactor Trip on, "Low Departure from Nucleate Boiling Ratio," protects the fuel against the risk of departure from nucleate boiling during events that lead to a decrease in the DNBR value. GTS Table 3.3.1-2 mode applicability specified in the FSAR markup provided with the June 30, 2009, response is Mode 1(d), where (d) is "With Permissive P2 validated" (> 10 percent RTP), for Functions A.1.a through A.1.e. Although the Reactor Trip functions are similar between NUREG-1431 and the GTS, the mode applicability is different. The U.S. EPR PS does not provide protection against Low DNBR in either Mode 1 (≤ 10 percent RTP) or Mode 2. In a March 19, 2009, response to RAI 103, Question 16-204, the applicant stated that (1) at low power levels below the P2 Permissive, DNBR is no longer the limiting thermal parameter, (2) before departure from nucleate boiling is challenged at these low power levels, Hot Leg saturation occurs, and (3) protection from Hot Leg saturation is provided by the Low Saturation Margin Reactor Trip, which is active at power levels above the P5 Permissive ($10^{-5}$ percent RTP). The staff was unable to confirm the RAI response on the basis of currently available information on this subject. In a follow-up RAI 300, Question 16-311, the staff requested that the applicant provide a qualified determination to substantiate that the fuel is protected against the risk of departure from nucleate boiling during events that lead to a decrease in the DNBR value, in Mode 1 (≤10 percent RTP), and in Mode 2. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-205, the staff requested that the applicant provide a technical justification regarding omission of the Overpower $\Delta$T Reactor Trip function from LCO 3.3.1. In accordance with NUREG-1431, the Overpower $\Delta$T Reactor Trip function ensures the integrity of the fuel (i.e., no fuel pellet melting and less than one percent cladding strain) under all possible overpower conditions. The applicable modes are Modes 1 and 2. The GTS LCO 3.3.1, Protection System Reactor Trip on "High-Linear Power Density," protects the fuel against melting at the center of the fuel pellet during events which lead to an increase in the linear power density within the core. GTS Table 3.3.1-2 mode applicability specified in the FSAR markup provided with the June 30, 2009, response is Mode 1(d), where (d) is "With Permissive P2 validated" (> 10 percent RTP), for Function A.2. Although the Reactor Trip functions are similar between NUREG-1431 and the U.S. EPR GTS, the mode applicability is different. The U.S. EPR PS does not provide protection against fuel pellet melting in either Mode 1 (≤ 10 percent RTP) or Mode 2. In a March 19, 2009, response to RAI 103,

Question 16-205, the applicant stated that (1) at low power levels below the P2 Permissive, fuel centerline melt (FCM) is not a concern, because there is no combination of neutronic peaking and core average power that can lead to a peak fuel centerline temperature greater than that experienced at full power conditions, and (2) there is an intermediate range (high-neutron flux) reactor trip that will prevent any events from increasing the power level above 25 percent of rated thermal power to protect against reactivity insertion events such as an uncontrolled control bank withdrawal. The staff was unable to confirm the applicant's response on the basis of currently available information on this subject. In a follow-up RAI 300, Question 16-311, the staff requested that the applicant provide a qualified determination to substantiate that the fuel is protected against melting at the center of the fuel pellet during events which lead to an increase in the linear power density within the core, in Mode 1 (≤10 percent RTP), and in Mode 2. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-206, the staff requested that the applicant provide an explanation regarding calculation of the Limiting Trip Setpoint values specified in GTS Table 3.3.1-2, on the basis that (1) the LTSP is a plant-specific value based on instrumentation uncertainties, and (2) the uncertainties used in LTSP calculations would not ordinarily be determined until after completion of the detailed design. In a March 19, 2009, response to RAI 103, Question 16-206, the applicant stated that the LTSP values provided in FSAR Tier 2, Table 3.3.1-2 are based on analytical limits, and that the final calculated values will be determined later in the design process. This issue is identified and addressed under RAI 103, Question 16-207. Therefore, RAI 103, Question 16-206 is closed.

- In RAI 311, Question 16-316, the staff requested that the applicant address discrepancies associated with setpoint value nomenclature in the FSAR. LCO Table 3.3.1-2 identifies setpoint values as LTSPs, whereas FSAR Tier 2, Table 15.0-7, "Reactor Trip Setpoints and Delays Used in the Accident Analysis," and FSAR Tier 2, Table 15.0-8, "Engineered Safety Features Actuation System (ESFAS) Functions Used in the Accident Analysis," identify the same values as "Nominal" setpoints. **RAI 311, Question 16-316 is being tracked as an open item.**

- In RAI 103, Question 16-207, the staff requested that the applicant provide an explanation regarding GTS Table 3.3.1-2 footnote content and Bases Reviewer's Note information pertaining to the LTSP and methodologies for calculating the associated As-Found and As-Left tolerances. In a November 26, 2008, response to RAI 103, Question 16-207, the applicant proposed a revision to the footnote and Bases to correct inconsistencies identified by the staff; however, the issue regarding the specification of calculated LTSP values for functions identified in LCO Table 3.3.1-2 remains unresolved. The LTSP is a plant-specific value based on instrumentation uncertainties. The uncertainties used in LTSP calculations would not ordinarily be determined until after completion of the detailed design. Uncertainty determinations rely upon supporting information such as equipment selections and manufacturer recommendations. Obtaining uncertainty information needed to obtain final LTSP technical specification values prior to combined license issuance is, therefore, impractical. In addition, the staff also noted that Reviewer's Note information provided in the GTS and Bases (Revision 1 and the FSAR markup provided with the June 30, 2009, response) allowing the optional approach of specifying a yet-to-be-defined Setpoint Control Program (SCP) Administrative Controls TS, instead of placing brackets around a fully developed SCP

Administrative Controls TS and SR or table references to the SCP TS, do not satisfy 10 CFR 52.47(a)(11). In an audit on August 13-14, 2009, the applicant acknowledged the staff's position and agreed to remove the Reviewer's Notes from the GTS and Bases. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns regarding the specification of plant-specific values in the FSAR. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-208, the staff requested that the applicant provide an explanation regarding the use of a footnote reference stating, "As specified in the COLR," to represent the Limiting Safety System Setting setpoint values specified for the Low DNBR Reactor Trip functions in the GTS Table 3.3.1-2. In a November 26, 2008, response to RAI 103, Question 16-208, the applicant confirmed that the Core Operating Limits Report was listed in TS Administrative Controls, FSAR Tier 2, Section 5.6, "Reporting Requirements." The response only partially addressed the staff's concerns regarding the control requirements associated with the analytical methods used to determine the LSSS setpoint values to be specified in the COLR. The staff noted that (1) Protection System LCO 3.3.1 was not identified among the individual specifications included in COLR Section 5.6.3.a of the Reporting Requirements, and (2) the NRC-approved document describing the analytical methods used to determine the LSSS setpoint values for the Low DNBR and High Linear Power Density Reactor Trip functions, was not identified in COLR Section 5.6.3.b of the "Reporting Requirements." In an audit on July 30-31, 2009, the applicant acknowledged the omissions and agreed to include the necessary information. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 103, Question 16-209, the staff requested that the applicant provide an explanation regarding the use of a footnote reference stating, "As specified in the Pressure Temperature Limits Report (PTLR)," to represent the Limiting Safety System Setting setpoint values specified for the Pressurizer Safety Relief Valve (PSRV) Actuation functions in the GTS Table 3.3.1-2. In a November 26, 2008, response to RAI 103, Question 16-209, the applicant confirmed that the PTLR was listed in TS Administrative Controls Section 5.6, "Reporting Requirements." The response only partially addressed the staff's concerns regarding the control requirements associated with the analytical methods used to determine the LSSS setpoint values to be specified in the PTLR. The staff noted that (1) Protection System LCO 3.3.1 was not identified among the individual specifications included in PTLR Section 5.6.4.a of the Reporting Requirements, and (2) the NRC-approved document describing the analytical methods used to determine the LSSS setpoint values for the PSRV Actuation functions, was not identified in PTLR Section 5.6.4.b of the "Reporting Requirements." In an audit on July 30-31, 2009, the applicant acknowledged the omissions and agreed to include the necessary information. The staff issued a follow-up RAI 300, Question 16-311 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-311 is being tracked as an open item.**

- In RAI 110, Question 16-212, the staff requested that the applicant provide information necessary to ensure that the GTS Table 3.3.2-1, "Post-Accident Monitoring Instrumentation," includes the entire population of instruments required by GDC 13, "Instrumentation and Control," GDC 19, "Control Room," and GDC 64, "Monitoring Radioactivity Releases," and the guidance included in Institute of Electrical and

Electronics Engineers (IEEE) Std 497-2002, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations," and RG 1.97, Revision 4. In a March 31, 2009, response to RAI 110, Question 16-212, the applicant removed the current list of PAM Instrumentation and associated discussions from TS Section 3.3.2, and Bases B 3.3.2, on the basis that PAM variable selection criteria in RG 1.97, Revision 4, depend on prior development of EPG, EOP, and AOP (procedures that cannot be completed prior to COL issuance). The staff has reviewed its current position regarding which accident monitoring instrumentation should be in technical specifications, in comparison to RG 1.97, Revision 4. The staff has concluded that accident monitoring instrumentation Type A, Type B, and Type C, as defined in RG 1.97, Revision 4, are similar to the Type A and the Category 1, non-Type A defined in RG 1.97, Revision 3. Therefore, it is, the staff's position that technical specifications should include (1) all RG 1.97, Revision 4, Type A instruments, and (2) all RG 1.97, Revision 4, Type B and Type C instruments. Therefore, a COL applicant should include a technical specification that meets this staff position if the applicant references RG 1.97, Revision 4. Identification of RG 1.97, Revision 4, Type A, Type B, and Type C accident monitoring instrumentation functions depends on the development of EOPs and AOPs which are post-COL activities. DC/COL-ISG-8 provides the guidance necessary to complete the plant-specific technical specification list of PAM instrumentation functions. This guidance provides three options:

- Option 1 involves the use of plant-specific information. Option 1 appears impracticable for PAM instrumentation technical specifications, because the list of Type A, Type B, and Type C PAM instrumentation functions cannot be finalized before COL issuance.

- Option 2 involves the use of useable bounding information. Option 2 may be practical if the COL applicant is able to develop a truly bounding list of Type A, Type B, and Type C PAM instrumentation functions to be included in the plant-specific technical specifications. However, if a RG 1.97, Revision 4, analysis considering plant-specific EOPs and AOPs, which are based on the as-built plant, shows that additional PAM instrumentation functions are necessary, then the COL holder would need to request a license amendment to make changes to the plant-specific technical specification PAM instrumentation required functions list. The NRC would need to approve this amendment before the COL holder would be allowed to load fuel.

- Option 3 involves an administrative program to control PAM instrumentation functions. Option 3 would require establishing a plant-specific administrative controls program technical specification that would require using an NRC-approved methodology to determine the required PAM instrumentation functions, and maintaining the list of required PAM instrumentation functions in a specified document with appropriate regulatory controls. Option 3 may be practical, because the approved methodology, RG 1.97, Revision 4, is already established, and FSAR Tier 2, Section 7.5.2.2.1 already commits the COL holder to establish a list of all types of PAM instrumentation.

Since standard technical specifications for Westinghouse PWRs include a technical specification to govern post-accident monitoring instrumentation, the staff concludes that requirements for PAM instrumentation must be included in the U.S. EPR GTS. The staff issued

a follow-up RAI 300, Question 16-315 to address this issue. In addition, the following items were also identified based on evaluation of the response:

- RG 1.97, Revision 4 and IEEE Std 497-2002 have been omitted from the References Section of PAM Instrumentation Bases B 3.3.2.

- NUREG-0737, "Clarification of TMI Action Plan Requirements," Supplement 1, "TMI Action Items," is listed in the References Section of PAM Instrumentation Bases B 3.3.2, but is not cited anywhere in the associated U.S. EPR Bases text. It was noted that NUREG-0737 is referenced in the Background Section of PAM Instrumentation Bases B 3.3.3 of NUREG-1431.

The staff issued a follow-up RAI 300, Question 16-312 to document and address the staff's concerns regarding the above two items. **RAI 300, Questions 16-312 and 16-315 are being tracked as open items.**

- In RAI 110, Question 16-213, the staff requested that the applicant provide an explanation regarding the determination of primary to secondary loop coupling in the PAM Bases discussion associated with Hot Leg Temperature Wide Range instrumentation on Page B 3.3.2-4 of Bases B 3.3.2, Revision 0. Clarification is needed with regard to how the Hot Leg Temperature WR instruments can be used to confirm primary to secondary loop coupling without Cold Leg Temperature WR instrumentation. In a March 19, 2009, response to RAI 110, Question 16-213, the applicant stated that the subject text is now bracketed as described in the response to RAI 110, Question 16-212. There does not appear to be any bracketed text as stated in the response, only a bracketed period. Note that the response to RAI 110, Question 16-212, removed the current list of PAM Instrumentation (including all references to LCO Table 3.3.2-1), and associated discussions from TS Section 3.3.2, and TS Bases B 3.3.2, on the basis that PAM variable selection criteria in RG 1.97, Revision 4, depend on prior development of EPGs, EOPs, and AOPs (procedures that cannot be completed prior to COL issuance). **RAI 300, Question 16-315, which is a follow-up to RAI 110, Question 16-212, is being tracked as a separate open item by the staff to address this issue.** The staff issued a follow-up RAI 300, Question 16-312 to document and address the staff's concerns regarding (1) primary-to-secondary loop coupling determination issues, and (2) potential discrepancies associated with bracketing of information in Bases Section B 3.3.2. **RAI 300, Question 16-312 is being tracked as an open item.**

- In RAI 110, Question 16-215, the staff requested that the applicant provide the information necessary to ensure that Bases B 3.3.3, Remote Shutdown System, includes all of the functions, control circuits, transfer switches and instrumentation necessary to meet the requirements of GDC 19. In a June 30, 2009, response to RAI 110, Question 16-215, the applicant stated that it had revised its design and regulatory compliance approach with regards to the Remote Shutdown System and its associated TS. Instead of specifying the required functions in FSAR Tier 2, Chapter 16, Bases Section 3.3.3, the Bases is being revised to state that the displays and controls at the Remote Shutdown Station are functionally the same as the displays and controls normally used by the operator to achieve and maintain Mode 3 from the main control room. Given the revised specification, it is unclear what actions would be taken if a single sensor associated with one of the Remote Shutdown Station functions became

inoperable. The entire Remote Shutdown Station apparently defaults to an inoperable status, since the specification as written, removes all references to "required Functions" in the LCO. The intent is not clearly understood. The staff was unable to make a conclusive determination that the applicant's revised design and regulatory compliance approach meets the requirements of GDC 19, on the basis of the information provided. The staff issued a follow-up RAI 315, Question 16-320 to address this concern.
**RAI 315, Question16-320 is being tracked as an open item.**

- In RAI 110, Question 16-217, the staff requested that the applicant provide confirmation that reactor trip and ESF actuation functions credited in the accident analysis are specifically identified by FSAR Tier 2, Table 7.2-1, "Reactor Trip Variables," and FSAR Tier 2, Table 7.3-1, "ESF Actuation Variables," since Bases references to FSAR Tier 2, Sections 7.2 and 7.3 in B 3.3.1, "Applicable Safety Analyses, LCO and Applicability," Page B 3.3.1-14 (Revision 0), were not sufficiently explicit to provide traceability to the accident analysis with respect to credited functions and associated instrumentation. In a June 30, 2009, response to RAI 110, Question 16-217, the applicant revised Bases B 3.3.1 to provide the necessary traceability by inclusion of the statement, "Credited functions are tabulated in FSAR Tier 2, Tables 15.0-7, 15.0-8, and 15.0-9." However, there is confusion over whether or not these tables should include only the credited functions. For example, the Steam Generator Isolation function is not included in the TS, but is listed in FSAR Tier 2, Table 15.0-8, with clarifying notes. The FSAR markup provided with the June 30, 2009, response removes Function B.6.c, EFWS Isolation on High-SG Level, from the TS on the basis of the response to RAI 103, Question 16-160, which states, "Emergency Feedwater Isolation on High-Steam Generator Level function is no longer credited in FSAR Tier 2, Table 15.0-8." Function B.6.c remains listed in the table with clarifying notes as well. The inclusion of these functions in the revision to FSAR Tier 2, Table 15.0-8 (FSAR markup provided with the June 30, 2009, response), appears to contradict the response to RAI 110, Question 16-217, which states that the table will be updated to delineate the safety-classified protection and safety-systems credited in the accident analysis. In addition, the following issues were also identified based on evaluation of the response:

    - Inconsistencies were noted between FSAR Tier 2, Tables 15.0-7 and 15.0-8 regarding the use of "Normal/Degraded" in the "Uncertainty" column headers. In an audit on August 13-14, 2009, the applicant acknowledged the table discrepancies and agreed to make the necessary changes.

    - FSAR Tier 2, Table 15.0-7, Note 6, does not clearly state the reason for the Low Saturation Margin Reactor Trip. FSAR Tier 2, Section 7.2.1.2.4 states the, "RT on low saturation margin is introduced because, in case of saturation occurring in a hot leg, the thermal power level calculation becomes invalid." The High-Core Power Level trip uses an enthalpy balance to calculate core thermal power. In an audit on August 13-14, 2009, the applicant acknowledged the need for clarification and agreed to make the necessary changes.

