16.0 TECHNICAL SPECIFICATIONS

16.1 Introduction

Chapter 16.0, "Technical Specifications," of the AP1000 design control document (DCD), provides the AP1000 generic technical specifications (GTS) in accordance with Section 50.36 of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50. Each operating license issued by the Commission is required to contain technical specifications (TS) that set forth the safety limits (SLs), limiting safety system settings (LSSSs), limiting conditions for operation (LCOs), and other limitations on facility operation deemed necessary for the protection of public health and safety. Section 50.36(a)(2) requires, among other things, that each applicant for design certification include in its application proposed GTS for the portion of the plant that is within the scope of the design certification (DC) application. For the AP1000 design these are accepted as documented in 10 CFR Part 52, Appendix B and NUREG 1793, "Final Safety Evaluation Report (FSER) Related to Certification of the AP1000 Standard Design."

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

This safety evaluation report chapter documents the U.S. Nuclear Regulatory Commission (NRC) staff review of the amended GTS proposed by the DC applicant for the AP1000 design and their associated Bases. The review is for completeness and correctness in regard to NRC requirements and guidance, and for consistency with related portions of the DCD. The TS are derived from the analyses and evaluations in the DCD.

16.2 Summary

The AP1000 design employs passive safety-related systems that rely on gravity and natural processes, such as convection, evaporation, and condensation. The AP1000 GTS were modeled after Revision 2 of NUREG-1431, "Standard Technical Specifications: Westinghouse Plants." In some cases, the applicant developed TS beyond those in the STS to account for the advanced passive design features of the AP1000. In many instances, the AP1000 system design functions are similar to those of operating pressurized-water reactors (PWRs), even though the components and systems are new. The amendment to the AP1000 DC affects the following sections of the AP1000 GTS and Bases:

- Section 1
- Section 2
- Sections 3.1 through 3.9
- Section 4
- Section 5

The AP1000 GTS contains reviewer's notes stating conditions that a COL applicant (or licensee) must satisfy in order to complete a particular GTS provision (e.g., incorporation of an NRC-approved methodology into a plant's licensing basis, or a staff determination that a licensee's probabilistic risk assessment (PRA) program is of adequate quality).

In some instances, detailed design information, equipment selection, instrumentation settings, or other information needed to establish appropriate TS and Bases was not provided during the review of the AP1000 DC or the amendment to the AP1000 DC. This information is identified in Chapter 16 of the DCD and in the GTS and Bases and will be included in the PTS by the applicant for a COL. Locations for the addition of this information are signified in the GTS by square brackets [ ] to indicate that the COL applicant must provide plant-specific values or alternative text.

As parts of the amendment to the AP1000 DC, the applicant proposed to complete some of the bracketed COL information items. Technical Report (TR)-74A (APP-GW-GLR-064), "AP1000 Generic Technical Specifications Completion," Revisions 0 and 1, were submitted to document these changes.

The remaining changes to the AP1000 GTS are either results of modifications to the plant equipment designs or are to resolve inconsistency between various TS requirements and their supporting information in the associated TS Bases. Revisions 0 and 1 to TR-74C (APP-GW-GLN-075), "AP1000 Generic Technical Specifications for Design Changes," were submitted to document these changes.

The applicant also submitted TR-134 (APP-GW-GLR-134), "AP1000 DCD Impacts to Support COLA Standardization," to document any supplemental changes to the AP1000 GTS that were not included in TR-74A or TR-74C.

This safety evaluation report (SER) addresses changes to AP1000 DCD, Revision 15, which are identified in AP1000 DCD, Revisions 16 and 17. These revisions were prepared using the guidance in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," and to the extent applicable for DC, using Regulatory Guide (RG) 1.206, Revision 0, "Combined License Applications for Nuclear Power Plants (LWR Edition)," as a guide for format and content.

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

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

16.3 Regulatory Basis

16.3.1 Regulatory Requirements

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

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

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

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

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

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

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

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

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

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

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

16.3.2 Regulatory Guidance

The relevant NRC requirements for TS and Bases reviews, and the associated acceptance criteria, are given in Section 16 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," (SRP). They are summarized below. Areas of review that interface with other SRP sections can also be found in Section 16 of NUREG-0800.