    - FSAR Tier 2, Table 15.0-8 includes use of the term, "RT check-back" in the Main Feedwater Full Load Closure on Reactor Trip functional description. "RT check-back" is not used in the description for Function B.2.a in LCO Table 3.3.1-2. Although the associated Bases discussion makes reference to a "reactor trip check-back," no explanation is provided and the meaning is not

readily apparent. In an audit on August 13-14, 2009, the applicant acknowledged the inconsistencies, along with the need to clarify the Bases, and agreed to make the necessary changes.

- Note 1 information in FSAR Tier 2, Figure 7.2-18 pertaining to the SG Pressure Drop Reactor Trip setpoint, is also relevant to the Startup and Shutdown Feedwater Isolation on SG Pressure Drop ESFAS setpoint, and should be included in FSAR Tier 2, Figure 7.3-17. In an audit on August 13-14, 2009, the applicant acknowledged the inconsistency and agreed to incorporate the Note information into the figure.

- The bolding of "SIS Actuation signal (Stage1)" under the "Containment Isolation" group of functions listed in FSAR Tier 2, Table 15.0-8 is confusing in that bolding is only used as a means of categorizing the functions specified. In an audit on August 13-14, 2009, the applicant acknowledged the inconsistency and agreed to clarify the table.

The staff issued a follow-up RAI 300, Question 16-312 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-312 is being tracked as an open item.**

- In RAI 110, Question 16-218, the staff requested that the applicant provide an explanation for the RCCA Assembly Position Indication sensors not being included in LCO Table 3.3.1-1. The December 1, 2008, response to RAI 110, Question 16-218, was directly affected by the June 30, 2009, response to RAI 103, Question 16-138, regarding the omission of permissive signals from LCO 3.3.1. In the June 30, 2009, response, the applicant stated that because these sensors are now required to support the operability of Permissive P8, the RCCA Position Indicators and the associated RCCA Units will be included in LCO Table 3.3.1-1. Note that RCCA Bottom Position Indicators (not RCCA Position Indicators) are the sensors actually required to support Permissive P8. Although the RCCA Units and RCCA Bottom Position Indicators were added to the table, the RCCA Position Indication sensors were not. This issue is identified and addressed under RAI 103, Question 16-131. Therefore, RAI 110, Question 16-218 is closed.

- In RAI 110, Question 16-219, the staff requested that the applicant provide clarification within the Bases that acceptable limits during accidents are such that the offsite dose shall be maintained within an "acceptable fraction" of 10 CFR Part 100 limits, based on the probability of occurrence of the specific accident category. The Background Section of Bases B 3.3.1, Revision 0, did not identify the need for margins to 10 CFR Part 100 limits. In a December 1, 2008, response to RAI 110, Question 16-219, the applicant proposed a revision to the Bases to provide the necessary clarification. However, pertinent information from the comparable Bases paragraph in NUREG-1431 was not included in the proposed revision. In an audit on July 30-31, 2009, the applicant acknowledged that the information was relevant and agreed to make the necessary changes to the Bases. The staff issued a follow-up RAI 300, Question 16-312 to document and address the staff's concerns relative to the response. **RAI 300, Question 16-312 is being tracked as an open item.**

- In RAI 110, Question 16-222, the staff requested that the applicant provide an explanation regarding the Bases statement on Page B 3.3.1-9 of Revision 0, which

reads, “The implementation of manual system level actuation of ESF functions and the priority between the automatic functions of the PS and the manual system level initiation is determined on a case-by-case basis.” In a March 19, 2009, response to RAI 110, Question 16-222, the applicant stated that because the possibility exists for contradictory protective orders (one automatic, one manual) to be given to a function simultaneously, priority must be established between the two functions. Although the response discusses compliance with requirements for manual initiation identified in IEEE Std 603-1998, “Criteria for Safety Systems for Nuclear Power Generating Stations,” it does not adequately address the staff’s question regarding the operator’s ability to effectively implement manual protective actions in all cases. The applicant deleted the statement on the basis that it is not necessary to the TS Bases discussion and could be confusing. The staff issued a follow-up RAI 315, Question 16-321 to document and address the staff’s concerns. **RAI 315, Question 16-321 is being tracked as an open item.**

- In RAI 110, Question 16-223, the staff requested that the applicant provide an explanation regarding surveillance testing of the hardwired “AND” logic for reactor trip functions, and the hardwired “OR” logic for ESF actuation functions. In a March 19, 2009, response to RAI 110, Question 16-223, the applicant stated that hardwired logic will be periodically tested by Actuating Device Operational Test SR 3.3.1.3 (for reactor trip functions) and SR 3.3.1.8 (for ESF actuation functions). SR 3.3.1.8 is specified for Sensors A.24, A.25, Manual Actuation Switches B.1, B.2, B.3, and Actuation Device D.1 in LCO Table 3.3.1-1 of the FSAR markup provided with the June 30, 2009, response. Components A.25 and B.1 do not appear to be associated with ESF actuation functions. Although the assignments associated with SRs 3.3.1.3 and 3.3.1.8 are being evaluated under RAI 103, Question 16-193, it remains unclear whether or not SR 3.3.1.8 is applicable only to ESF actuation functions, as indicated in the response. In an audit on July 30-31, 2009, the applicant acknowledged the need for clarification and agreed to make any necessary changes. The staff issued a follow-up RAI 300, Question 16-312 to verify that the necessary clarifications are made and that any resultant changes are correct and properly incorporated. **RAI 300, Question 16-312 is being tracked as an open item.**

- In RAI 110, Question 16-226, the staff requested that the Bases be clarified to specify the conditions in Modes 4 and 5 for which the Protection System instrumentation that supports reactor trip functions, is not required to be operable. In a June 30, 2009, response to RAI 110, Question 16-226, the applicant revised the Bases to include the necessary clarifying information; however, the response deleted the reference to “manual actuation switches” on Page B 3.3.1-15 of the FSAR markup provided with the June 30, 2009, response (first full paragraph). The conditions of operability in Modes 4 and 5 for Manual Actuation Switch B.1, Reactor Trip, are the same as for the PS sensors, signal processors, and actuation devices that would be required to support automatic reactor trip functions in Modes 4 and 5 with the RCSL System capable of withdrawing an RCCA or one or more RCCAs not fully inserted. The deleted text appears to be relevant to the Bases discussion. In an audit on August 13-14, 2009, the applicant acknowledged that the deletion may have been inadvertent and agreed to make any necessary changes. The staff issued a follow-up RAI 300, Question16-312 to verify that the Bases information is accurate and complete and that any resultant changes are correct and properly incorporated. **RAI 300, Question 16-312 is being tracked as an open item.**

- In RAI 110, Question 16-227, the staff requested that the applicant provide an explanation regarding the use of inequality signs associated with the Limiting Trip Setpoint values specified in LCO Table 3.3.1-2. In a March 19, 2009, response to RAI 110, Question 16-227, the applicant stated that use of ≤ or ≥ symbols is appropriate for the general class of Limiting Safety System Settings related to variables having significant safety functions but which do not protect Safety Limits, otherwise referred to as the "Design Limit" by the applicant. Although the column headings and placement of relevant footnotes were revised in LCO Table 3.3.1-2 to reflect the distinction between values associated with LTSPs and Design Limits, a discrepancy was noted regarding the use of inequality sign information for Function B.9.c, Containment Isolation (Stage 2) on High-High-Containment Pressure. The ≤ symbol specified for the LTSP/Design Limit of 250.3 kPa (36.3 psia) in the FSAR markup (RAI 110, Question 16-227) and incorporated into Revision 1 of the FSAR, was not included in LCO Table 3.3.1-2 of the FSAR markup provided with the June 30, 2009, response, nor was there any footnote information in place of the ≤ sign to indicate that the value may be associated with a Safety Limit. In an audit on July 30-31, 2009, the applicant acknowledged the discrepancy and agreed to make any necessary corrections. 10 CFR 50.36(c)(1)(ii)(A) requires that the TSs include LSSSs for variables that have significant safety functions. For variables on which a Safety Limit has been placed, the LSSS must be chosen to initiate automatic protective action to correct abnormal situations before the SL is exceeded. 10 CFR 50.36(c)(1)(ii)(A) also contains requirements for a general class of LSSSs; LSSSs related to variables having significant safety functions but which do not protect SLs. All plant operating licenses have TSs for LSSSs that are not related to SLs. For these LSSSs, 10 CFR 50.36(c)(1)(ii)(A) also requires that a licensee take appropriate action if it is determined that the automatic safety system does not function as required. The use of Footnotes (b) and (c) to distinguish between SL-LSSS and non-SL LSSS functions in the Limiting Trip Setpoint / Design Limit column in LCO Table 3.3.1-2 of the TS is unnecessary. The distinctions add little value and the classification of U.S. EPR Protection System instrumentation setpoints as either SL-LSSS or non-SL LSSS is not clearly understood for all functions. In an audit on July 30-31, 2009, the applicant acknowledged the staff's concerns and agreed to review the issue. The staff issued a follow-up RAI 300, Question16-312 to document and address staff's concerns relative to this response. **RAI 300, Question 16-312 is being tracked as an open item.**

- In RAI 110, Question 16-229, the staff requested that the applicant provide an explanation regarding the means by which the emergency diesel generator (EDG) start signals (Loss of Offsite Power (LOOP) and degraded voltage) are implemented in the Protection System. This issue is identified and addressed under RAI 103, Question 16-135. Therefore, RAI 110, Question 16-229 is closed.

- In RAI 110, Question 16-230, the staff requested that the applicant provide an explanation regarding provisions to periodically test the continuous self-monitoring functions and automatic test features, and how the execution of automatic tests are confirmed during plant operation. In a December 1, 2008, response to RAI 110, Question 16-230, the applicant stated that the cyclic self-monitoring task performed by the TELEPERM XS protective systems (1) is in continuous operation and will alarm if not successful, (2) is performed by software, the adequacy and proper functioning of which does not have to be periodically verified by surveillance testing, and (3) includes a cyclic redundancy check to verify the software has not been degraded. The Continuous self-testing and online diagnostic monitoring capabilities, including the means to confirm

that these features remain functional, are evaluated in Section 7 of this report (RAI 75, Questions 07.02-1 and 07.02-17 and RAI 60, Question 07.03-2). **RAI 110, Question 16-230 is being tracked as an open pending resolution of the Chapter 7 RAIs.**

- In RAI 110, Question 16-232, the staff requested that the applicant revise the Bases to reference versions or revisions of topical reports for which the staff has issued an SER accepting the report. In a December 1, 2009, response to RAI 110, Question 16-232, the applicant (1) revised the Bases to reflect the NRC-approved version of ANP-10275P-A, "U.S. EPR Instrument Setpoint Methodology Topical Report," February 2008, (2) cited a technical report reference in Bases B 3.3.1 whose version had not been accepted by the staff via an SER; ANP-10282P, "POWERTRAX/E Online Core Monitoring Software for the U.S. EPR Technical Report," November 2007, is currently under NRC review, and (3) indicated that EMF-2341P, "Generic Strategy for Periodic Surveillance Testing of TELEPERM XS Systems in U.S. Nuclear Generating Stations," Revision 1, March 2000, was referenced by the NRC in the May 5, 2000, "Safety Evaluation for Licensing Topical Report EMF-2110NP, Revision 1," rather than separately approved. These reports are evaluated in Chapter 7 of this report. **RAI 110, Question 16-232, which is associated with the above request, is being tracked as an open item pending the resolution of this issue in Chapter 7 of this report.**

- In RAI 110, Question 16-234, the staff requested that the applicant provide an explanation regarding the validity of the Bases discussion for SR 3.3.2.2, Sensor Operational Test, on Page B 3.3.2-8 of Revision 0. In a December 1, 2008, response to RAI 110, Question 16-234, the applicant deleted the requirement for performance of an SOT from LCO 3.3.2, Post-Accident Monitoring Instrumentation, on the basis of information contained in the Bases that does not accurately reflect the definition for SOT in GTS Definitions Section 1.1. The staff questions the applicant's decision to remove the surveillance requirement on the basis that the current definition for SOT appears to be applicable to PAM Instrumentation. This issue has been identified as an open item. In addition, the following issues were also identified based on evaluation of the response:

    - The Note in SR 3.3.3.2 of NUREG-1431 and the associated Bases discussion pertaining to the exclusion of neutron detectors from the Channel Calibration surveillance have been omitted from Calibration surveillance SR 3.3.2.1 in the GTS and Bases. This information appears to be relevant to the FSAR. In an audit on July 30-31, 2009, the applicant acknowledged the omissions and agreed to make the necessary changes.

    - Bases text associated with Core Exit thermocouples in Bases Section SR 3.3.3.2 of NUREG-1431 has been omitted from the comparable EPR Bases discussion for SR 3.3.2.1. The Core Exit thermocouple information appears to be relevant to the FSAR. In an audit on July 30-31, 2009, the applicant acknowledged the omission and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question 16-312 to ensure the resolution of all items, including verification that the referenced changes are correct and properly incorporated. **RAI 300, Question 16-312 is being tracked as an open item.**

In correspondence dated November 26, 2008 (Response to RAI No. 103, Revision 0), March 19, 2009 (Response to RAI 103, Supplement 1), June 30, 2009 (Response to RAI 103, Supplement 2), (Questions 16-128 through 16-209), and December1, 2008 (Response to RAI 110, Revision 0), March 19, 2009 (Response to RAI 110, Supplement1), March 31, 2009 (Response to RAI 110, Supplement 2), June 30, 2009 (Response to RAI 110, Supplement 3), (Questions 16-210 through 16-235), the applicant acknowledged the need to revise the FSAR with respect to each of the RAI questions listed in the following table and included markups of the necessary changes. The staff reviewed the applicant's response to the RAIs and verified that each of the applicant's proposed changes to the GTS are adequate to ensure that, during plant operation, the accident analyses with respect to instrumentation, as described in FSAR Tier 2, Chapter 15, remain valid. Among other things, the applicant supplied information that was missing from GTS and Bases, modified the GTS and Bases to conform to the corresponding STS, and clarified the GTS and Bases. Verification that each RAI change is correctly incorporated into the FSAR is via the corresponding RAI confirmatory item identifier referenced below:

| | |
|---|---|
| RAI 103, Question 16-136 | Confirmatory Item: **RAI 103, Question 16-136** |
| RAI 103, Question 16-140 | Confirmatory Item: **RAI 103, Question 16-140** |
| RAI 103, Question 16-152 | Confirmatory Item: **RAI 103, Question 16-152** |
| RAI 103, Question 16-155 | Confirmatory Item: **RAI 103, Question 16-155** |
| RAI 103, Question 16-156 | Confirmatory Item: **RAI 103, Question 16-156** |
| RAI 103, Question 16-158 | Confirmatory Item: **RAI 103, Question 16-158** |
| RAI 103, Question 16-163 | Confirmatory Item: **RAI 103, Question 16-163** |
| RAI 103, Question 16-173 | Confirmatory Item: **RAI 103, Question 16-173** |
| RAI 103, Question 16-176 | Confirmatory Item: **RAI 103, Question 16-176** |
| RAI 103, Question 16-179 | Confirmatory Item: **RAI 103, Question 16-179** |
| RAI 103, Question 16-183 | Confirmatory Item: **RAI 103, Question 16-183** |
| RAI 103, Question 16-186 | Confirmatory Item: **RAI 103, Question 16-186** |
| RAI 103, Question 16-189 | Confirmatory Item: **RAI 103, Question 16-189** |

**Conclusion**

GTS Section 3.3, "Instrumentation," and its Bases, attempts to model the Westinghouse STS, Section 3.3 and its Bases to the greatest extent possible. However, with regards to GTS Section 3.3.1, PS, and its Bases, many differences exist as a result of dissimilarities between the U.S. EPR PS integrated RPS/ESFAS, digital I&C platform design and the Westinghouse Instrumentation System, conventional design. GTS Section 3.3.1 and its Bases consolidates Westinghouse STS Sections 3.3.1, 3.3.2, 3.3.5, 3.3.7, and 3.3.9. The U.S. EPR digital PS includes continuous self-monitoring and online diagnostics to verify proper functioning of digital systems and to ensure integrity of the installed application and system software. FSAR Tier 2 credits these features as a means of ensuring partial compliance with established surveillance testing requirements for reactor protection systems, including the justification for deletion of both the Channel Check and Actuation Logic Test surveillances. In addition, the U.S. EPR PS utilizes a "component-based" approach to surveillance testing rather than the "function-based"

approach that has been the standard for nuclear power plants currently operating in the United States. Therefore, acceptability of GTS Section 3.3.1, PS, is largely contingent upon satisfactory resolution of the RAIs needed to better understand the uniqueness associated with the digitally-based PS design; a design that (1) combines signals between all four divisions (Divisional versus Channelized concept where protective action signals are shared and processed by voting logic computers within each division), and (2) relies upon individual sensing devices to provide the input signals to multiple functions and permissives. Accordingly, the staff is not making any conclusions with respect to the surveillance requirements of GTS Section 3.3.1, or the accuracy and completeness of GTS Section 3.3.1 and its Bases, until resolution of the open items identified in the RAIs.

Regarding GTS Section 3.3.2, the applicant has removed the current list of PAM Instrumentation and associated discussions from TS Section 3.3.2, and TS Bases B 3.3.2, on the basis that PAM variable selection criteria in RG 1.97, Revision 4, depend on prior development of EPGs, EOPs, and AOPs (procedures that cannot be completed prior to COL issuance). The staff has reviewed its current position regarding which accident monitoring instrumentation should be in technical specifications, in comparison to RG 1.97, Revision 4. The staff has concluded that accident monitoring instrumentation Type A, Type B, and Type C, as defined in RG 1.97, Revision 4, are similar to the Type A and the Category 1, non-Type A defined in RG 1.97, Revision 3. It is the staff's position that technical specifications should include (1) all RG 1.97, Revision 4, Type A instruments, and (2) all RG 1.97, Revision 4, Type B, and Type C instruments. Therefore, a COL applicant should include a technical specification that meets this staff position if the applicant references RG 1.97, Revision 4. Identification of RG 1.97, Revision 4, Type A, Type B, and Type C accident monitoring instrumentation functions depends on the development of EOPs and AOPs which are post-COL activities. DC/COL-ISG-8 provides the guidance necessary to complete the plant-specific technical specification list of PAM instrumentation functions. The staff issued a follow-up RAI to document and address this issue. The staff also issued RAIs to (1) address omission of the channel check surveillance requirement in GTS Section 3.3.2, and (2) ensure the verification of information, and the accuracy and completeness of GTS Section 3.3.2 and its Bases.

Regarding GTS Section 3.3.3, the applicant has revised its design and regulatory compliance approach with respect to the Remote Shutdown System and its associated TS. Instead of specifying the required functions in TS Bases Section 3.3.3, the Bases is being revised to state that the displays and controls at the Remote Shutdown Station are functionally the same as the displays and controls normally used by the operator to achieve and maintain Mode 3 from the main control room. Given the revised specification (all references to "required Functions" in the LCO have been removed), it appears that the entire Remote Shutdown Station defaults to an inoperable status anytime a single sensor associated with any of the Remote Shutdown Station functions becomes inoperable. The staff was unable to make a conclusive determination that the applicant's revised design and regulatory compliance approach meets the requirements of GDC 19. The staff issued a follow-up RAI to document and address this issue. The staff also issued RAIs to (1) address omission of the channel check surveillance requirement in GTS Section 3.3.3, and (2) ensure the verification of information, and the accuracy and completeness of GTS Section 3.3.3 and its Bases.

## 16.4.8 Reactor Coolant System

### Introduction

GTS Section 3.4, “Reactor Coolant System,” and Bases includes requirements for reactor coolant system parameters such as RCS pressure, temperature, flow, and specific activity; RCS subsystems, components and parameters such as RCS loops, the Pressurizer, and low-temperature overpressure protection; and RCS leakages limits to ensure fuel integrity and reactor coolant pressure boundary integrity are preserved during all modes of plant operation.

### Evaluation

In general, GTS Section 3.4 follows the model of Westinghouse STS Section 3.4 for plants, with differences to reflect U.S. EPR-unique design features. GTS Section 3.4, “Reactor Coolant System,” corresponds to the Westinghouse STS in the following manner:

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.4.1* | 3.4.1 | RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling Limits (*same) |
| 3.4.2* | 3.4.2 | RCS Minimum Temperature for Criticality (*same) |
| 3.4.3* | 3.4.3 | RCS Pressure and Temperature Limits (*same) |
| 3.4.4* | 3.4.4 | RCS Loops - Modes 1 and 2 (*same) |
| 3.4.5* | 3.4.5 | RCS Loops - Mode 3 (*same) |
| 3.4.6* | 3.4.6 | RCS Loops - Mode 4 (*same) |
| 3.4.7* | 3.4.7 | RCS Loops - Mode 5, Loops Filled (*same) |
| 3.4.8* | 3.4.8 | RCS Loops - Mode 5, Loops Not Filled (*same) |
| 3.4.9* | 3.4.9 | Pressurizer (*same) |
| 3.4.10* | 3.4.10 | Pressurizer Safety Relief Valves (*Pressurizer Safety Valves) |
| 3.4.11* | None | (*Pressurizer Power-Operated Relief Valves (PORVs)) |
| 3.4.12* | 3.4.11 | Low-Temperature Overpressure Protection (*same) |
| 3.4.13* | 3.4.12 | RCS Operational LEAKAGE (*same) |
| 3.4.14* | 3.4.13 | RCS Pressure Isolation Valve (PIV) Leakage (*same) |
| 3.4.15* | 3.4.14 | RCS Leakage Detection Instrumentation (*same) |
| 3.4.16* | 3.4.15 | RCS Specific Activity (*same) |
| 3.4.17* | None | (*RCS Loop Isolation Valves) |
| 3.4.18* | None | (*RCS Isolated Loop Startup) |
| 3.4.20* | 3.4.16 | Steam Generator Tube Integrity (*same) |
| 3.4.19* | 3.4.17 | RCS Loops - Test Exceptions (*same) |

Contrary to the typical Westinghouse PWR design currently in operation in the U.S., the U.S.-EPR design does not contain RCS loop isolation valves or Pressurizer powered-operated relief valves. As a result, the GTS does not contain operability requirements for these components as are provided in the Westinghouse STS Sections 3.4.11, 3.4.17, and 3.4.18. The staff determined these omissions in the GTS to be acceptable.

Although GTS Section 3.4, does follow the Westinghouse STS model in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in GTS Section 3.4 and its Bases. The staff requested additional information for each of the following items in order to evaluate the adequacy and completeness of GTS Section 3.4, and Bases Section B 3.4. Details regarding the responses to these RAIs are described below.

- GTS Section 3.4.1, contains limits for RCS DNB. GTS Section 3.4.1 models the DNB limits in the Westinghouse STS. During its review, however, the staff noted that the applicant did not include an RCS flow limit as part of LCO Section 3.4.1. In the Westinghouse STS, a numerical flow limit which is based on the maximum allowable steam generator tube plugging is listed in addition to the flow limit specified in the core operating limits report and, as such, it was unclear to the staff as to why this flow limit was not included in the GTS. In RAI 101, Question 16-54, the staff requested that the applicant justify not specifying the minimum thermal design flow of 453,084 lpm (119,692 gpm) in LCO Section 3.4.1. This minimum flow is listed as an initial condition for design-basis accident analyses in LCO, Section 15.0.0.3.1, "Design Plant Conditions and Initial Conditions." In a March 21, 2009, response to RAI 101, Question 16-54, the applicant stated that since the SG tube plugging limit is provided in the Westinghouse STS as a bracketed value, it elects not to include the flow of 453,084 lpm (119,692 gpm) in the GTS. The staff determined this answer inadequate. In the GTS bases, the applicant needs to state that the RCS flow limit specified in the COLR is at least equal to or more restrictive than the SG tube plugging limit before the staff can determine the adequacy of LCO 3.4.1 requirements. Therefore, the staff issued a follow-up RAI 293, Question 16-294 to address this concern. **RAI 293, Question 16-294 is being tracked as an open item.**

- GTS Section 3.4.4, contains the RCS Loops – MODES 1 and 2 operability requirements. GTS Section 3.4.4 models similar operability requirements in the Westinghouse STS. As part of its review, however, the staff noted that the applicant proposed a new Condition A, with associated Required Actions and Completion Times which allows three-RCS loop operation for 2 hours and a restart of the fourth RCS loop at around 50 percent reactor power. In the Westinghouse STS, the same condition would require a unit shutdown to Mode 3. In RAI 101, Question 16-56, the staff requested that the applicant justify this new Condition. The staff's concern is that the cause of the problem should be identified and corrected before restarting the idle loop or the plant could possibly be put in an unanalyzed condition. In a February 19, 2009, response to RAI 101, Question 16-56, the applicant stated:

  > The 15 minute time limit to reduce power to less than or equal to 60 percent allows an orderly power reduction to restore the power to flow ratio of the reactor coolant system (RCS). Condition A and the associated actions reduce the number and severity of transients imposed on the RCS by a forced reduction to Mode 3.

> The U.S. EPR is designed to operate at power with three reactor coolant pumps (RCP) running for a limited period of time. The two hour time limit allows for RCP restart for simple problems and includes time for investigation, correction, and evaluation of the restart of the RCP. The two hour time limit allows an RCP to be restarted in the event of simple failure or fault where the cause is identified and corrected. The RCP restart at power is evaluated in U.S. EPR FSAR Tier 2, Section 15.4. If the problem is more extensive, complex, or the two hour allowance cannot be met, the unit is required to be placed in Mode 3 within the following six hours.

The applicant also proposed changes to the bases to incorporate the above details. The staff determined this response acceptable because a restart of the fourth RCP pump at power is an analyzed plant condition in the U.S. EPR design, while in a Westinghouse design it constitutes an unanalyzed plant condition. The staff's evaluation of this condition is in Section 15.4.4 of this report. The staff has confirmed that Revision 1 of FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-56 is resolved.

- GTS Section 3.4.6 and GTS Section 3.4.7 contain operability requirements for RCS Loops - MODE 4 and MODE 5 with loops filled, respectively. GTS Sections 3.4.6 and 3.4.7 model the RCS Loops – MODE 4 and MODE 5 with loops filled operability requirements in the Westinghouse STS. As part of its review, however, the staff noted that the applicant omitted a precautionary "Note" regarding low temperature overpressure protection before starting an idle reactor coolant pump. In RAI 101, Question 16-77, the staff requested that the applicant clarify this omission. In a March 12, 2009, response to RAI 101, Question 16-77, the applicant proposed to revise GTS Section 3.4.6 and its associated bases to include this "Note" in LCO 3.4.6. In reviewing this response, the staff finds that the same Note should also be placed in LCO 3.4.7, since during planned heatup to Mode 4, at least one RCS loop can be placed in operation. Therefore, the staff issued a follow-up RAI 293, Question 16-295 to address this concern. **RAI 293, Question 16-295 is being tracked as an open item.**

- In RAI 101, Question 16-57, the staff requested that the provide clarification on the minimum flow rate of 8,328 lpm (2,200 gpm) specified for residual heat removal (RHR) loops in SR 3.4.6.1. LCO 3.4.6 requires two RHR loops in operation and LCO Table 6.3-2, "Low Head Safety Injection Pumps Design and Operating Parameters," lists a normal flow rate of 8,328 lpm (2,200 gpm) for each RHR pump. In a March 12, 2009, response to RAI 101, Question 16-57, the applicant proposed to remove the specific value of RHR flow rate from SR 3.4.6.1 and to revise the affected information in the bases regarding RHR flow requirements in Mode 4 to be consistent with the content provided for the similar SR in the Westinghouse STS. The staff determined this response is acceptable because the minimum value of 2200 gpm is for coolant transport to ensure boron mixing while the plant is in shutdown modes and in the U.S. EPR design only one RHR loop is needed for this purpose. In Mode 4, the proposed GTS require two RHR loops to be in operation for decay heat removal and verification of a minimum flow to ensure boron mixing is no longer relevant. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-57 is resolved.

- In RAI 101, Question 16-64, the staff requested that the applicant provide a discussion in the Bases 3.4.6 on Required Action A.2 and its associated completion time of 24 hours. In a December 12, 2008, response to RAI 101 Question 16-64, the applicant proposed to revise the GTS Bases to add the requested information. In reviewing this response, the staff noted that the proposed changes to the description of Condition A and Required Action A.1 are in conflict with the discussion provided for Required Actions A.1 and A.2 in the bases. Therefore, the staff issued a follow-up RAI 293, Question 16-296 to address this concern. **RAI 293, Question 16-296 is being tracked as an open item.**

- GTS Section 3.4.9, "Pressurizer," contains operability requirements for the pressurizer. The GTS 3.4.9 models similar operability requirements in the Westinghouse STS. During its review, the staff noted that the discussion on capacities of emergency powered heaters in the bases is not clear (e.g., SR 3.4.9.1 specifies a minimum value of 144 kW for these heaters and no explanation was given on how this value is determined nor is there a reference to an FSAR section that contains such information). In RAI 101, Question 16-79, the staff requested that the applicant clarify the designed capacity of these heaters. In a March 12, 2009, response to RAI 101, Question 16-79, the applicant proposed to revise the bases to provide specific details for these emergency powered heaters as described in FSAR, Tier 2, Section 5.4. The staff determined that the response is acceptable because the revised basis contains sufficient justification for the minimum value of 144 kW specified in SR 3.4.9.1, and reflects the relevant information in the FSAR; however, the staff noted an editorial error that needs to be corrected. The staff issued a follow-up RAI 293, Question 16-297 to address this concern. **RAI 293 Question 16-297 is being tracked as an open item.**

- Also, in RAI 271, Question 16-293, the staff requested that the applicant provide an assessment to confirm that all the LCO values in the proposed TS are consistent with the initial conditions assumed in the safety analyses. The staff, in particular, cited the proposed pressurizer maximum water level of 75 percent specified in LCO 3.4.9.a as an example where a TS requirement is not consistent with the initial condition assumed in the safety analyses (e.g., a pressurizer water level of 59 percent is assumed in heat-up transients in LCO Section 15.2). In a September 30, 2009, response to RAI 271, Question 16-293, the applicant proposed to revise LCO 3.4.9.a and the associated discussion in the TS Bases B 3.4.9 to reflect the assumed value of 59 percent in a feedwater line break event which is identified as the limiting event for pressurizer water level concerns. The revised LCO 3.4.9.a and its associated TS Bases B 3.4.9 are acceptable; however, the requested assessment of all the LCO values proposed in the GTS is not provided. In a follow-up RAI 311, Question 16-293, the staff requested that the applicant provide an overall assessment as stated in the original RAI 271, Question 16-293. **RAI 311, Question 16-317 is being tracked as an open item.**

- GTS Section 3.4.10, "Pressurizer Safety Relief Valves," contains operability requirements for the pressurizer safety valves. The GTS 3.4.10 models similar operability requirements in the Westinghouse STS. In a February 19, 2009, response to RAI 101, Question 16-67, regarding a reference to an overpressure protection analysis topical report in the TS Bases B 3.4.10, the applicant stated the bases would be revised to delete that reference, since a generic topical report is not included in the U.S. EPR design certification application. The staff determined that this response is acceptable. To ensure the stated change is properly incorporated in the GTS bases, **RAI 101, Question 16-67 is being tracked as a confirmatory item.**

- GTS Section 3.4.11, "Low Temperature Overpressure Protection," contains operability requirements for the low temperature overpressure protection system. The GTS 3.4.11 models similar operability requirements in the Westinghouse STS. During its review, the staff noted incomplete information provided in the TS bases and relevant information in the FSAR Tier 2, Section 5.2.2, "Overpressure Protection." In RAI 101, Question 16-68, the staff requested that the applicant provide further clarifying details. In an April 9, 2009, response to RAI 101, Question 16-68, the applicant provided the requested information and revised affected areas in both FSAR and the GTS Bases to complete the missing details. The staff determined that the revised GTS Bases are otherwise acceptable because they conform to guidance in the STS and contain necessary supporting information which reflects the relevant information in FSAR Tier 2, Section 5.2.2, however, noted that the applicant also removed a discussion of single-failure criteria applicable to the required number of PSRVs. This discussion appears to conform with the approach used in the Westinghouse STS. In a follow-up RAI 293, Question 16-299, the staff requested that the applicant clarify why this information was removed. **RAI 293, Question 16-299 is being tracked as an open item.**

- Also, in RAI 101, Question 16-69, the staff questioned why further direction is not provided if remedial actions could not be completed as specified for Condition A involving over pressurization caused by operation of MHSI pumps. In a March 12, 2009, response to RAI 101, Question 16-69, the applicant proposed to revise Condition C to close the action loop. The staff reviewed the proposed change and noted that Condition C is applicable only to the accumulators, not the MHSI pumps. In a follow-up RAI 293, Question 16-300, the staff requested that the applicant revise the last Condition F which accounts for failure to complete the required actions specified in other conditions of LCO 3.4.11, to resolve this issue. **RAI 293, Question 16-300 is being tracked as an open item.**

- GTS Section 3.4.12, "RCS Operational LEAKAGE," contains RCS operational leakage limits. The GTS 3.4.12 models similar operability requirements in the Westinghouse STS. During its review, the staff noted that the applicant has adopted TSTF-449, "Steam Generator Tube Integrity, Revision 4," in GTS 3.4.12, 3.4.16, and 5.5.8; however, TSTF-449 model requirements were not properly incorporated in LCO 3.4.12.d and TS 5.5.8. In RAI 63, Questions 05.04.02.02-3 and 05.04.02.02-9, the staff requested that the applicant address these discrepancies. In a November 14, 2008, response to RAI 63, Questions 05.04.02.02-3 and 05.04.02.02-9, the applicant proposed to revise LCO 3.4.12.d, TS 5.5.8 and the affected supporting information in the GTS Bases to resolve these discrepancies. The staff reviewed Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, and found that required changes were incorporated in LCO 3.4.12.d and TS 5.5.8 to more closely follow TSTF-449, but conforming changes (eight places) were not made in the GTS bases (B 3.4.12 and B 3.4.16). In a follow-up RAI 293, Question 16-301, the staff requested that the applicant make the conforming changes to GTS bases (B 3.4.12 and B 3.4.16). **RAI 293, Question 16-301 is being tracked as an open item.**

- GTS Section 3.4.13, "RCS Pressure Isolation Valve Leakage," contains RCS pressure isolation valve (PIV) leakage limits. GTS Section 3.4.13 models the RCS pressure isolation valve leakage limits in the Westinghouse STS. As part of its review, however, the staff noted an inconsistency between SR 3.4.13.1 requirements and supporting

information in the bases. In RAI 101, Question 16-71, the staff requested that the applicant address this inconsistency. In a December 12, 2008, response to RAI 101, Question 16-71, the applicant proposed to resolve this issue by revising the SR 3.4.13.1 to include the same text used for the SR in the Westinghouse STS. The staff determined that this response is acceptable because they conform to the guidance in the Westinghouse STS. The staff confirmed that Revision 1 of U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-71 is resolved.