For the reasons discussed in detail below, the acceptance criteria adequate to meet the above requirements are included in the STS documents. The STS for PWRs are contained in three NRC NUREGs. For each NUREG, Volume 1 contains the TS and Volume 2 contains the associated TS bases. The STS include bases for SLs, LSSSs, LCOs, and associated action and surveillance requirements. The NUREGs for the STS for PWRs are as follows:

- NUREG-1430, "Standard Technical Specifications Babcock and Wilcox Plants"
- NUREG-1431, "Standard Technical Specifications Westinghouse Plants"
- NUREG-1432, "Standard Technical Specifications Combustion Engineering Plants"

The STS reflect the results of a detailed review of the application of the Interim Policy Statement criteria to generic system functions, which were published in a "Split Report" issued to the nuclear steam supply system vendor owners groups in May 1988. The STS also reflect the results of extensive discussions concerning various drafts of STS so that the application of the TS criteria and the Writer's Guide would consistently reflect detailed system configurations and operating characteristics for all reactor designs. As such, the generic Bases presented in the NUREGs provide an abundance of information regarding the extent to which the STS present the requirements necessary for protecting public health and safety.

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

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

16.3.3 Other Guidance

The June 2005 "Writer's Guide for Plant-Specific Improved Technical Specifications," prepared by the TSTF, provides specific guidance for the preparation of PTS. The purpose of the guide is to provide guidance on the format and content of the improved TS and to promote consistency in content, format, and style.

Design/plant-specific risk insights were developed by the staff for use during the review of AP1000 applications and are provided in a risk insights report. The risk insights were developed using information from the AP1000 DCD and AP1000 PRA. The risk insights were used to identify areas that warranted more detailed review and to identify equipment and systems that met Criterion 4 in 10 CFR 50.36(c)(2)(ii).

16.3.4 Applicable Generic Communication

The following generic communications issued by the NRC are TS-related and require consideration when developing TS and associated bases:

- Generic Letter (GL) 88-016, "Removal of Cycle-Specific Parameter Limits from Technical Specifications," October 3, 1988
- GL 91-004, "Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle," April 2, 1991
- GL 96-003, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits," January 31, 1996
- GL 03-001, "Control Room Habitability," June 12, 2003
- GL 06-001, "Steam Generator Tube Integrity and Associated Technical Specifications," January 20, 2006

The following NRC generic safety issues (GSI) are TS-related and require consideration when developing TS and associated Bases:

- GSI-78, "Monitoring of Fatigue Transient Limits for Reactor Coolant System"
- GSI-120, "On-Line Testability of Protection Systems"

16.4 Technical Evaluation

The staff reviewed and evaluated the GTS and Bases to verify their accuracy and completeness. The staff also reviewed the GTS to confirm the appropriateness of the restrictions imposed by the GTS to ensure that an operating AP1000 will operate within its SLs and LSSSs, as described in the final safety analysis report (FSAR). The GTS must ensure that a plant designed and constructed in accordance with the AP1000 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 an AP1000 licensee to take specified actions, up to and including shutting down the plant, if one or more SSCs are not functioning as designed, such that the plant may not respond as predicted in the FSAR, including the accident analyses in FSAR Tier 2, Chapter 15. In addition, the GTS must include provisions to govern every SSC that meets one or more of the four criteria in 10 CFR 50.36(c)(2)(ii).

As described in more detail below, the staff verified the adequacy of the GTS primarily by comparing them with the STS developed for the operating fleet of power reactors. 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 AP1000 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 allows 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. In view of its 2 Loop PWR design and the similar functions of many of its SSCs to the SSCs of a Westinghouse 4 Loop design, the Westinghouse STS in NUREG-1431 can be applied as guidance in evaluating most of the AP1000 GTS.

The staff evaluated each of the changes in the respective TS sections listed below. The applicant has committed to making the changes in the final version of the AP1000 DCD that are identified in AP1000 DCD, Revision 17. Therefore, to ensure that the final version of the AP1000 DCD is correct, the Revision 17 changes will require verification and are noted as confirmatory items.

The staff did not review sections of the AP1000 GTS and Bases that were unaffected by the changes proposed in AP1000 DCD, Revisions 16 and 17. The technical evaluation for the sections that were not affected by the amendment can be found in NUREG-1793.

16.4.1 Use and Application

Section 1.0 of the AP1000 GTS includes definitions of terms used in the context of plant TS, and examples to illustrate the applications of logical connectors, completion times for required actions, and frequencies for surveillance requirements. Changes to the AP1000 GTS Section 1.0 are as follows:

- In TS Section 1.1, the applicant proposed changes to the definition of “SHUTDOWN MARGIN” which is used in conjunction with TS Sections 3.1.1, 3.1.4, 3.1.5 and 3.1.6, to clarify how the gray rod cluster assemblies (GRCA) will be accounted for in the calculation of SHUTDOWN MARGIN. In request for additional information (RAI)-SRP16-CTSB-01, the staff requested additional details regarding this change. In its response letter dated November 11, 2008, the applicant provided the requested information including a markup of changes to TS Section 1.1 in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is Confirmatory Item (CI)-SRP16-CTSB-01. Subsection 16.4.3.1 below provides the staff’s evaluation of proposed changes to TS Section 3.1.