- GTS Section 3.4.14, "Leakage Detection Instrumentation," contains the operability requirements for the RCS leakage detection instrumentation. GTS Section 3.4.14 models the RCS leakage detection instrumentation operability requirements in the Westinghouse STS 3.4.15. As part of its review, however, the staff noted that the applicant omitted the channel operational test SR for the containment atmosphere activity monitor. In RAI 101, Question 16-72, the staff requested that the applicant justify the absence of an equivalent COT for the containment atmosphere monitor. In a March 19, 2009, response to RAI 101, Question 16-72, the applicant proposed to add a sensor operational test as SR 3.4.14.5 for the subject monitor in the GTS. The staff determined that this response is acceptable because the revised GTS 3.4.14 and associated bases conform to the guidance in the STS. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-72 is resolved.

- GTS Section 3.4.15, "RCS Specific Activity," contains RCS Dose Equivalent I-131 and Dose Equivalent Xe-133 limits. GTS Section 3.4.15 models similar requirements in the Westinghouse STS. As part of its review, however, the staff noted that the GTS Bases contain information that was different from the information contained in TSTF-490, Revision 0. Specifically, limits for Dose Equivalent I-131 in the U.S. EPR design are different than those recommended in the Westinghouse STS. In RAI 101, Question 16-81, the staff requested that the applicant address these differences. In a December 12, 2008, response to RAI 101, Question 16-81, the applicant adequately provided the basis for the specified requirements and proposed to revise the GTS Bases to include clarifying details. The staff determined that the stated response is acceptable because the revised supporting information in the bases are consistent with the assumptions used in the accident analyses described in FSAR Tier 2, Chapter 15; however, editorial errors still exist in the GTS bases that need to be corrected. In a follow-up RAI 293, Question 16-302, the staff requested that the applicant correct these editorial errors. **RAI 293, Question 16-302 is being tracked as an open item.**

- In RAI 101, Questions 16-73, 16-75, and 16-78, the staff requested that the applicant correct editorial errors found in GTS Section 3.4 and its associated bases. In a December 12, 2008, response to RAI 101, Questions 16-73, 16-75, and 16-78, the applicant agreed to revise the GTS and its Bases to make these corrections. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Questions 16-73, 16-75, and 16-78 are resolved.

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

**Conclusion**

The applicant proposed TS for the RCS in accordance with the Westinghouse STS, with some differences to reflect U.S. EPR-unique design features. In addition, GTS Section 3.4, and its Bases do not contain any bracketed information or Reviewer's Notes. Therefore, except for the open items and confirmatory item discussed above, the staff finds GTS Section 3.4 and Bases Section B 3.4 acceptable.

## 16.4.9 Emergency Core Cooling Systems (ECCS)

**Introduction**

The GTS and Bases Section 3.5, "Emergency Core Cooling Systems," includes requirements for the safety-related equipment designed for emergency core safety injection, decay heat removal, and RCS emergency makeup and boration.

**Evaluation**

In general, GTS Section 3.5 is modeled after STS Section 3.5 for Westinghouse plants, with differences to reflect U.S. EPR-unique design features, most notably the four 100 percent safety-injection pump trains versus the two 100 percent pump trains in most of the current PWR plants. The GTS for the emergency core cooling system corresponds to the Westinghouse STS in the following manner:

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.5.1* | 3.5.1 | Accumulators (*same) |
| 3.5.2* | 3.5.2 | ECCS - Operating (*same) |
| 3.5.3* | 3.5.3 | ECCS - Shutdown (*same) |
| 3.5.4* | 3.5.4 | IRWST - Operating (*RWST) |
| 3.5.5* | None | (*Seal Injection Flow) |
| 3.5.6* | 3.5.5 | Extra Borating System (*Boron Injection Tank) |

Contrary to the typical Westinghouse PWR design currently in operation in the U.S., the U.S. EPR design does not use the charging pumps to perform any safety-related function during a design-basis accident event. As a result, the GTS does not contain operability requirements for the charging pumps as is provided in the Westinghouse STS, Section 3.5.5. The staff finds this omission in the GTS to be acceptable, because the safety analyses in FSAR Tier 2, Chapter 15 do not take credit for charging pump operation to mitigate any DBA.

Although GTS Section 3.5, does model the STS in format and content, the staff noted differences between the two that warranted technical justification and clarification beyond what was given in GTS Section 3.5 and its Bases. The staff requested additional information for each of the following items in order to evaluate the adequacy and completeness of GTS Section 3.5,

and Bases Section B 3.5. Details regarding the responses associated with these RAIs are described below.

- GTS Section 3.5.1, "Accumulators," contains operability requirements for accumulators as a source of safety injection during large break LOCAs. GTS Section 3.5.1 models the accumulator operability requirements in the Westinghouse STS. During its review, however, the staff noted that the applicant discussed a unique role for Accumulators three and four during plant cool-down operation to prevent any RCP seal injection damage. In RAI 101, Question 16-84, staff requested that the applicant provide further clarification on this role. In a December 12, 2008, response to RAI 101, Question 16-84, the applicant stated:

  > Reconnection of an accumulator to the reactor coolant system during cooldown is an operational consideration. Discussion of this evolution was included in the Bases as clarification. Without this explanation, the Bases would imply that all four accumulator isolation valves are closed with RCS pressure below 1,000 psig. Any of the accumulators can be depressurized as described in the revised Applicability discussion of FSAR Tier 2, Chapter 16, Technical Specifications Section 3.5.1 Bases. The train three or four accumulators are preferred, but are not a requirement. The FSAR Tier 2, Chapter 16, Technical Specifications Section 3.5.1 Bases Applicability discussion will be revised to delete the reference to trains three and four. Cooldown of the RCS can be accomplished without reconnecting one accumulator. Operability of accumulators for this evolution is not needed.

The staff determined the above explanation is acceptable because the use of accumulators during Mode 4 is for RCP Seal protection only and is not credited in any safety analysis described in the FSAR Tier 2. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-84 is resolved.

- GTS Section 3.5.2, "ECCS – Operating," contains operability requirements for the ECCS. GTS Section 3.5.2 models the ECCS operability requirements in the Westinghouse STS. The staff noted the increased level of train redundancy (e.g., four trains in the U.S. EPR design versus two trains in the typical Westinghouse design, and determined that it was not clear whether the GTS ECCS LCO was equivalent to that provided in the Westinghouse STS. In RAI 101, Question 16-93, the staff requested that the applicant provide further clarifications on LCO 3.5.2. In a December 12, 2008, response to RAI 101, Question 16-93, the applicant provided the requested information, including a revised Condition C and various supporting information in the bases to include the clarifying details. In reviewing this response, the staff noted that the revised discussion in the bases on Actions B.1, B.2, and C.1 is incomplete. In a follow-up RAI 293, Question 16-307, the staff requested that the applicant complete the revised discussion in the bases. **RAI 293, Question 16-307 is being tracked as an open item.**

- In addition, for Conditions A and B with one subsystem (MHSI pump and LHSI pump, respectively) within a redundant train inoperable, the applicant proposed a completion time (CT) of 120 days to restore the affected pump to operable status. In RAI 101,

Question 16-102, the staff requested that the applicant provide a technical justification for the proposed CT of 120 days, because the 120 days exceed any completion times used in current operating PWR plants. This RAI applies also to GTS Sections 3.7.5, 3.7.7, 3.7.8, 3.7.19, and 3.8.4 which cover other U.S. EPR plant systems with four redundant trains. In a December 12, 2008, response to RAI 101, Question 16-102, the applicant provided a detailed assessment of the 120 day CT against existing regulatory guidance on the allowable outage time. Out of the six systems for which the LCO action statement specifies a CT of 120 days, only two systems will need additional equipment realignment. For the low pressure safety injection system, realignment is needed to address steam entrainment. For the emergency diesel generator system, realignment is needed so that the single failure criterion will still be satisfied by the remaining three operable EDG trains. Therefore, in conjunction with the staff review of LCO 3.8.4, additional information was further requested from the applicant on the scope of maintenance activities associated with an EDG outage. The acceptance of the 120-day CT is identified as an open item discussed in Section 16.4.12 of this report.

- In RAI 101, Question 16-85, the staff requested that the applicant clarify the statement in the bases which reads, "this LCO is only applicable in MODE 3 and above. Below 180 °C (356 °F), the PS signal setpoint is manually bypassed by operator control." In the U.S. EPR design, the PS signal is manually bypassed only for the LHSI subsystem to allow the alignment of the LHSI subsystem in RHR mode. The MHSI subsystem can still be automatically started by a PS signal. In a December 12, 2008, response to RAI 101, Question 16-85, the applicant proposed to revise this statement to improve its clarity. The staff determined this response is acceptable since the revised GTS Bases include the necessary supporting information to reflect the description of system operation in FSAR Tier 2, Section 6.3. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, was revised as committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-85 is resolved.

- GTS Section 3.5.4, contains operability requirements for In-Containment Refueling Water Storage Tank (IRWST). GTS Section 3.5.4 models similar operability requirements in the Westinghouse STS. In RAI 101, Questions 16-94 and 16-95, the staff requested that the applicant provide missing details in discussions in the GTS Bases regarding the water volume and temperature requirements specified in LCO 3.5.4. Specifically, temperature requirements were not discussed in the bases and volume requirements were not explicitly addressed in any action statement of GTS 3.5.4. In a December 12, 2008, response to RAI 101, Questions 16-94 and 16-95, the applicant proposed to revise the GTS, the associated bases, and relevant information the FSAR Tier 2, Section 6.3 to include the requested details. The staff determined this response is acceptable since the revised GTS Bases include necessary supporting information to reflect the description of system operation in FSAR Tier 2, Section 6.3, and the proposed revision to GTS 3.5.4 includes an action statement for volume. The staff confirmed that Revision 1 of U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Questions 16-94 and 16-95 are resolved.

- GTS Section 3.5.5, contains the operability requirements for the extra borating system (EBS). The EBS requirements were formulated following guidance from the

Westinghouse STS with respect to the system's importance to safety, the availability of redundant equipment, and the potential loss of the safety function. As part of its review, the staff determined that additional clarification was needed regarding the EBS requirements. In RAI 101, Question 16-96, the staff requested that the applicant justify not including surveillance testing for the automatic reset feature in EBS containment isolation valve control circuits. In RAI 101, Question 16-97, the staff requested that the applicant provide further clarification regarding actions to restore boron concentration, water volume, and temperature to within specified limits. In RAI 101, Question 16-99, the staff requested that the applicant provide additional details on how piping containing borated water is protected from cold surrounding areas without heat tracing. In a December 12, 2008, response to RAI 101, Question 16-96, the applicant proposed to add SR 3.5.5.8 for testing the automatic reset feature in the EBS containment isolation valve control circuits. In a December 12, 2008, response to RAI 101, Question 16-97, the applicant proposed to revise discussions in the bases to include details of how deficiencies found in water volume or temperature affect EBS train operability, and for Question 16-99, the applicant added clarifying details of how the safety-related Fuel Building Ventilation System maintains air temperature in areas where piping containing borated water resides. The staff determined these responses acceptable since the revised GTS Section 3.5.5 and its associated bases include requirements and supporting information to reflect the description of system operation in FSAR Tier 2, Section 6.8. The staff confirmed that Revision 1 of U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Questions 16-96, 16-97, and 16-99 are resolved.

- In addition, in responding to RAI 142, Question 19-269 regarding the use of Criterion 4 of 10 CFR 50.36(c)(2)(ii) for establishing LCO requirements in the GTS, the applicant proposed three new LCOs: LCO 3.5.6, LCO 3.5.7, and LCO 3.5.8. These three LCOs establish controls for operation of MHSI pumps, which are automatically actuated in the event of a loss of RCS inventory during Mid-Loop operation. The staff reviewed these new LCOs and, in RAI 207, Question 16-292, requested further clarification from the applicant regarding the effectiveness of various specified actions for the described conditions in these new TSs and the completeness of supporting information provided in the respective bases. In May 8, 2009, and July 5, 2009, responses to RAI 207, Question 16-292, the applicant provided the requested information and revised the GTS and Bases to capture the new details. The staff notes that the STS do not contain model specifications for shutdown mode operation. However, the AP1000 GTS in Revision 15 of the AP1000 DCD contains similar provisions, which the staff reviewed in connection with the AP1000 design certification and which were incorporated by reference in 10 CFR Part 52, Appendix D. The staff determined that the response is acceptable because these newly proposed technical specifications conform to the content of the corresponding AP1000 GTS and reflect the description of system operation in FSAR Tier 2, Section 19.1.6; however, the proposed changes still contain editorial errors that need to be corrected. In a follow-up RAI 293, Question 16-308, the staff requested that the applicant correct these editorial errors. **RAI 293, Question 16-308 is being tracked as an open item.**

- Also, in response to RAI 212, Question 6.2.2-23, the applicant proposed modification to the isolation valves at the interface between the non-safety-related severe accident heat removal system (SAHRS) and the IRWST. In connection with this design change, and in

response to RAI 281, Question 6.2.2-35, the applicant proposed to revise TS 3.5.4, TS 3.5.6 and TS 3.5.7 and their associated bases. The staff's evaluation of the proposed changes and related TS changes will be documented in Section 6.2.2 of this report.

- In addition, in RAI 101, Questions 16-98, 16-100, and 16-101, the staff requested that the applicant correct editorial errors found in GTS Section 3.5. In a December 12, 2009, response letter, the applicant agreed to revise the GTS and Bases to reflect these corrections. The staff confirmed that Revision 1 of U.S. EPR FSAR, dated May 29, 2009, was revised as committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Questions 16-98, 16-100, and 16-101 are resolved.

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

**Conclusion**

The applicant adhered to the model ECCS TS as provided in the Westinghouse STS, with some differences to reflect U.S. EPR-unique design features. In addition, GTS Section 3.5, and its Bases do not contain any bracketed information or Reviewer's Notes. Therefore, except for the open items discussed above, the staff finds GTS Section 3.5 and Bases Section B 3.5 acceptable.

## 16.4.10 Containment Systems

**Introduction**

The 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, GTS Section 3.6 is modeled after STS Section 3.6 for Westinghouse plants, with differences to reflect U.S. EPR-unique design features. The GTS for the Containment Systems corresponds to the Westinghouse STS in the following manner:

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.6.1* | 3.6.1 | Containment (*same) |
| 3.6.2* | 3.6.2 | Containment Air Locks (*same) |
| 3.6.3* | 3.6.3 | Containment Isolation Valves (*same) |
| 3.6.4A* | 3.6.4 | Containment Pressure (*same) |
| 3.6.5A* | 3.6.5 | Containment Air Temperature (*same) |
| 3.6.6A* | None | (*Containment Spray and Cooling Systems) |
| 3.6.8* | 3.6.6 | Shield Building (*same) |

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.6.13* | 3.6.7 | Annulus Ventilation System (AVS) (*Shield Building Air Cleanup System) |
| None | 3.6.8 | pH Adjustment |
| 3.6.7* | None | (*Spray Additive System) |
| 3.6.9* | None | (*Hydrogen Mixing System) |
| 3.6.11* | None | (*Iodine Cleanup System) |
| 3.6.12* | None | (*Vacuum Relief Valves) |

Contrary to typical PWR designs currently in operation in the U.S., the U.S. EPR design does not have a safety-related Containment Spray System, a safety-related Containment Cooling System, a Containment Hydrogen Mixing System, a Containment Iodine Cleanup System, or Containment Vacuum Relief Valves. As a result, the GTS do not include any requirements comparable to the Westinghouse STS, Sections 3.6.6, 3.6.7, 3.6.9, 3.6.11, and 3.6.12 for operations of these systems. The staff determined these omissions in the GTS are acceptable, in part, because the safety analyses in FSAR Tier 2, Chapter 15 do not take credit for the Containment Spray System and Containment Cooling System.

Although GTS Section 3.6, does model the Westinghouse STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in GTS Section 3.6 and its Bases. The staff requested that the applicant provide additional information for each of the following items in order to evaluate the adequacy and completeness of GTS Section 3.6, and Bases Section B 3.6. Details regarding the responses to these RAIs are described below.