- In addition, the staff noted that an error in TS Section 1.4 had not been corrected in accordance with the NRC approved TSTF-485, which corrects Example 1.4-1, Revision 0. RAI-SRP16-CTSB-02 was issued to the applicant for its correction. In its response letter dated December 2, 2008, the applicant agreed to revise TS Section 1.4 in a future DCD revision. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-02.

The applicant adhered to the definitions for terms, logical connectors, conventions for completion times, and frequency requirements as provided in the Westinghouse STS. In addition, the AP1000 GTS, Section 1, and its Bases do not contain any "bracketed information" or "Reviewer's Notes." Therefore, except for the confirmatory items described above, the staff finds that Section 1.0 of the AP1000 GTS is acceptable.

16.4.2 Safety Limits

Section 2.0 of the AP1000 DCD GTS and Bases include requirements for safety limits, to ensure that the fuel design limits are not exceeded during steady state conditions, normal operational transients and anticipated operational occurrences.

The specifications provided in Section 2.0, which include the Reactor Core SLs and the Reactor Coolant System (RCS) Pressure Safety Limit, are consistent with the STS and are found acceptable by the staff. Changes to the AP1000 GTS Section 2.0 are as follows:

- In RAI-SRP16-CTSB-66, the staff asked the applicant to make an editorial change regarding an acronym contained in the bases of Section 2.1.1. In a letter dated December 2, 2008, the applicant acknowledged the need for the change and included a mark-up of the applicable section contained in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-66.

The applicant adhered to the SL information as provided in the Westinghouse STS. In addition, the AP1000 GTS, Section 2, and its Bases do not contain any "bracketed information" or "Reviewer's Notes." Therefore, except for the confirmatory item described above, the staff finds that Section 2.0 of the AP1000 GTS and Section B 2.0 of the AP1000 Bases are acceptable.

16.4.3 Limiting Condition for Operation and Surveillance Requirement Applicability

Section 3.0 of the AP1000 GTS and Bases includes general provisions regarding determination of equipment operability and performance of surveillance requirements (SR) in specific TS Section 3-series (i.e., TS Sections 3.1 through 3.9). There is no proposed change to the AP1000 GTS Section 3.0.

16.4.3.1 Reactivity Control Systems

Section 3.1 of the AP1000 DCD GTS and Bases includes requirements for the reactivity control systems, which are designed to reliably control reactivity changes and ensure that the capability to cool the core is maintained under postulated accident conditions.

The specifications provided in Section 3.1, which consists of: 3.1.1, Shutdown Margin, 3.1.2, Core Reactivity, 3.1.3, Moderator Temperature Coefficient, 3.1.4, Rod Group Alignment Limits, 3.1.5, Shutdown Bank Insertion Limits, 3.1.6, Control Bank Insertion Limits, 3.1.7, Rod Position Indication, 3.1.8, Physics Tests Exceptions – Mode 2, and 3.1.9, Chemical and Volume Control System Demineralized Water Isolation Valves and Makeup Line Isolation Valves, are consistent with the STS and are found acceptable by the staff. Changes to the AP1000 GTS Section 3.1 are as follows:

- In RAI-SRP16-CTSB-34, the staff asked the applicant to clarify the mode of applicability for an SR contained in the bases of Section 3.1.1. In a letter dated December 2, 2008,

the applicant acknowledged the need for the change and included a mark-up of the applicable section contained in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-34.

- In RAI-SRP16-CTSB-67, the staff asked the applicant to make a minor editorial change regarding the title of an LCO contained in the Bases portions of Sections 3.1.4 and 3.1.8. In a letter dated December 2, 2008, the applicant acknowledged the need for the change and included a mark-up of the applicable sections in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-67.

- In RAI-SRP16-CTSB-05, the staff asked the applicant to clarify certain notes and their corresponding applicability modes in the specification and Bases portions of Sections 3.1.4, 3.1.5, and 3.1.6. In a letter dated November 19, 2008, the applicant acknowledged the need for the change and included a mark-up of the applicable sections in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-05.

- In RAI-SRP16CTSB-60, the staff asked the applicant to make an editorial change regarding required actions stated in the Bases of Section 3.1.7. In a letter dated December 2, 2008, the applicant acknowledged the need for the change and included a mark-up of the applicable sections in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-60.

- In RAI-SRP16-CTSB-43, the staff asked the applicant to make an editorial change regarding the required reactor power level stated in the specification and Bases portions of Section 3.1.8. In a letter dated December 2, 2008, the applicant acknowledged the need for the change and included a mark-up of the applicable sections in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-43.