- GTS Section 3.6.1, contains operability requirements for the Containment structure. GTS Section 3.6.1 models similar operability requirements in the Westinghouse STS. In RAI 101, Question 16-117, the staff requested that the applicant address inconsistencies between supporting information provided in the TS Bases B 3.6.1 and relevant information in FSAR Tier 2, Section 6.2.6.1, “Containment Integrated Leakage Rate Test (Type A),” regarding the allowable leakage rate for the Type A test. Specifically, the phrase, "containment air mass per day," is used in the FSAR versus, "containment air weight per day," in the TS Bases. In a December 12, 2008, response to RAI 101, Question 16-117, the applicant stated that "air weight" is the correct term which is also used in the accident analyses in FSAR Tier 2, Chapter 15, and proposed to revise FSAR Tier 2, Section 6.2.6.1 to resolve these inconsistencies. The staff determined that this response is acceptable. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-117 is resolved.

- GTS Section 3.6.3, contains operability requirements for Containment isolation valves. GTS Section 3.6.3 models similar operability requirements in the Westinghouse STS. During its review, the staff noted differences between the GTS and the Westinghouse STS regarding resilient seals used in Containment purge valves. In RAI 101, Question 16-116, the staff requested that the applicant provide clarification on these

differences. In a December 12, 2008, response to RAI 101, Question 16-116, the applicant stated that resilient seals are used in both U.S. EPR full-flow and low-flow containment purge isolation valves, and proposed to revise GTS 3.6.3 and its associated bases to conform to the guidance provided in the STS regarding operating experience with resilient seals in current PWR plants. The staff determined that this response is acceptable because the revised GTS 3.6.3 and Bases include the detail necessary to address generic issues on resilient seals; however, a conforming change to Condition D description was missed. In a follow-up RAI 293, Question 16-309, the staff requested that the applicant address the conforming change to condition D description. **RAI 293, Question 16-309 is being tracked as an open item.**

- GTS Section 3.6.6, contains operability requirements for the Shield Building. GTS Section 3.6.6 models the Shield Building operability requirements in the Westinghouse STS. As part of its review, the staff identified some inconsistencies between GTS Section 3.6.6, its Bases and relevant information in the FSAR Tier 2, Section 6.2.3, "Secondary Containment Functional Design." Specifically, for a negative differential pressure between the Shield Building and the outside atmosphere, GTS 3.6.6 specifies the pressure in "inches water gauge," while FSAR Tier 2, Section 6.2.3 uses "psig," and the relationship between the operating differential pressure and the accident differential pressure was unclear. In RAI 101, Question 16-123, the staff requested that the applicant address these inconsistencies. In a December 12, 2008, response to RAI 101, Question 16-123, the applicant proposed to revise FSAR Tier 2, Section 6.2.3 to convert the pressure readings from "psig" to "inches water gauge." The staff determined that this response is acceptable because the GTS 3.6.6 requirements are now consistent with relevant information in the revised FSAR Tier 2, Section 6.2.3. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-123 is resolved.

- In addition, GTS 3.6.6 did not include an SR to verify the structural integrity of the Shield Building. The staff noted that this was not consistent with guidance in the STS. In RAI 101, Question 16-124, the staff requested that the applicant provide justification for the omission. In a December 12, 2008, response to RAI 101, Question 16-124, the applicant proposed to add SR 3.6.6.5 to the GTS and Bases. The staff determined that this response is acceptable because the revised GTS 3.6.6 and its associated bases conform to the guidance in the STS. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains as the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-124 is resolved.

- GTS Section 3.6.7, "Annulus Ventilation System," contains operability requirements for the Annulus Ventilation System. GTS Section 3.6.7 models similar operability requirements in the Westinghouse STS. As part of its review of SR 3.6.7.1, the staff noted a much shorter minimum run time (15 minutes) for the filter train (with heaters on) as compared to the STS 10-hour minimum run time. In RAI 101, Question 16-60, the staff requested that the applicant provide a justification for the shorter run time. In a December 12, 2008, response to RAI 101, Question 16-60, the applicant referenced guidance provided in Section 6.1 of RG 1.52, Revision 3, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled

Nuclear Power Plants," June 2001, as the basis for the 15-minute run time. The staff agrees with this position because the recommended minimum run time in RG 1.52, Revision 3, June 2001, reflects new operating experience with testing of filtration units in operating nuclear power plants since the issuance of its Revision 2 in March 1978 and, therefore, RAI 101, Question 16-60 is resolved.

- In RAI 101, Question 16-112, the staff requested that in TS 3.6.7, the applicant add surveillance testing of the air inlet and exhaust isolation dampers, as well as applicable action statements for their inoperability. In a December 12, 2008, response to RAI 101, Question 16-112, the applicant revised GTS 3.6.7 to add a new SR 3.6.7.4 and a new Condition B to reflect operability requirements for these isolation dampers. The staff determined that this response is acceptable because these new requirements conform to the guidance in STS for similar design functions in other systems. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-112 is resolved.

- In RAI 101, Question 16-113, the staff requested that the applicant provide further clarification on the operation of the Annulus Ventilation System, both during normal and accident conditions. In a December 12, 2008, response to RAI 101, Question 16-113, the applicant provided the requested information and proposed to revise the GTS Bases to include these clarifying details. The staff determined that this response is acceptable because the revised GTS and Bases include the necessary details describing the relationship between the normal and accident subsystems to support the specified system operability requirements. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-113 is resolved.

- GTS Section 3.6.8, "pH Adjustment," contains U.S. EPR design-specific operability requirements for the pH adjustment baskets. The U.S. EPR pH adjustment basket, more commonly referred to as the trisodium phosphate (TSP) basket, models the TSP requirements in the Combustion Engineering STS, Section 3.5.5. As part of its review, however, the staff noted that this LCO did not include a SR to periodically sample the TSP to ensure that the performance of the TSP baskets is not degraded by long-term storage inside the Containment Building. In RAI 101, Question 16-61, the staff requested that the applicant provide justification for this omission. In a December 12, 2008, response to RAI 101, Question 16-61, the applicant proposed to add a new SR 3.6.8.2 which is similar to the one in the Combustion Engineering STS. The staff determined that this response is acceptable because the revised GTS 3.6.8 and its associated bases conform to the guidance in the STS for a similar application. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-61 is resolved.

- In RAI 122, Question 16-248, the staff requested that the applicant provide additional details in the GTS Bases B 3.6.1 and B 3.6.6 for integration of relevant U.S. EPR dual containment features from FSAR Tier 2, Section 6.2.3. In a March 19, 2009, response to RAI 122, Question 16-248, the applicant proposed to revise the GTS Bases to

indicate that Containment Building provides for leak tightness and the Shield Building provides protection from external hazards. The applicant indicated that together, these two buildings provide radiation shielding and, in conjunction with the Annulus Ventilation System, allow controlled release of the annulus atmosphere under accident conditions. The staff determined that this response is acceptable because the revised GTS Bases conform to the guidance in the STS, and reflects the relevant information in FSAR Section 6.2.3. The staff confirmed that Revision 1 of U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 122, Question 16-248 is resolved.

- In RAI 101, Questions 16-58, 16-59, 16-114, 16-115, 16-122, and 16-249, the staff requested that the applicant correct editorial errors found in GTS Section 3.6. In a December 19, 2008, response to RAI 101, Questions 16-58, 16-59, 16-114, 16-115, 16-122, and 16-249, the applicant agreed to revise the GTS and Bases to reflect these corrections. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Questions 16-58, 16-59, 16-114, 16-115, 16-122, and 16-249 are resolved.

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

**Conclusion**

The applicant adhered to the model Containment Systems TS as provided in the applicable STS, with some differences to reflect U.S. EPR unique design features. In addition, GTS Section 3.6, and its Bases do not contain any bracketed information or Reviewer's Notes. Therefore, except for the open item discussed above, the staff finds GTS Section 3.6 and Bases Section B 3.6 acceptable.

## 16.4.11 Plant Systems

**Introduction**

The 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, which include main steam safety valves (MSSVs), main steam isolation valves, main feedwater valves (MFVs), main steam relief trains, emergency feedwater system; and plant cooling water systems that include the component cooling water (CCW) system, essential service water system (ESWS), safety-chilled water (SCW) system, Control Room emergency filtration (CREF) system, and Control Room air conditioning system. The GTS and Bases Section 3.7 also include 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, GTS Section 3.7 is modeled after STS Section 3.7 for Westinghouse plants, with differences to reflect U.S. EPR-unique design features. The GTS for secondary-side plant systems correspond to the Westinghouse STS in the following manner:

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.7.1* | 3.7.1 | Main Steam Safety Valves (*same) |
| 3.7.2* | 3.7.2 | Main Steam Isolation Valves (*same) |
| 3.7.3* | 3.7.3 | Main Feedwater Valves (*MFIVs and Main Feedwater Regulation Valves (MFRVs)) |
| 3.7.4* | 3.7.4 | Main Steam Relief Trains (*Atmospheric Dump Valves (ADVs)) |
| 3.7.5* | 3.7.5 | Emergency Feedwater System (*Auxiliary Feedwater (AFW) System) |
| 3.7.6* | 3.7.6 | EFW Storage Pools (*Condensate Storage Tank (CST)) |
| 3.7.7* | 3.7.7 | Component Cooling Water System (*same) |
| 3.7.8* | 3.7.8 | Essential Service Water System (*Service Water System (SWS)) |
| 3.7.9* | 3.7.19 | Ultimate Heat Sink (UHS) (*same) |
| None | 3.7.9 | Safety-Chilled Water System |
| 3.7.10* | 3.7.10 | Control Room Emergency Filtration (*Control Room Emergency Filtration System) |
| 3.7.11* | 3.7.11 | Control Room Air Conditioning System (*Control Room Emergency Air Temperature Control System (CREATCS)) |
| 3.7.12* | 3.7.12 | Safeguard Building Controlled-Area Ventilation System (SBVS) (*ECCS Pump Room Exhaust Air Cleanup System) |
| None | 3.7.13 | Safeguard Building Ventilation System Electrical Division (SBVSED) |
| 3.7.13* | None | (*Fuel Building Air Cleanup System) |
| 3.7.14* | None | (*Penetration Room Exhaust Air Cleanup System (PREACS)) |
| 3.7.15* | 3.7.14 | Spent Fuel Storage Pool Water Level (*Fuel Storage Pool Water Level) |
| 3.7.16* | 3.7.15 | Spent Fuel Storage Pool Boron Concentration (*Fuel Storage Pool Boron Concentration) |
| 3.7.17* | 3.7.16 | Spent Fuel Pool Storage (*same) |
| 3.7.18* | 3.7.17 | Secondary Specific Activity (*same) |

In the U.S. EPR design, the Fuel Building Air Cleanup system is integral to the Safeguard Building Controlled-Area Ventilation system (covered under GTS 3.7.12), and the Penetration Room Exhaust Air Cleanup system is replaced by the Annulus Ventilation system (covered under GTS 3.6.7). As a result, the GTS does not contain separate operability requirements for these systems as are provided in the Westinghouse STS 3.7.13 and 3.7.14. The staff finds this approach in the GTS acceptable.

Although GTS Section 3.7 does model the Westinghouse STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in GTS Section 3.7 and its Bases. The staff requested additional information for each of the following items in order to evaluate the adequacy and completeness of GTS Section 3.7, and Bases Section B 3.7. Details regarding the responses associated with these RAIs are described below.

- GTS Section 3.7.1, "Main Steam Safety Valves," contains the operability requirements for the main steam safety valves. GTS Section 3.7.4, "Main Steam Relief Trains," contains the operability requirements for the main steam relief trains. The MSSVs and MSRTs are designed to function together to provide overpressure protection of piping systems on the steam generator secondary side. The requirements of GTS 3.7.1 and GTS 3.7.4 were formulated following the guidance from the Westinghouse STS with respect to loss of equipment redundancy, potential loss of applicable safety function(s), and relief capacity assumed in the accident analyses for each affected component. In RAI 101, Question 16-62, the staff requested that the applicant provide justification for the as-found tolerance of 3 percent for the setpoint setting of MSSVs. This 3 percent value is not consistent with requirements of ASME Code, Section III, NC 7000 which is listed as a reference in the U.S. EPR GTS Bases B 3.7.1. American Society of Mechanical Engineers (ASME) Code, Subsection NC 7512 requires a tolerance of one percent unless a greater tolerance is established as permissible in the Overpressure Protection Report per NC 7200. In a December 12, 2008, response to RAI 101, Question 16-62, the applicant reiterated a discussion of SR 3.7.1.1 in the GTS Bases 3.7.1 which states, "The SR allows a +/- 3 percent setpoint tolerance for OPERABILITY; however, the valves are reset to +/- 1 percent during the surveillance to allow for drift. The lift settings correspond to ambient conditions of the valve at nominal operating temperature and pressure," and concluded that "the ASME Code requirement is met provided the +/- 1 percent tolerance is met during pre-service and in-service testing." The staff disagreed with this conclusion. In the Westinghouse STS, as discussed in the bases of STS LCO 3.4.6 for the pressurizer safety valves and of STS LCO 3.7.1 for the main steam safety valves, ASME Code requirements apply to the setpoint tolerance for OPERABILITY. Further, in the Westinghouse STS, the 3 percent value is bracketed as preliminary and subject to additional conformance of referenced ASME Code requirements (e.g., if the 3 percent value is selected for use it should be addressed in the applicable Overpressure Protection Report). The staff issued a follow-up RAI 293, Question 16-303 to address this concern. **RAI 293, Question 16-303 is being tracked as an open item.**

- In RAI 101, Question 16-90, the staff requested that the applicant address inconsistency between requirements of ASME Code, Section III, Article NC-7512.1 and relevant information provided in FSAR Tier 2, Table 15.2-1, "Turbine Trip - Key Input Parameters," regarding the MSSV rated lift capacity. In a December 12, 2008, response to RAI 101, Question 16-90, the applicant stated, "the flow area of the main steam safety

valves is calculated based on rated flow rate being achieved when system pressure is equal to nominal setpoint pressure, plus 3 percent accumulation. The MSSV setpoint pressure used in the safety evaluation is calculated as the nominal setpoint pressure, + 3 percent setpoint uncertainty (to account for drift). Since accumulation and uncertainty have the same value of 3 percent, rated flow will be achieved at the initial valve opening." The applicant also indicated that no change to the FSAR is needed. The staff determined this response is unacceptable in that combining a one-sided + 3 percent accumulation with a two-sided +/- 3 percent setpoint uncertainty can result in a total of + 6 percent difference from the nominal setpoint value. The rated lift capacity assumed in the accident analysis should be at the upper limit of the combined tolerance (e.g., at the RCS pressure of 11.09 MPa (1,608.7 psia) instead of 10.47 MPa (1,518.5 psia) for the first MSSV). The staff issued a follow-up RAI 293, Question 16-304 to address this concern. **RAI 293, Question 16-304 is being tracked as an open item.**

- In RAI 101, Question 16-86, the staff requested that the applicant explain how specified actions would ensure that a loss of safety function does not exist during the time when two MSSVs are inoperable. Required Action B.1 calls for restoring one MSSV to operable status within 7 days. A 7-day completion time (CT) is usually applied to an LCO Condition where the system safety function is still fulfilled by the remaining operable equipment. In the U.S. EPR design, each main steam header has two MSSVs and one MSRT. Each MSSV has a relief capacity of 25 percent of the full load steam generation per SG, and the MSRT has 50 percent relief capacity. The MSSVs together with the MSRT are credited in the accident analyses where a failure of one MSRT to open is identified as the worst case single failure. In a December 12, 2008, response to RAI 101, Question 16-86, the applicant determined that Condition B would constitute a loss of safety function that warrants a plant shutdown action and proposed to revise all LCO 3.7.1 action statements to reflect this new safety assessment. Specifically, for Condition A with one inoperable MSSV, the completion time to restore it to operable status would be changed from 30 days to 72 hours after the associated MSRT is verified operable. Condition B would be deleted, and a part of Condition C would be changed from, "three or more MSSVs inoperable," to "two or more MSSVs inoperable," for which a plant shutdown is required. The staff determined that this response is acceptable, since the proposed approach is consistent with general guidance provided in the Westinghouse STS for such plant conditions and will ensure the continued validity of the assumptions in the accident analyses for steam relief capacity described in FSAR Tier 2, Chapter 15. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-86 is resolved.

- GTS Section 3.7.2, "Main Steam Isolation Valves," contains operability requirements for the main steam isolation valves. GTS Section 3.7.2 models the MSIV operability requirements in the Westinghouse STS. As part of its review, the staff noted that the specified closing time for cycling each MSIV provided in the STS was not included in the GTS SR 3.7.2.3. In RAI 101, Question 16-108, the staff requested that the applicant provide a justification for this omission. In a December 12, 2008, response to RAI 101, Question 16-108, the applicant cited the NRC-approved TSTF-491, "Removal of Main Steam and Main Feedwater Isolation Times From the Technical Specifications," Revision 2, as the basis for the closing time removal. The staff agrees with this position and, therefore, RAI 101, Question 16-108 is resolved.