- In RAI-SRP16-CTSB-20, the staff asked the applicant to make an editorial change regarding the correct revision year for a reference used in the Bases portion of Section 3.1.8. In a letter dated December 9, 2008, the applicant acknowledged the need for the change and included a mark-up of the applicable sections contained in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-20.

The applicant adhered to the Reactivity Control Systems information as provided in the Westinghouse STS. In addition, the AP1000 GTS, Section 3.1, and its Bases do not contain any “bracketed information” or “Reviewer’s Notes.” Therefore, except for the confirmatory items described above, the staff finds that Section 3.1 of the AP1000 GTS and Section B 3.1 of the AP1000 Bases are acceptable.

16.4.3.2 Power Distribution Limits

Section 3.2 of the AP1000 GTS and Bases includes requirements for the reactor core power distribution limits, which are designed to reliably control core thermal limits and core power distribution consistent with the design safety analysis. Changes to the AP1000 GTS, Section 3.2 are described as follows:

- The specifications provided in Section 3.2, which consists of 3.2.1, Heat Flux Hot Channel Factor, 3.2.2, Nuclear Enthalpy Rise Hot Channel Factor, 3.2.3, Axial Flux Difference, 3.2.4, Quadrant Power Tilt Ratio, and 3.2.5, OPDMS-Monitored Parameters are consistent with the STS and are found acceptable by the staff.

- In RAI-SRP16-CTSB-68, the staff asked the applicant to make an editorial change regarding the documentation of the use of a reference in the Bases portion of Section 3.2.3. In a letter dated December 2, 2008, the applicant acknowledged the need for the change and included a mark-up of the applicable sections contained in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-68.

- In RAI-SRP16-CTSB-23, the staff asked the applicant to clarify the mode of applicability stated in the specification and Bases portions of Section 3.2.5. In a letter dated December 2, 2008, the applicant acknowledged the need for the change and included a mark-up of the applicable sections contained in AP1000 DCD, Revision 17. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-23.

The applicant adhered to the Power Distribution Limits information as provided in the Westinghouse STS. In addition, the AP1000 GTS, Section 3.2, and its Bases do not contain any "bracketed information" or "Reviewer's Notes." Therefore, except for the confirmatory items described above, the staff finds that Section 3.2 of the AP1000 GTS and Section B 3.2 of the AP1000 Bases are acceptable.

16.4.3.3 Instrumentation

Section 3.3 of the AP1000 GTS and Bases include requirements for the instrumentation systems that display information required to protect against violating the core fuel design limits and RCS, and to mitigate accidents. Changes to the AP1000 GTS, Section 3.3 are described as follows:

- Section 3.3, "Instrumentation," of the AP1000 DCD, Revision 15, was approved by the staff in the certified design. In the AP1000 DCD, Revision 16, and TR-134, "AP1000 DCD Impacts to Support COLA Standardization," Revisions 0 through 5, the applicant made minor editorial changes and updated technical information. The applicant justified other editorial changes in TR-74C, APP-GW-GLN-075, Revision 0, May 2007, "AP1000 Generic Technical Specifications for Design Changes." RAI-SRP16-CTSB-69 was submitted to correct editorial errors in these changes. In the AP1000 DCD, Revision 17, the applicant corrected the editorial and typographical errors.

- The applicant removed the brackets [ ] around the completion times in Sections 3.3.1 and 3.3.2., and restored the 92-day frequency to SR 3.3.1.6 and SR 3.3.2.5. The applicant documented the basis for these changes in TR-74, APP-GW-GLR-064, Revision 1, April 13, 2007, "AP1000 Generic Technical Specifications Completion Update on Open Items," and APP-GW-GSC-020, Revision 0, March 17, 2008, "AP1000 Protection and Safety Monitoring System Technical Specification Completion Time and Surveillance Frequency Justification." The applicant has incorporated these changes in the AP1000 DCD, Revision 17. The applicant revised the SR completion times to be consistent with APP-GW-GSC-020.

- The applicant stated that ALL values specified for Trip Setpoints and Allowable Values, in Tables 3.3.1-1 and 3.3.2-1, must be confirmed following the completion of the plant-specific setpoint study. After selection of specific instrumentation, the Trip Setpoints can be calculated using the setpoint methodology described in WCAP-16361, APP-PMS-JEP-001, Revision 0, May 2006, "Westinghouse Setpoint Methodology for Protection Systems – AP1000." In the AP1000 DCD, Revision 17, the applicant has removed all bracketed items for Trip Setpoints and Allowable Values in the tables, but includes a Reviewer's Note to direct the COL applicant to use the approved methodology to calculate these values. A discussion of the acceptability of the AP1000 Setpoint Control Program, used to calculate setpoint values with this methodology, is included in subsection 16.4.5 of this SER.

- In TS 3.3.1, Table 3.3.1-1, equations for overtemperature ΔT (Note 1) and overpower ΔT (Note 2) are provided. The staff previously requested, in RAI-SRP16-CTSB-42, that the applicant provide the technical bases and derivation of the revised overtemperature ΔT and overpower ΔT reactor trip setpoint equations presented in Revision 16, and provide a reference to a document approved by the staff for the basis of the revised equations, or submit the basis for the revised equations to the staff for further review. The response provided for RAI-SRP16-CTSB-42 via submittal ML083290461 did not fully address the staff's request. WCAP-8745-P-A, previously reviewed and approved by the staff, provided the bases for the overtemperature ΔT and overpower ΔT setpoint equations presented in Revision 15 of the DCD. The revised equations presented in DCD Revision 16 for these reactor trip functions differ from those previously submitted in Revision 15 of DCD 7.2.1.1.3 and Technical Specification Table 3.3.1-1, Note 1.

  Based on this the staff believed that the applicant should document the bases for the revised equations; the bases for development of the tables of allowable core thermal power as a function of core inlet temperature at various pressures for the overtemperature ΔT trip equation, the bases for the determination of the preset bias K4 in the overpower ΔT trip equation, and the bases for the constants and bracketed values that appear in the revised equations presented in Revision 16. The staff reviewed technical report APP-GW-GLR-137, Revision 0, "Bases of Digital Overpower and Overtemperature Delta-T (OPΔT/OTΔT) Reactor Trips," submitted by the applicant, in WCAP- 8745-P-A, "Design Bases for the Thermal Overpower ΔT and Thermal Over Temperature ΔT Trip Functions," September 1986 (Agencywide Documents Access and Management System (ADAMS)) Accession Number ML073521507. The content of this review is found in Chapter 7.2.2.1.1 of this SER. The applicant described and clarified these items in more detail, as well as provided commitments to update references in the report and add this additional information. The applicant proposes to implement these changes in Revision 18 of the DCD. The staff finds these acceptable; however, verification that these changes are correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-42.

- In RAI-SRP16-CTSB-44, the staff requested clarification/consistency of Function 6 (overtemperature ΔT) and Function 7 (overpower ΔT) "required channel" column in Table 3.3-1, "Reactor Trip System Instrumentation." The applicant added "4 (2/loop)" in the required channel column for clarification. This has been reviewed and accepted by NRC staff. The applicant proposes to implement this change in Revision 18 of the DCD. Verification that these changes are correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-44.

- In RAI-SRP16-CTSB-45, the staff requested clarification/consistency of Function 12 (reactor coolant pump [RCP] speed-low) ”required channel” column in Table 3.3-1, “Reactor Trip System Instrumentation.“ The applicant added ”4 (1/pump)” in the required channel column for clarification. This has been reviewed and accepted by NRC staff. The applicant proposes to implement this change in Revision 18 of the DCD. Verification that these changes are correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-45.

- In RAI-SRP16-CTSB-52, the staff requested resolution of conflicting information for the required minimum number of core exit thermocouples per core quadrant. The conflict was between note (b) in Table 3.3.3-1 (Post Accident Monitoring) and DCD Table 7.5-1, sheet 2 (Instrumentation and Controls). The applicant changed the Number of Instruments required from “2 quadrants” to “2 quadrants per Division” in Table 7.5-1, sheet 2 (Instrumentation and Controls). This has been reviewed and accepted by NRC staff. The applicant proposes to implement this change in Revision 18 of the DCD. Verification that these changes are correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-52.

The applicant adhered to the Instrumentation information as provided in the Westinghouse STS. In addition, the AP1000 GTS, Section 3.3, and its Bases contain “bracketed information.” The staff reviewed each piece of “bracketed information” to understand its intent and to determine whether each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the AP1000 GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, except for the confirmatory items described above, the staff finds that Section 3.3 of the AP1000 GTS and Section B 3.3 of the AP1000 Bases are acceptable.