- In RAI 101, Question 16-118, the staff requested that the applicant provide additional information in the bases on the new staggered test specified in SR 3.7.2.4 for a full stroke cycling of MSIVs. In a December 12, 2008, response to RAI 101, Question 16-118, the applicant proposed to revise the GTS Bases to clearly describe the alternate use of the two redundant control lines during this MSIV full closure test. The staff determined that this response is acceptable because the revised GTS Bases conforms to the guidance in the STS. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-118 is resolved.

- GTS Section 3.7.3, "Main Feedwater Valves," contains operability requirements for the main feedwater valves. In the U.S. EPR design, each main feedwater flow path has three isolation valves in-series in contrast to the two isolation valves in-series in the Westinghouse plants. In GTS 3.7.3, Condition A is provided for one inoperable valve, and Conditions B and C are provided for two and three inoperable valves, respectively. In the GTS Bases, the justification for a CT of 7 days for Condition A are restated for the 72-hour CT for Condition B, and the 8-hour CT for Condition C. In RAI 101, Question 16-92, the staff requested that the applicant provide different justifications for the specified completion times for Conditions B and C in the bases. In a December 12, 2008, response to RAI 101, Question 16-92, the applicant proposed to revise the GTB Bases to add the requested justifications. The staff determined that this response is acceptable because the revised GTS Bases conforms to the guidance in the STS. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-92 is resolved.

- GTS Section 3.7.8, "Essential Service Water (ESW) System," combines operability requirements for both the ESW System and the Ultimate Heat Sink. The staff noted that, in the Westinghouse STS, separate sections are provided for the ESWS and the UHS, since their respective design and operating characteristics are completely different (e.g. the UHS contains a common system parameter that affects all four ESW redundant trains). In RAI 166, Question 16-291, the staff requested that the applicant justify this change in format. In a March 26, 2009, response to RAI 166, Question 16-291, the applicant proposed to revise the GTS to reflect separate sections for these two systems (TS 3.7.8 for the ESWS and TS 3.7.19 for the UHS). The staff determined that this response is acceptable; however, editorial errors still exist that need correcting. The staff issued a follow-up RAI 293, Question 16-305 to address this concern. **RAI 293, Question 16-305 is being tracked as an open item.**

- With a new TS 3.7.19 for the UHS, the GTS Bases B 3.7.19, now contains bracketed information regarding the makeup water source for the UHS to be provided by potential applicants for construction permits or COLs.

- GTS Section 3.7.9, "Safety Chilled Water System," includes operability requirements for the safety-chilled water system. The Westinghouse STS does not have a separate TS LCO for the safety-chilled water system. In a typical Westinghouse plant, the chilled water system is normally considered as a part of the system which it serves (e.g., the chilled water system for the Control Room Air Conditioning system). GTS Section 3.7.9,

operability requirements were formulated from the STS guidance regarding system importance to safety, the availability of redundant equipment, and potential loss of a safety function. In RAI 101, Question 16-121, the staff requested that the applicant provide further explanation on an LCO Note that requires entering only LCO 3.4.6 action statements for RHR loops made inoperable by SCW system inoperability. In FSAR Tier 2, Section 9.2.8, "Safety Chilled Water System," the SCW system is shown to provide cooling loads not only to the LHSI/RHR pump bearing coolers (LCO 3.4.6 and LCO 3.5.2), but also to the Control Room Air Conditioning units (LCO 3.7.10) and the Safeguard Building Ventilation Units for Electrical Divisions (LCO 3.7.13). In a December 12, 2008, response to RAI 101, Question 16-121, the applicant stated that the reason for that Note is the longer completion time allowed for an inoperable SCWS train in LCO 3.7.9 when compared to that allowed for the affected RHR loop in LCO 3.4.6. The staff determined that this response is acceptable because it explains how LCO 3.7.9 accounts for the stricter LHSI/RHR operability requirements of LCO 3.4.6. However, a discussion of this Note and the reason for not having to enter LCOs 3.5.2, 3.7.11, and 3.7.13 should have been provided in the TS Bases B 3.7.9. Also, considering a longer completion time allowed for an inoperable CCW system train in LCO 3.7.7 when compared to that allowed for the affected SCW system train in LCO 3.7.9, the staff believes a similar Note in GTS Section 3.7.7 for the CCW system should be revised to include LCO 3.7.9, in addition to LCO 3.4.6. The staff issued a follow-up RAI 293, Question 16-306 to address this concern. **RAI 293, Question 16-306 is being tracked as an open item.**

- In addition, in response to RAI 174, Question 9.2.2-53, the applicant proposed a major modification to the SCWS design including revising TS 3.7.9 and its associated bases. The staff's evaluation of the SCWS design modification and related changes to the GTS will be documented in Section 9.2.2 of this report.

- GTS Section 3.7.10, "Control Room Emergency Filtration," contains operability requirements for the control room emergency filtration system. GTS Section 3.7.10 models similar operability requirements in the Westinghouse STS. As part of its review, the staff noted that the applicant did not fully incorporate the TSTF-448 model requirements into GTS Section 3.7.10, and associated Bases B 3.7.10. In RAI 101, Question 16-63, the staff requested that the applicant address these errors. In a December 12, 2008, response to RAI 101, Question 16-63, the applicant proposed to revise GTS 3.7.10 and its bases to reflect all of the TSTF-448 model requirements. The staff determined that this response is acceptable because the revised GTS and Bases conform to guidance in the STS. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-63 is resolved.

- In addition, GTS Section 3.7.10 and the associated bases, contain bracketed information and Reviewer's Notes regarding an assessment of a toxic gas release event to be addressed by potential applicants for construction permits or COLs.

- The GTS Bases B 3.7.12, "Safeguard Building Controlled Area Ventilation System," contains a Reviewer's Note that calls for commitments regarding maintaining boundary integrity of the controlled area to be addressed by potential applicants for construction permits or COLs.

- GTS Section 3.7.13, "Safeguard Building Ventilation System Electrical Division," includes new operability requirements for the SBVSED. The Westinghouse STS does not have a separate TS LCO for the SBVSED. In a typical Westinghouse plant, the ventilation system that controls air temperature in the area where the respective safety-related equipment resides is normally considered as a part of that safety-related system. GTS Section 3.7.13, operability requirements were formulated from the STS guidance regarding system importance to safety, the availability of redundant equipment, and potential loss of a safety function. The staff determined this GTS section and the associated Bases conform to the STS guidance since the imposed requirements reflect the effect of this ventilation system inoperability on the supported electrical equipment in the respective division area and the required actions and associated completion time are commensurate with TS requirements for the supported electrical system. The staff also determined the GTS 3.7.13 reflects the relevant information provided in the FSAR and, therefore, the staff finds GTS Section 3.7.13 acceptable.

- GTS Sections 3.7.15, "Spent Fuel Storage Pool Boron Concentration and Enrichment," and 3.7.16, "Spent Fuel Storage," contain Reviewer's Notes regarding the design of the spent fuel storage racks to be addressed by potential applicants for construction permits or COLs. However, in COL applications that reference the U.S. EPR certified design, COL applicants have indicated that the final design details of the fuel storage racks as provided in the U.S. EPR Topical Report UN-TR-08-001P will be incorporated as part of the U.S. EPR certified design and this will no longer be considered as a COL information item. This is considered as a part of an open item discussed below in Section 16.4.14 for RAI 293, Question 16-310.

- In addition, in responding to RAI 168, Question 03.06.03-19 regarding evaluation of leak-before-break (LBB) criteria for piping systems inside the Containment, the applicant proposed to add a new TS 3.7.18 for controls of main steam line leakage inside the Containment. The staff evaluation of this newly proposed GTS 3.7.18 will be documented in Section 3.6.3 of this report.

- In RAI 101, Questions 16-87, 16-89, 16-91, 16-109, 16-110, and 16-250, the staff requested that the applicant correct editorial errors found in GTS Section 3.7 and its associated Bases. In a December 18, 2008, response to RAI 101, Questions 16-87, 16-89, 16-91, 16-109, 16-110, and 16-250, the applicant agreed to revise the GTS and its associated bases to reflect these corrections. The staff confirmed that Revision 1 of U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Questions 16-87, 16-89, 16-91, 16-109, 16-110, and 16-250 are resolved.

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

**Conclusion**

The applicant adhered to the model Plant Systems TS as provided in the applicable STS, with differences to reflect U.S. EPR-unique design features. In addition, GTS Section 3.7, and its Bases do contain bracketed information and Reviewer's Notes. The staff reviewed each bracketed information and Reviewer's Note and determined that each was site-specific and

appropriately deferred to resolution in an application for a construction permit or COL that references the GTS. Applicants that reference the GTS and Bases will need to address the bracketed information and Reviewer's Notes that the staff determined to be appropriately deferred as part of its approval process for the GTS and Bases. Therefore, except for the open items discussed above, the staff finds GTS Section 3.7 and Bases Section B 3.7 acceptable.

## 16.4.12 Electrical Power Systems

### Introduction

GTS and Bases Section 3.8, "Electrical Power Systems," include 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 offsite power, onsite diesel generators and batteries are provided to supply electrical power equipment necessary for the safe-shutdown of the plant.

### Evaluation

In general, GTS Section 3.8 is modeled after STS Section 3.8 for Westinghouse plants, with differences to reflect U.S. EPR-unique design features. GTS Section 3.8, corresponds to the Westinghouse STS in the following manner:

| STS | U.S. EPR GTS | EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.8.1* | 3.8.1 | AC Sources – Operating (*same) |
| 3.8.2* | 3.8.2 | AC Sources – Shutdown (*same) |
| 3.8.3* | 3.8.3 | Diesel Fuel Oil, Lube Oil, and Starting Air (*same) |
| 3.8.4* | 3.8.4 | DC Sources – Operating (*same) |
| 3.8.5* | 3.8.5 | DC Sources – Shutdown (*same) |
| 3.8.6* | 3.8.6 | Battery Parameters (*same) |
| 3.8.7* | 3.8.7 | Inverters – Operating (*same) |
| 3.8.8* | 3.8.8 | Inverters – Shutdown (*same) |
| 3.8.9* | 3.8.9 | Distribution Systems – Operating (*same) |
| 3.8.10* | 3.8.10 | Distribution Systems – Shutdown (*same) |

Although GTS Section 3.8, models the STS in format and content, the staff noted differences that warranted technical justification and clarification beyond what was given in GTS Section 3.8 and its Bases. The staff requested additional information for each of the following items in order to evaluate the adequacy and completeness of GTS Section 3.8, and Bases Section B 3.8. Details regarding the responses associated with RAI 74, Questions 16-1 through 16-53 and RAI 110, Questions 16-236 through 16-239 are described below.

- In RAI 74, Question 16-1, the staff requested that the applicant provide an explanation regarding omission of a SR for Emergency Load Sequencer interval verification between each sequenced load block. In an October 30, 2008, response to RAI 74,

Question 16-1, the applicant stated that no additional periodic TS surveillance tests are required for the load sequencing function on the basis that (1) the U.S. EPR design does not have a separate physical load sequencer component which includes relays and time delay circuits, (2) load sequencing is a software controlled function performed by the Protection System, where loads are only allowed to be placed on the EDGs after specified conditions are met, (3) the software utilized by the PS is highly reliable, (4) the PS is designed with self-diagnostic test features to detect both hardware and software faults and assist in diagnostic repair activities, (5) the integrity of the software is checked cyclically as part of the processor self-monitoring programs, and (6) an Extended Self Test which includes a verification of the operating system is performed every cycle. The staff finds this explanation acceptable because load sequencing is a software controlled function with appropriate self-testing and checking provisions. This RAI adequately addresses the Automatic Load Sequencer issues identified in RAI 74, Questions 16-16 and 16-48. Therefore, RAI 74, Questions 16-1, 16-16, and 16-48 are resolved.

- In RAI 74, Questions 16-2, 16-3, 16-4, 16-5, 16-10, and 16-15, the staff requested that the applicant provide an explanation regarding the five percent steady upper voltage limit of 7,260 volts in SRs 3.8.1.12.b, 3.8.1.11.c.3, 3.8.1.18.c.3, 3.8.1.9.b, 3.8.1.15.b, and 3.8.1.2 respectively. In an October 30, 2008, response to RAI 74, Question 16-2 (which also serves as the response for the other RAIs identified above), the applicant stated that the specified maximum steady state output voltage of 7,260 volts (1) equals the maximum operating voltage specified for 6,600 volt motors, and (2) ensures that for a lightly loaded distribution system, motor terminal voltage does not exceed the maximum rated operating voltages. The staff determined that this explanation is acceptable because operation within this TS limit will preclude motor terminal voltage from exceeding the maximum rated operating voltages. The response also states that the minimum steady state output voltage of 6,210 volts is 90 percent of the nominal 6.9 kV output voltage, which allows for (1) voltage drops to the terminals of 6,600 volt motors whose minimum operating voltage is specified as 90 percent or 5,940 volts, and (2) voltage drops to motors and other equipment down through the 120 volt level where minimum operating voltage is also specified as 90 percent of name plate rating. In a March 19, 2009, response to RAI 110, Question 16-237, which directly affects the response to RAI 74, Question 16-2, the applicant provided an updated minimum steady state EDG output voltage of 6,555 volts (95 percent of the nominal 6.9 kV output voltage) to ensure that the EDG allowable voltage range is within the cumulative total variation of the voltage and frequency range permitted by National Electrical Manufacturers Association (NEMA) MG 1-2006, "NEMA Standards Publication MG 1-2006 Motors and Generators," National Electrical Manufacturers Association, 2006. Because application of the NEMA standard is acceptable to the staff in these circumstances, the staff finds the applicant's response acceptable. In addition, the staff has confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contained the markups committed to in the response to RAI 110, Question 16-237, which reflect the minimum steady state EDG output voltage of 6,555 volts. Therefore, RAI 74, Questions 16-2, 16-3, 16-4, 16-5, 16-10, and 16-15 are resolved.

- In RAI 74, Question 16-11, the staff requested that the applicant justify the omission of Mode Restriction information from GTS SR 3.8.1.10 and the associated Bases. GTS SR 3.8.1.10 omits bracketed Note 1 in Westinghouse STS SR 3.8.1.10, which states, "This Surveillance shall not normally be performed in MODE 1 or 2. However, this Surveillance may be performed to reestablish OPERABILITY provided an assessment

determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR." In an October 30, 2008, response to RAI 74, Question 16-11, the applicant stated that the proposed deviation from the STS is justified based on the acceptable small-risk associated with paralleling an EDG to offsite power for surveillance testing when considering the robust design features of the electrical distribution system and that three EDGs remain capable of mitigating a design-basis accident and supporting safe-shutdown of the nuclear power plant during performance of this surveillance testing. The associated STS Bases Reviewer's Note establishes the criteria for which the Mode Restrictions may be deleted. One of the criteria is that the performance of the SR will not cause perturbations to any of the electrical distribution systems that could result in a challenge to steady state operation or to plant-safety systems. The Reviewer's Note specifically states that the Mode Restrictions may be deleted if it can be demonstrated to the staff, on a plant-specific basis, that performing the SR with the reactor in any of the restricted modes can satisfy the established criteria. The staff questioned the applicant's position on the basis that an electrical system perturbation of some magnitude can be expected from a full-load reject when paralleled to the grid. Also, every offsite electrical power system is different. There may be something unique to a particular system whereby an assessment determining the safety of the plant is warranted for performance of SR 3.8.1.10 in Modes 1 or 2. The staff issued a follow-up RAI 300, Question 16-313 to document and address the staff's concerns. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-12, the staff requested that the applicant (1) confirm that the requirement for an EDG to achieve required voltage and frequency within 15 seconds of when it receives a start signal, supports the assumptions of the design basis LOCA analysis, and (2) validate that the 15 second time requirement is accurately reflected in FSAR Tier 2, Table 15.0-8. In an October 30, 2008, response to RAI 74, Question 16-12, the applicant indicated that the 15 second value bounds the safety function performance credited in the safety analysis in FSAR Tier 2, Chapter 15. For example, FSAR Tier 2, Table 15.6-21, "SBLOCA - Sequence of Events for 16.51 cm (6.5 inch) Break with LOOP," does not credit MHSI until 246 seconds into the event. The MHSI pump is assumed to start at 24 seconds, given a LOOP at approximately 4 seconds and generation of a SIS signal at approximately 17 seconds (SIS signal actuation occurs before closure of the EDG output breaker), on the basis of the load sequence times indicated in FSAR Tier 2, Tables 8.3-4 through 8.3-7. The safety analysis models the time between initiating events and the time when ESF could start to perform their functions. However, in cases involving a loss of offsite power, the safety analysis models include the 15 seconds from when the EDG receives a start signal to the closure of its output breaker as part of the ESF performance time. Because the 15 second requirement bounds the safety function credited in the FSAR Tier 2, Chapter 15 safety analysis, the staff determined the explanation to be acceptable. This RAI addresses the same issues identified in RAI 74, Questions 16-13, 16-20, 16-21, and 16-45. Therefore, the staff finds that RAI 74, Questions 16-12, 16-13, 16-20, 16-21, and 16-45 are resolved.