16.4.3.4 Reactor Coolant System

Section 3.4 of the AP1000 GTS and Bases include requirements for various RCS parameters (i.e., pressure, temperature, flow, etc.) and subsystems (i.e., RCS loops, pressurizer, low-temperature overpressure protection (LTOP), etc.) to ensure the fuel integrity and the RCPB integrity are preserved during all modes of plant operation. Changes to the AP1000 GTS, Section 3.4 are described as follows:

- In TS 3.4.1, the applicant proposed to use the preliminary bracketed value of 1.41E6 (Lpm) (301,670 gallons per minute (gpm)), specified in LCO 3.4.1.c for the minimum RCS total flow rate, as a final value based on latest system design specifications, approved engineering calculation notes, and/or verified analysis input assumptions. The staff finds this final value acceptable since it is consistent with supporting information provided in the TS bases B 3.4.1 and relevant information described in the AP1000 DCD Sections 4.4 (Table 4.4-1) and 15.0 (Table 15.0-3).

- The applicant also proposed to change requirements specified in SR 3.4.1.4 for monitoring RCS flow, to reflect an alternate testing method to the precision heat balance (an NRC-accepted method). In RAI-SRP16-CTSB-25, the staff asked Westinghouse to provide justification for the change. In the December 2, 2008, response letter, Westinghouse provided additional details about the basis for the alternate method and also stated the following:

> The intent of the proposed Section 3.4.1 is to permit either method, whichever is demonstrated to provide less measurement uncertainty....The total uncertainty in measuring flow will depend upon analysis of the baseline flow measurements and the accuracy of the devices used to periodically measure dP caused by RCS flow. If the total uncertainty is not shown to be less than for the precision heat balance plus Delta-T method, then the alternate method would not be used.

Westinghouse also indicated that no change to the AP1000 DCD or the TS 3.4.1 and associated bases is required.

In reviewing this response, the staff noted that the alternate testing method using elbow tabs had been approved for use at the South Texas Project Electric Generating Station. A review of the current South Texas Project TS found the following descriptions for the affected SRs:

> SR 4.2.5.2 The RCS flow rate indicators shall be subjected to a channel calibration at least once per 18 months.
>
> SR 4.2.5.3 The RCS total flow rate shall be determined by precision heat balance or elbow tab dP measurements at least once per 18 months.

Based on the above, the staff believed a revision to the SR 3.4.1.4 and TS Bases 3.4.1 was needed to incorporate additional details regarding the choice of a testing method that produces better uncertainty analysis results, including a new SR for a channel calibration of the RCS flow rate indicators. In the August 20, 2009, response letter, Westinghouse proposed to (1) add a new SR for a channel calibration for RCS flow indicators at the main control room board, and (2) revise SR 3.4.1.4 and TS Bases B 3.4.1 to incorporate a discussion of uncertainty analyses related to the use of elbow tabs as an alternate method for RCS flow verification. The staff finds this response acceptable; however, verification that the stated changes are properly incorporated into a future revision of the AP1000 DCD is CI-SRP16-CTSB-25.

- In TS 3.4.2, the applicant proposed to use the preliminary bracketed value of 288 Degrees Celsius (C) (551 degrees Fahrenheit (F)), for the minimum RCS cold-leg temperature for criticality, as a final value based on historical relationships between the no-load operating temperature (292 Degrees C, 557 degrees F), the minimum temperature for criticality (288 Degrees C, 551 degrees F), and the limit for Mode 2 physics testing (283 Degrees C, 541 degrees F). The staff finds this final value acceptable since it is consistent with supporting information provided in the TS Bases B 3.4.2 and relevant information described in the AP1000 DCD, Sections 5.4 and 15.0.3.

- In TS 3.4.4, the applicant proposed to replace the preliminary bracketed values of 135 Degrees C (275 degrees F) with a new final value of 93 Degrees C (200 degrees F) and to use the preliminary bracketed value of 10 Degrees C (50 degrees F) as a final value, regarding temperature requirements for the primary coolant and the secondary-side water as listed in Note 2 of LCO 3.4.4. In addition, the applicant proposed to add an extra precautionary note regarding restrictive plant conditions before starting an RCP for the reactor vessel low-temperature overpressure protection. In RAI-SRP16-CTSB-55, the applicant was asked to provide clarification of the selected value of 93 Degrees C (200 degrees F). This value (200 degree F) is not consistent with the one listed in the

Westinghouse STS (275 degree F). In the March 23, 2009, response letter, Westinghouse proposed a further change from "200 degree F" to "350 degree F" based on an updated LTOP analysis which now credits a technical design difference for AP1000 related to the variable-speed RCP start-up design limitations (e.g., RCPs are required to be started at a relatively slow pump speed and they are unable to start at full speed) not recognized in the Westinghouse STS (NUREG-1431). The staff finds the changes and justification as provided in this latest response acceptable; however, verification that the stated changes are properly incorporated in a future revision of the AP1000 DCD is Confirmatory Item CI-SRP16-CTSB-55.