- In RAI 74, Question 16-18, the staff requested that the applicant enhance the Bases discussion associated with Required Actions C.1 and C.2 of LCO 3.8.1, "AC Sources − Operating," to provide a clearer understanding of how these Actions are able to ensure the availability of sufficient standby AC sources to (1) power the minimum ESF functions credited in the safety analysis, and (2) achieve completion of safety functions credited in

the safety analysis following an anticipated operational occurrence or postulated accident, regardless of which two diesels are inoperable. In an October 30, 2008, response to RAI 74, Question 16-18, the applicant described the alternate feed concept, but did not discuss alternate feed powering capabilities with respect to the four categories of safety-related systems (Two Train systems, Valve Isolation functions, Four Train systems, Support systems). This information is relevant and needs to be included in the Bases. In an audit on June 24, 2009, the applicant acknowledged the need to enhance Bases Section B 3.8.1 and agreed to make the necessary changes. The staff issued a follow-up RAI 300, Question 16-313 to document and address the staff's concerns. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-22, the staff requested that the applicant justify the omission of Mode Restriction information from GTS SR 3.8.1.12 and the associated Bases. GTS SR 3.8.1.12 omits bracketed Note 2 in Westinghouse STS SR 3.8.1.12, which states, "This Surveillance shall not normally be performed in MODE 1 or 2. However, this Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR." In an October 30, 2008, response to RAI 74, Question 16-22, the applicant stated that the proposed deviation from the STS is justified based on the testing having no affect on the Emergency Power Supply System (EPSS) or plant loads, the availability of the EDG under test for accident mitigation, and that during testing three EDGs remain capable of mitigating a DBA and supporting safe-shutdown of the unit. The associated STS Bases Reviewer's Note establishes the criteria for which the mode restrictions may be deleted. One of the criteria is that the performance of the SR will not cause perturbations to any of the electrical distribution systems that could result in a challenge to steady state operation or to plant-safety systems. The Reviewer's Note specifically states that the mode restrictions may be deleted if it can be demonstrated to the staff, on a plant specific basis, that performing the SR with the reactor in any of the restricted modes can satisfy the established criteria. The staff questioned the applicant's claim that (1) there is no load shedding during performance of the SR, and (2) since there is no load shedding or sequencing of loads, there is no impact to the EPSS by performing the surveillance. The staff determined that load shedding and load sequencing may actually occur during performance of an actual or simulated ESF signal which auto starts the EDG from a standby condition. Electrical system perturbations can be expected from the shedding and sequencing of loads powered by the offsite power system. Also, every offsite electrical power system is different. There may be something unique to a particular system whereby an assessment determining the safety of the plant is warranted for performance of SR 3.8.1.12 in Modes 1 or 2. The staff issued a follow-up RAI 300, Question 16-313 to document and address the staff's concerns. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-23, the staff requested that the applicant justify the omission of Mode Restriction information from GTS SR 3.8.1.13 and the associated Bases. GTS SR 3.8.1.13 omits the bracketed Note in Westinghouse STS SR 3.8.1.13, which states, "This Surveillance shall not normally be performed in MODE 1 or 2. However, this Surveillance may be performed to re-establish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR." In an October 30, 2008, response to RAI 74, Question 16-23, the applicant stated that the proposed deviation from the STS is justified

based on the testing having no affect on the EPSS or plant loads, the capability to restore the EDG to an available status within a short time, and that during testing three EDGs remain capable of mitigating a DBA and supporting safe-shutdown of the nuclear plant. The associated STS Bases Reviewer's Note establishes the criteria for which the Mode Restrictions may be deleted. One of the criteria is that the performance of the SR will not cause perturbations to any of the electrical distribution systems that could result in a challenge to steady state operation or to plant-safety systems. The Reviewer's Note specifically states that the Mode Restrictions may be deleted if it can be demonstrated to the staff, on a plant-specific basis, that performing the SR with the reactor in any of the restricted Modes can satisfy the established criteria. The staff questioned the applicant's position that the performance of SR 3.8.1.13 is limited solely to a logic function test that is conducted without the EDG operating. If this were the case, the STS surveillance Note would not be necessary. The staff determined that the surveillance could actually be performed with the EDG in service (i.e., during performance of LOOP/LOCA testing in accordance with GTS SR 3.8.1.18 for example), which is common practice in the operating fleet. Note that GTS SR 3.8.1.18 is preceded by a Note that allows portions of the surveillance to be performed in Modes 1 through 4 to re-establish operability provided an assessment determines the safety of the plant is maintained or enhanced. There is no mention in the Bases discussion for SR 3.8.1.13 that the surveillance is strictly a logic function test or that it is to be performed without the EDG operating. Electrical system perturbations resulting from a failed surveillance performed with the EDG running would not be unexpected. Also, every offsite electrical power system is different. There may be something unique to a particular system whereby an assessment determining the safety of the plant is warranted for performance of SR 3.8.1.13 (diesel operating) in Modes 1 or 2. The staff issued a follow-up RAI 300, Question 16-313 to document and address the staff's concerns relative to the response, including evaluation of the testing strategy for SR 3.8.1.13. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-26, the staff requested that the applicant justify the omission of Mode Restriction information from GTS SR 3.8.1.9 and the associated Bases. GTS SR 3.8.1.9 omits bracketed Note 1 in Westinghouse STS SR 3.8.1.9, which states, "This Surveillance shall not normally be performed in MODE 1 or 2. However, this Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR." In an October 30, 2008, response to RAI 74, Question 16-26, the applicant stated that the proposed deviation from the STS is justified based on the acceptable small risk associated with paralleling an EDG to offsite power for surveillance testing when considering the robust design features of the electrical distribution system and that during testing three EDGs remain capable of mitigating a design-basis accident and supporting safe-shutdown of the unit. The associated STS Bases Reviewer's Note establishes the criteria for which the Mode Restrictions may be deleted. One of the criteria is that the performance of the SR will not cause perturbations to any of the electrical distribution systems that could result in a challenge to steady state operation or to plant-safety systems. The Reviewer's Note specifically states that the Mode Restrictions may be deleted if it can be demonstrated to the staff, on a plant specific basis, that performing the SR with the reactor in any of the restricted Modes can satisfy the established criteria. The staff questioned the applicant's position on the basis that an electrical system perturbation of some magnitude can be expected from rejection of the single largest post-accident load when paralleled to the grid. Also,

every offsite electrical power system is different. There may be something unique to a particular system whereby an assessment determining the safety of the plant is warranted for performance of SR 3.8.1.9 in Modes 1 or 2. The staff issued a follow-up RAI 300, Question 16-313 to document and address the staff's concerns. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 74, Questions 16-27, 16-36, 16-39, 16-42, and 16-43, the staff requested that the applicant provide an explanation regarding omission of the reference to "Engineered Safety Features Systems," in the first paragraph of the GTS Bases, Applicable Safety Analyses Sections for B 3.8.10, B 3.8.6, B 3.8.7, B 3.8.8, and B 3.8.9, respectively. Inconsistencies exist throughout TS and the FSAR with respect to use of the phrase "Engineered Safety Features Systems." In an October 30, 2008, response to RAI 74, Question 16-27, (which also serves as the response for the other RAIs identified above), the applicant stated, "The systems that perform the ESF functions (e.g., emergency feedwater, control room air conditioning, and medium head safety injection, etc) are considered to be separate systems and are not part of the PS. There is no 'Engineered Safety Features System' in the U.S EPR design. However, the Bases will be clarified to state that both the Protection System and systems that perform Engineered Safety Features functions are operable." The staff determined that the distinction between ESF Systems and systems that perform ESF functions is confusing. "ESF systems" is cited throughout FSAR Tier 2, Chapter 7. For example, FSAR Tier 2, Section 7.3 is titled, "Engineered Safety Features Systems." In a follow-up RAI 300, Question 16-313, the staff requested that the applicant resolve the inconsistencies, clarify the response, and make the appropriate changes to the FSAR and Technical Specifications. **RAI 300 Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-29, the staff requested that the applicant provide clarification regarding conflicting information and inconsistencies between GTS Bases B 3.8.3 and FSAR Tier 2, Section 9.5.4 relating to diesel fuel oil inventory requirements. In a December 17, 2008, response to RAI 74, Question 16-29, the applicant adequately addressed all of the items identified; however, the staff noted the following discrepancies based on evaluation of the response:

    - The response incorrectly lists Chapter 16, "Technical Specifications," Section 3.8.3, "Diesel Fuel Oil, Lube Oil, and Starting Air," as one of several FSAR Tier 2 sections that are being revised to reflect a minimum required 7 day supply of fuel oil for each EDG. No changes are being made to TS Section 3.8.3 with respect to the minimum fuel oil inventory supply. In an audit on June 24, 2009, the applicant acknowledged the discrepancy and agreed to update the response.

    - Bases B 3.8.3, Revision 1, discussions associated with the fourth paragraph on Page B 3.8.3-1 and SR 3.8.3.2, on Page B 3.8.3-5 contain conflicting information regarding diesel lube oil system specifics. In an audit on June 24, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes.

The staff issued a follow-up RAI 300, Question16-313 to document and address the staff's concerns. **RAI 300 Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-33, the staff requested that the applicant provide an explanation regarding information in the LCO Section of Bases B 3.8.5, that two direct current (DC) subsystems are required to be operable to support two divisions of the distribution systems required operable by LCO 3.8.10, "Distribution Systems - Shutdown." In an October 30, 2008, response to RAI 74, Question 16-33, the applicant adequately addressed the staff's concerns, explaining that (1) the DC electrical power system provides normal and emergency DC electrical power for the EDGs, emergency auxiliaries, and control and switching during all modes of operation, and (2) two subsystems (divisions) of DC power are required to ensure the operability of the EDGs to mitigate the consequences of postulated accidents and AOOs that can occur during shutdown when coupled with a loss of offsite power. In addition, staff evaluation of the response identified an inaccuracy regarding the statement, "The chemical and volume control system charging line isolation on anti-dilution mitigation at shutdown conditions (RCP not operating) engineered safety feature (ESF) function is shown on FSAR Tier 2, Figure 7.3-22." The CVCS charging line does not isolate on ADM. In an audit on June 24, 2009, the applicant acknowledged the discrepancy and agreed to update the response. The staff issued a follow-up RAI 300, Question 16-313 to document and address the staff's concerns. **RAI 300 Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-35, the staff requested that the applicant explain how maintaining at least two divisions of DC sources operable during accident conditions is consistent with the initial assumptions of the accident analyses, as stated in the Applicable Safety Analyses Section of Bases 3.8.6. This issue is identified and addressed under RAI 74, Question 16-33. Therefore, RAI 74, Question 16-35 is closed.

- In RAI 74, Question 16-40, the staff requested that the applicant provide an explanation regarding the requirements for Inverter operability associated with LCO 3.8.8, "Inverters-Shutdown." In an October 30, 2008, response to RAI 74, Question 16- 40, the applicant stated that two subsystems (divisions) of DC power are required to ensure the operability of the EDG to mitigate the consequences of postulated accidents and anticipated operational occurrences that can occur during shutdown when coupled with a loss of offsite power. Although the requirements for Inverter operability are clearly stated, the staff determined that Condition A of LCO 3.8.8 was somewhat ambiguous. Condition A states, "One or more required inverters inoperable." In a follow-up RAI 300, Question 16-313, the staff requested that the applicant clarify what was meant by the word "required" in terms of operable inverters for the U.S. EPR Electrical System design, and to evaluate the technical accuracy of Condition A and its Required Actions. The staff requested that this information consider that (1) the wording associated with Condition A of comparable LCO 3.8.8 in the Westinghouse STS is similar, (2) the Westinghouse design has two inverters per train (total of four inverters), whereas the U.S. EPR design has one inverter per division (total of four inverters), and (3) the Condition A Bases reference (first sentence) to "remaining OPERABLE Inverters," implies there is more than one operable inverter remaining following the loss of one or more "required" inverters. Follow-up RAI 300, Question 16-313 also requests the applicant correct an inaccuracy associated with the response to RAI 74, Question 16-40 regarding the statement, "The chemical and volume control system (CVCS) charging line isolation on anti-dilution mitigation (ADM) at shutdown conditions (reactor coolant pump (RCP) not operating) engineered safety feature (ESF) function is shown on FSAR Tier 2, Figure 7.3-22." The CVCS charging line does not isolate on ADM. In an audit on

June 24, 2009, the applicant acknowledged the staff's concerns and agreed to address the issues identified. **RAI 300, Question 16-313, which is associated with the above request, is being tracked as an open item.**

- In RAI 74, Question 16-46, the staff requested that the applicant provide an explanation regarding the requirement in LCO 3.8.2, "AC Sources - Shutdown," that two operable EDGs reside within the same divisional pair, as opposed to one operable EDG residing in each of the two separate divisional pairs. The staff determined that associated Bases Section B 3.8.2 (LCO discussion) did not address the inability of two EDGs in separate divisional pairs to supply the necessary electrical power for the various combinations of subsystems, equipment, and components required operable by LCO 3.8.1.10 with the alternate feeds not aligned. In an October 30, 2008, response to RAI 74, Question 16-46, the applicant described the divisional pair concept, but did not provide the requested explanation. This information is relevant and needs to be included in the Bases. In an audit on June 24, 2009, the applicant acknowledged the need to enhance Bases Section B 3.8.2 and agreed to make the necessary changes. The staff issued a follow-up RAI 300, Question 16-313 to document and address the staff's concerns. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-49, the staff requested that the applicant justify the omission of automatic load sequencing statements from the LCO Section of Bases B 3.8.2, AC Sources-Shutdown. In an October 30, 2008, response to RAI 74, Question 16-49, the applicant states that no individual periodic TS surveillance tests are required for the load sequencing function on the basis that (1) the U.S. EPR design does not have a separate physical load sequencer component which includes relays and time delay circuits, and (2) load sequencing is a software controlled function performed by the I&C Protection System, where loads are only allowed to be placed on the EDGs after specified conditions are met. The staff determined that the applicant's response did not adequately justify exclusion of load sequencing information from the Bases. The load sequencing function remains applicable, regardless of the means by which it is accomplished. The proper sequencing of loads ensures that sufficient time exists for the diesel to restore voltage and frequency before the next load is applied. As such, load sequencing has the potential to affect diesel operability. In a follow-up RAI 300, Question 16-313, the staff requested that the applicant include applicable load sequencing information from the Westinghouse STS LCO Section of B 3.8.2, in the GTS LCO Section of B 3.8.2. Follow-up RAI 300, Question 16-313 also requested that the applicant evaluate the technical accuracy of the GTS B 3.8.1 LCO Bases statement on Page B 3.8.1-4 of Revision 1 that reads, "Proper sequencing of loads is a required function for EDG OPERABILITY." It appears that the bracketed phrase, "including tripping of nonessential loads," in the comparable STS B 3.8.1 LCO Bases statement, may be applicable to the referenced GTS Bases statement as well, on the basis of GTS surveillance requirements SR 3.8.1.11.b and 3.8.1.18.b which verify load shedding from the emergency buses. In an audit on June 24, 2009, the applicant acknowledged the staff's concerns and agreed to make the necessary changes. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-51, the staff requested that the applicant enhance the Bases discussion associated with LCO 3.8.9, "Distribution Systems − Operating," to describe how redundant electrical power distribution subsystem equipment within a divisional pair is considered operable and capable of performing its safety-related functions when

alternate feed cross tie breakers are closed. In an October 30, 2008, response to RAI 74, Question 16-51, the applicant adequately described the capabilities of the inter-divisional alternate feed protection and coordination scheme to provide protection so that a fault on one division does not degrade the other division below an acceptable level with a tie breaker closed. The FSAR markup, however, did not include this information in the associated Bases discussion. In an audit on June 24, 2009, the applicant acknowledged the need to enhance Bases Section B 3.8.9 and agreed to make the necessary changes. The staff issued a follow-up RAI 300, Question 16-313 to document and address the staff's concerns. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 74, Question 16-53, the staff requested that the applicant enhance the Bases discussion associated with Required Action B.5 of LCO 3.8.1, "AC Sources − Operating," as an added means of justification for the proposed 120-day Completion Time beyond the claim that (1) it provides a reasonable time for repairs, (2) the probability of a postulated accident or AOO occurring during this period is low, and (3) operation of the inoperable EDG with alternate feed aligned in its divisional pair is not assumed in the safety analysis to mitigate the consequences of postulated accidents or AOOs. The alternate feed design feature serves as the basis for the 120 day allowed outage time (AOT). Although the alternate feed alignment is not a temporary modification in that it is part of the actual design, the referenced configuration is not the normal alignment and is implemented only when in a TS Action Statement that is intended to be temporary in nature. In an October 30, 2008, response to RAI 74, Question 16-53, the applicant touched on certain aspects of the safety analysis and described emergency power supply system specifics. However, it did not address the staff's concern that use of the alternate feed configuration required to support EDG maintenance will be infrequent. The response to Chapter 8 RAI 11, Question 08.03.01-3, states that the alternate feed design feature is only used during specific maintenance activities, and cites EDG maintenance as an example. In a follow-up RAI 300, Question 16-313, for the staff requested that the applicant (1) provide a detailed list of maintenance activities that would result in an EDG being out of service for a period up to 120 days, (2) provide the associated maintenance time needed for each activity, (3) state how frequently these maintenance activities will be needed (e.g., every 10 years), and (4) provide what type of compensatory measures would be in effect during the 120 days and what configuration control management would be in place for an additional EDG failure. **RAI 300, Question 16-313 is being tracked as an open item.**

- In RAI 110, Question 16-237, the staff requested that the applicant confirm that the U.S. EPR EDG voltage acceptance criteria specified in SR 3.8.1.2 would result in acceptable voltage for all safety-related loads. In a March 19, 2009, response to RAI 110, Question 16-237, the applicant revised the EDG steady state output voltage acceptance criteria to indicate an allowable minimum voltage of -5 percent in SRs 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.18, and 3.8.1.19. The following discrepancies were noted in the associated FSAR markup:

    - The FSAR markup for AC Sources - Operating Bases B 3.8.1, "Surveillance Requirements," states, "This value allows for a combined variation in voltage and frequency of 60 percent when considering voltage drop to the terminals of 6,600 V motors whose minimum operating voltage is specified as 90 percent or 5,940 V." The 60 percent value is incorrect. The revised minimum voltage

of -5 percent allows for a combined variation in voltage and frequency of 7 percent, which is within the 10 percent cumulative total variation permitted by NEMA MG 1-2006, "NEMA Standards Publication MG 1-2006 Motors and Generators," National Electrical Manufacturers Association, 2006.