- Although no change was proposed to TS 3.4.6 as part of the AP1000 DC amendment application, the staff noted inconsistencies between SR 3.4.6.1 requirements and supporting information in the bases B 3.4.6, regarding lift setpoints for pressurizer safety valves. In RAI-SRP16-CTSB-08, the NRC staff asked the applicant to address these inconsistencies. In its response dated December 17, 2008, the applicant proposed to revise the Bases for SR 3.4.6.1 to indicate +/- 1 percent OPERABLE range for the valve lift settings, to be consistent with SR 3.4.6.1 and with the tolerance established in the Westinghouse topical report WCAP-16779, "AP1000 Overpressure Protection Report," April 2007. The staff finds this change acceptable; however, verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-08.

- In TS 3.4.7, the applicant proposed to delete LCO 3.4.7.d for the total primary-to-secondary leakage through both steam generators (SGs) because it is redundant to LCO 3.4.7.e for primary to secondary leakage through any one SG. In addition, changes were proposed to SR 3.4.7.2 to reflect the implementation of a new SG program to maintain the SG tube integrity. The staff agreed with Westinghouse's position on deleting LCO 3.4.7.d and finds the proposed changes to SR 3.4.7.2 acceptable since they are consistent with other requirements in the AP1000 GTS (GTS 3.4.18, GTS 5.5.4, and GTS 5.6.8).

- In TS 3.4.8, the applicant proposed to add a missing clarifier to the applicability statement that allows stopping all RCPs without having to enter an action statement. The staff finds this change acceptable since the added special plant condition is consistent with remaining TS 3.4.8 requirements.

- The applicant also proposed to replace the preliminary bracketed value of 37,785 Lpm (10,000 gpm) for the minimum RCS flow with a final value of 11,356 Lpm (3,000 gpm). Conforming changes were proposed in SR 3.4.8.1 and related information in the TS Bases to match the new minimum flow value (e.g., the minimum pump speed setting of 25 percent was replaced with a new value of 10 percent). Westinghouse cited the NRC-accepted response to RAI 440.106 during the Revision 14 AP1000 DC review as justification for the proposed flow reduction. In RAI-SRP16-CTSB-62, the NRC staff asked the applicant to provide additional details to support these changes. In its response dated December 17, 2008, the applicant reiterated information that was provided in the response to RAI 440.106 but also stated the following:

  > AP1000 RCS flow calculations show that the expected RCS flow with a single reactor coolant pump (RCP) operating at its lowest allowable operating speed is approximately 17,000 gpm. The associated reactor vessel flow is approximately 11,000 gpm. This is well above the 3,000

> gpm flow mixing requirement from the LOFT testing, and also above the preliminary bracketed value of 10,000 gpm...

The staff noted that the new proposed value of 10 percent for the pump minimum speed setting in SR 3.4.8.1, corresponding approximately to a calculated flow of 29,810 Lpm (7,875 gpm), appears to be inconsistent with the lowest allowable operating speed stated above. In the July 15, 2009, response letter, the applicant stated that the mentioned lowest allowable operating speed is for equipment protection while the minimum speed specified in TS 3.4.8 is to reflect the assumed RCS flow through the core in shutdown event analyses. The TS limit will be satisfied if the operating limit is maintained in accordance with plant equipment operating procedures. The staff finds this response acceptable and RAI- SRP16-CTSB-62 is closed.

- Although no change was proposed to TS 3.4.11/12 as part of the AP1000 DC amendment application, the staff noted that the scope of Condition A was not clearly defined. In RAI-SRP16-CTSB-07, the staff asked Westinghouse to explain the difference in scope of inoperable equipment involved between TS 3.4.11/3.4.12 Condition A, which states "One required flow path inoperable," and Condition B, which states, "One required stage 1 ADS flow path inoperable AND Either one required stage 2 or stage 3 ADS flow path inoperable."

  In its October 27, 2008, response letter, Westinghouse stated the following:

  > As described in the 3.4.11 and 3.4.12 Bases, Conditions A and B cover two different combinations of ADS flow path inoperabilities....Separate Conditions are specified, since both Conditions A and B may be entered at the same time. The inoperabilities covered by the two Conditions are permissible at the same time, since the safety function can be accomplished by the remaining seven ADS flow paths without a single failure. The loss of capacity while in Conditions A and B is equivalent to a single failure of the power to the valves in one division, as considered in the accident analyses.

  Westinghouse further stated "the LCO 3.4.11 and LCO 3.4.12 and associated Bases are technically correct, as-is. However, to clarify the system status while in both Conditions A and B the following statement is added in each of the Bases at the beginning of the Actions sections:

  > The loss of automatic depressurization system (ADS) capacity, if both Conditions A and B are entered at the same time, is equivalent to a single failure of the power to the valves in one division, as considered in the accident analyses."