- The FSAR markup for AC Sources - Operating Bases B 3.8.1, Surveillance Requirements, states "motor terminal voltages and frequency requirements as indicated in NEMA MG 1-2006 (Ref. 1)." The reference number for NEMA MG 1-2006 should be 11 instead of 1.

In an audit on June 24, 2009, the applicant acknowledged the discrepancies and agreed to make the necessary changes. The staff issued a follow-up RAI 300, Question 16-314 to document and address the staff's concerns. **RAI 300, Question 16-314 is being tracked as an open item.**

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

**Conclusion**

The applicant adhered to the model electrical power systems TS as provided in the applicable STS, with differences to reflect U.S. EPR-unique design features, most notably the inter-divisional alternate power feed capability and its use as the basis for the proposed 120-day Completion Time for an inoperable EDG. The staff has issued the RAIs described above to ensure the verification of information and the accuracy and completeness of GTS Section 3.8 and its Bases. Therefore, except for the open items discussed above, which are associated with the RAIs forwarded to the applicant for resolution, the staff finds GTS Section 3.8 and Bases Section B 3.8 acceptable.

## 16.4.13 Refueling Operations

**Introduction**

The GTS and Bases Section 3.9, "Refueling Operations," include requirements for boron concentration, nuclear instrumentation, containment penetrations, and water inventory in the refueling pool during Mode 6.

**Evaluation**

In general, GTS Section 3.9 is modeled after STS Section 3.9 for Westinghouse plants, with differences to reflect U.S. EPR-unique design features. GTS Section 3.9, corresponds to the Westinghouse STS in the following manner:

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.9.1* | 3.9.1 | Boron Concentration (*same) |
| 3.9.2* | None | N/A (*Unborated Water Source Isolation Valves) |
| 3.9.3* | 3.9.2 | Nuclear Instrumentation (*same) |

| STS | U.S. EPR GTS | U.S. EPR GTS TITLE (*STS TITLE) |
|---|---|---|
| 3.9.4* | 3.9.3 | Containment Penetrations (*same) |
| 3.9.5* | 3.9.4 | Residual Heat Removal Loops - High-Water Level (*RHR and Coolant Circulation - High-Water Level) |
| 3.9.6* | 3.9.5 | Residual Heat Removal Loops - Low Water Level (*RHR and Coolant Circulation - Low Water Level) |
| 3.9.7* | 3.9.6 | Refueling Cavity Water Level (*same) |

The GTS does not contain technical specifications for unborated water source isolation valves equivalent to those in STS Section 3.9.2. STS Section 3.9.2 contains a Reviewer's Note which states, "this Technical Specification is not required for units that have analyzed a boron dilution event in MODE 6. It is required for those units that have not analyzed a boron dilution event in MODE 6. For units which have not analyzed a boron dilution event in MODE 6, the isolation of all unborated water sources is required to preclude this event from occurring." The applicant provided an analysis for a boron dilution event in Mode 6 in the FSAR Tier 2, Section 15.4.6, which serves as the basis for not including technical specifications for unborated water source isolation valves in the GTS. The staff finds the applicant has adequately addressed the above mentioned Reviewer's Note and, therefore, the omission is acceptable.

Although 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 GTS Section 3.9 and its Bases. The staff requested additional information for each of the following items in order to evaluate the adequacy and completeness of GTS Section 3.9 and Bases Section B 3.9. Details regarding the responses to these RAIs are described below.

In GTS Section 3.9.3, "Containment Penetrations," LCO 3.9.3a contains a requirement for containment closure, (i.e., for the equipment hatches to be held in place with four bolts). The Westinghouse STS identifies this requirement as preliminary, pending additional details regarding equipment hatch weight, bolting size, and bolt material. In RAI 101, Question 16-83, the staff requested that the applicant provide final equipment hatch design details. In addition, in RAI 101, Question 16-104, the staff requested that the applicant provide clarification on differences between the GTS bases and the Westinghouse STS bases regarding incorporation of TSTF-51 and TSTF-471 model requirements. TSTF-51, "Revise containment requirements during handling irradiated fuel and core alterations," Revision 2, November 1, 1999, and TSTF-471, Revision 1, December 7, 2006, were issued to address containment closure requirements prior to handling of irradiated fuel assemblies in Mode 6. Specifically, these two TSTFs provide specific guidance that a licensee can use to determine if containment closure is required based on minimum decay time from the last reactor shutdown. This guidance states, in part, "a minimum decay time of 100 hours prior to irradiated fuel movement with containment closure capability or a minimum decay time of [x] days without containment closure capability." It should be noted that the value of 100 hours is typically assumed in the accident analyses for Westinghouse plants. In a December 18, 2008, response to RAI 101, Question 16-104, the applicant stated that the fuel handling accident (FHA) as described in the FSAR Tier 2, Section 15.0.3.10 was evaluated to occur in an open containment or fuel building with a single-fuel assembly that has decayed a minimum of 34 hours. The applicant further stated that the combination of LCO 3.9.6 for refueling cavity water level and the newly proposed LCO for

decay time discussed below will ensure that the release of fission product radioactivity, subsequent to a FHA, results in doses that are within the guideline values specified in RG 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors,” July 2000. The applicant, therefore, concluded that LCO 3.9.3 for containment closure requirements is not needed and proposed to delete it from the GTS. The staff agreed with the stated conclusion since the U.S. EPR accident analyses support "a minimum decay time of 34 hours without containment closure capability," and none of the four criteria of 10 CFR 50.36(c)(2)(ii) is applicable to the fuel handling operation. As a result, the requested information under RAI 101, Question 16-83 is no longer needed. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Questions 16-83 and 16-104 are resolved.

With respect to decay time, the staff determined as follows: The “decay time” is the time interval between the time the reactor was last critical and the initial movement of an irradiated fuel assembly. The decay time is a key assumption in the dose consequence estimates of an U.S. EPR design-basis fuel handling accident analysis. As such, this decay time satisfies 10 CFR 50.36(c)(2)(ii), Criterion 2, and is required to be included in an LCO in GTS, preferably in Section 3.9. In RAI 101, Question 16-65, the staff requested that the applicant provide an LCO and applicable bases information for decay time requirements. In a December 18, 2008, response to RAI 101, Question 16-65, the applicant proposed to add a new TS to the GTS. The original TS 3.9.3 for Containment Penetrations is being deleted as a result of the response to RAI 101, Question 16-104 discussed above, and the new requirement for decay time is assigned as TS 3.9.3. This specification provides a decay time limit and associated requirements consistent with the U.S. EPR FHA analysis, STS format, and requirements of 10 CFR 50.36. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Question 16-65 is resolved.

In RAI 101, Question 16-103, the staff requested that the applicant provide a discussion of the Note attached to SR 3.9.5.2 regarding verification within 24 hours of breaker alignment and electrical power available for a required pump that is in standby status. In RAI 101, Question 16-107, the staff requested that the applicant provide a discussion of the exception noted in Required Action A.1 of GTS 3.9.2 regarding introduction of coolant into the RCS while the action calls for suspending positive reactivity addition. In a December 12, 2008, response to RAI 101, Questions 16-103 and 16-107, the applicant proposed to revise GTS Base B 3.9.5 to include the requested discussion, which is consistent with similar SR applications in the STS, and to revise GTS 3.9.2 and its associated bases to delete the noted exception to make GTS 3.9.2 requirements consistent with similar STS requirements. The staff determined that these responses are acceptable because the revised GTS and Bases conform to the guidance in the STS. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI responses. Accordingly, the staff finds that the applicant has adequately addressed this issue and, therefore, RAI 101, Questions 16-103 and 16-107 are resolved.

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

### Conclusion

The applicant adhered to the model refueling operations TS as provided in the applicable STS, with differences to reflect U.S. EPR-unique design features. In addition, GTS Section 3.9, and its Bases do not contain any bracketed information or Reviewer's Notes. Therefore, the staff finds GTS Section 3.9 and Bases Section B 3.9 acceptable.

## 16.4.14 Design Features

### Introduction

GTS Section 4.0, "Design Features," contains other design features not covered elsewhere in the GTS. GTS Section 4.0 contains such information as site location, site maps, and other information related to core design and fuel storage design.

### Evaluation

GTS Section 4.1, "Site Location," contains bracketed information regarding site-specific information for future plant location to be provided by potential applicants for construction permits or COLs.

GTS Section 4.3, "Fuel Storage," contains bracketed information and a Reviewer's Note regarding the new and spent fuel storage rack final design that is to be provided by potential applicants for construction permits or COLs referencing the U.S. EPR design. Also during its review, the staff noted that the assembly pitch provided in the GTS Paragraph 4.3.1.1.c does not match the values provided in the spent fuel pool criticality Topical Report, UN-TR-08-001P. In RAI 102, Question 16-126, the staff requested that the applicant provide clarification on the difference. In a November 20, 2008, response to RAI 101, Question 16-126, the applicant indicated that the values of storage rack parameters cited in UN-TR-08-001P are site-specific and, therefore, are not appropriate for inclusion in the GTS. However, in reviews of combined operating license applications that reference the U.S. EPR certified design, COL applicants have indicated that the final design details of the fuel storage racks as provided in UN-TR-08-001P will be incorporated as part of the U.S. EPR certified design and will no longer be considered as a COL information item. If the applicant agrees with the proposed plan by COL applicants, relevant information in UN-TR-08-001P should be incorporated in the FSAR Tier 2, Section 9.1, "Fuel Storage and Handling," and the GTS. The staff issued a follow-up RAI 300, Question 16-310 to address this concern. **RAI 300, Question 16-310 is being tracked as an open item.**

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

### Conclusion

The applicant adhered to guidance for the design features information as provided in the Westinghouse STS. GTS Section 4.0 does contain bracketed information and Reviewer's Notes. The staff reviewed the bracketed information and Reviewer's Notes and determined that each was site-specific and appropriately deferred to resolution in an application for a construction permit or COL that references the GTS. An applicant for a CP or COL that references the GTS and Bases will need to address the bracketed information and Reviewer's Notes that the staff determined to be appropriately deferred as part of its approval process of

the GTS and Bases. Therefore, except for the open item discussed above, the staff finds GTS Section 4.0 acceptable.

## 16.4.15 Administrative Controls

### Introduction

GTS Section 5.0, "Administrative Controls," includes provisions which address various administrative controls related to key plant personnel responsibilities, plant procedures, special programs and reports, and the like, to ensure the plant is safely operated.

### Evaluation

In general, GTS Section 5.0 is modeled after the Westinghouse STS Section 5.0, with few differences to reflect the applicant's choice of presenting specific details for various administrative programs and reports.

GTS Section 5.0 contains Reviewer's Notes regarding various aspects of the administrative programs and reports as listed below. These are COL information items:

- TS Sections 5.1, 5.2, and 5.3 on organization and qualifications of the plant staff
- TS 5.5.11 on radioactive releases from the gaseous waste processing system
- TS 5.5.15 on the containment leakage rate testing program
- TS 5.6.1 on the annual radiological environmental operating report
- TS 5.6.2 on the radioactive effluent release report

In RAI 237, Question 09.03.02-16, the staff requested that the applicant identify all applicable plant systems that should be included in the control of leakage from primary coolant sources outside the Containment Building as described in GTS Section 5.5.2. 10 CFR 50.34(f)(2)(xxvi) requires the establishment of this leakage control program. In an August 12, 2009, response to RAI 237, Question 09.03.02-16, the applicant provided a complete list of applicable plant systems (low head safety injection, medium head safety injection, severe accident heat removal, nuclear sampling, severe accident sampling, hydrogen monitoring, chemical and volume control, and gaseous waste processing) and revised GTS 5.5.2 to incorporate this list. The staff verified that this list of systems is complete. Accordingly, the staff determined that this response is acceptable and the inclusion of these systems in the program satisfies 10 CFR 50.34(f)(2)(xxvi) requirements. To ensure the stated changes are incorporated in a future revision of the FSAR, **RAI 237, Question 09.03.02-16 is being tracked as a confirmatory item**. The response to RAI 237, Question 09.03.02-16, supersedes an earlier response to RAI 122, Question 16-255, on the same subject that the staff determined to be inadequate. Therefore, the staff finds RAI 122, Question 16-255 is resolved.

In RAI 122, Questions 16-252, 16-253, and 16-254, the staff requested that the applicant correct editorial errors found in GTS Section 5.0. In a December 18, 2008, response to RAI 122, Questions 16-252, 16-253, and 16-254, the applicant agreed to revise the GTS to reflect these corrections. The staff confirmed that Revision 1 of the U.S. EPR FSAR, dated May 29, 2009, contains the changes committed to in the RAI response. Accordingly, the staff finds that the

applicant has adequately addressed the editorial errors and, therefore, RAI 122, Questions 16-252, 16-253, and 16-254 are resolved.

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

**Conclusion**

The applicant adhered to the guidance for Administrative Programs provided in the Westinghouse STS. GTS Section 5.0 does contain bracketed information and Reviewer's Notes. The staff reviewed each bracketed information item and Reviewer's Note and determined that each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the GTS. Applicants that reference the GTS and Bases will need to address the bracketed information and Reviewer's Notes that the staff determined to be appropriately deferred as part of its approval process of the GTS and Bases. Therefore, except for the confirmatory item discussed above, the staff finds GTS Section 5.0 acceptable.

## 16.5 Combined License Information Items

Table 16-1 provides a list of Technical Specifications related COL information item numbers and descriptions from FSAR Tier 2, Table 1.8-2:

**Table 16-1 U.S. EPR Combined License Information Items**

| Item No. | Description | FSAR Tier 2 Section |
|---|---|---|
| 16.0-1 | Brackets are used to identify information or parameters that are plant-specific or are based on preliminary design information. A COL applicant that references the U.S. EPR design certification will replace preliminary information provided in brackets of the Technical Specifications and Technical Specification Bases with plant specific values. | 16.0 |

## 16.6 Conclusions

The staff based on the technical review of the U.S. EPR FSAR, Chapter 16, documented above, determined that the applicant closely modeled the format and content described in RG 1.206, Revision 1, March 2007, and used the guidance provided in NUREG 0800, Revision 2, March 2007, to prepare the U.S. EPR GTS. In addition, the applicant did generally conform to the STS in NUREG-1431, the "Standard Technical Specifications Westinghouse Plants" or NUREG-1432, the "Standard Technical Specifications Combustion Engineering Plants," as the applicant determined applicable to its U.S. EPR design. The applicant also omitted, and changed some of the requirements in the applicable STS, or developed new specifications, surveillances and bases when they determined differences in design warranted such changes or additions.

The GTS identified conditions that COL applicants must satisfy in order to complete particular plant-specific TS. For example, the approach for seismic and dynamic qualification of

mechanical and electrical equipment is highly dependent on the selection of equipment and the type of experience database proposed. AREVA will not be requested to submit the information that can only be obtained through plant-specific analyses. However, all design certification-related information, including specific or bounding values, or methodologies for determining specific or bounding values, will be required prior to final approval of the GTS for the U.S. EPR design certification.

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, reactor coolant system, instrumentation and control systems, electrical systems, containment systems, other engineered safety features, auxiliary and emergency systems, power conversion systems, radioactive waste handling systems, and fuel handling systems were discussed insofar as they are pertinent.

Finally, as noted in the individual subsections of this chapter above, staff approval of the GTS is limited, and excludes matters that are the subject of several topical and technical reports cited above that are still under review at the time of the issuance of this SER Chapter. Staff approval of the current version of the GTS also excludes the matters discussed in the OIs and CIs as noted in the individual subsections of the technical evaluation portion of this SER Chapter. Chapter 16 of this report will be updated to reflect topical report and technical report review results and the disposition of the associated open items (OIs) and confirmatory items (CIs) as well as resolution of other outstanding OIs and CIs if the applicant provides additional satisfactory information and correct changes to subsequent revisions of the FSAR are confirmed by the staff.

For the reasons set forth above, and with the noted exceptions, the staff finds the U.S. EPR 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).