  Based on this response and considering the four-stage ADS design, the staff believed that additional changes were required for Condition A to explicitly list Stage 4 ADS flow path in its scope and to clearly indicate the difference between Conditions A and B. In the July 15, 2009, response letter, the applicant proposed to revise all Action statements in TS 3.4.11 and TS 3.4.12, and the associated TS bases to clearly define the scope of inoperable ADS valves for each LCO Condition and to assign a completion time consistent with guidance in the STS for cases with the same remaining operable ADS valves. The staff finds this response acceptable; however, verification that the stated

changes are properly incorporated in a future revision of the AP1000 DCD is Confirmatory Item CI-SRP16-CTSB-07.

- In TS 3.4.14, the applicant proposed to replace the preliminary bracketed value of 152.4 square cm (9.3 square inches) for the minimum RCS vent area with a final value of 68 square cm (4.15 square inches). In RAI-SRP16-CTSB-35, the NRC staff asked the applicant to provide a justification for the change. In its response dated December 12, 2008, the applicant stated that the change is a result of the final design of the normal residual heat removal system (RNS) suction relief valve with its inlet changed from 10.16 cm (4 inches) to 7.62 cm (3 inches). The staff finds the stated justification acceptable since either the RNS suction relief valve or a depressurized RCS with a vent area is considered an acceptable means for providing low-temperature overpressure protection. The staff considers RAI-SRP16-CTSB-35 closed.

- In addition, in RAI-SRP16-CTSB-54, the staff asked the applicant to address inconsistencies in the TS bases B 3.4.14 regarding discussion on restarting of one reactor coolant pump (RCP) as a heat input event. In the March 23, 2009, response letter, Westinghouse proposed to revise the LCO 3.4.14 and its associated TS bases to make the descriptions of the LCO 3.4.14 Notes 1 and 2 consistent with those specified in LCO 3.4.4 and LCO 3.4.8 for the same situation. The staff finds this response acceptable; however, verification that the stated changes are properly incorporated in a future revision of the AP1000 DCD is Confirmatory Item CI-SRP16-CTSB-54.

- In TS 3.4.15, the applicant proposed to use the preliminary bracketed value of 15,272 kPa (2,215 pounds per square inch gauge (psig)) and 15,549 kPa (2,255 psig), for the range of RCS pressure during performance of SR 3.4.15.1 to verify leakage through each RCS pressure isolation valve, as final values based on the nominal RCS pressure design of AP1000 and the requirements for test pressures identified in American Society of Mechanical Engineers (ASME) Operation and Maintenance (OM) Code ISTC-3630(b). The staff finds the stated reason for the final selected values acceptable.

- At the end of TS Section 3.4, the applicant proposed to add a new TS 3.4.18, "Steam Generator Tube Integrity," to reflect implementation of the NRC-approved TSTF-449, Revision 3. The staff finds the proposed addition of TS 3.4.18 acceptable since implementing TSTF-449 is one acceptable option for addressing the safety issues identified in GL 06-001.

The applicant adhered to the RCS information as provided in the Westinghouse STS, with differences to reflect AP1000 unique design features. With respect to AP1000 unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analysis. In addition, the AP1000 GTS, Section 3.4, and its Bases do not contain any "bracketed information" or "Reviewer's Notes." Therefore, except for the confirmatory items described above, the staff finds that Section 3.4 of the AP1000 GTS and Section B 3.4 of the AP1000 Bases are acceptable.

16.4.3.5 Emergency Core Cooling Systems

Section 3.5 of the PTS and Bases includes requirements for the safety-related passive core cooling system (PXS) which is designed to perform emergency core decay heat removal, RCS emergency makeup and boration, and safety injection. Changes to the AP1000 GTS, Section 3.5 are described as follows:

- In TS Section 3.5.2, the applicant proposed to use the preliminary bracketed value of 0.0057 cubic meters (0.2 cubic feet), for the maximum allowable volume of noncondensable gases in each of the core makeup tanks' inlet piping, as a final value based on latest system design specifications, approved engineering calculation notes, and/or verified analysis input assumptions. The staff finds this final value acceptable since it is consistent with related information described in the AP1000 DCD, Section 6.3.

- In TS Section 3.5.4, the applicant proposed to replace the preliminary bracketed value of 0.011 cubic meters (0.4 cubic feet), for the maximum allowable volume of noncondensable gases in the passive residual heat removal heat exchanger inlet piping, with a new final value of 0.025 cubic meters (0.9 cubic feet). In RAI-SRP16-CTSB-36, the NRC staff asked the applicant to provide justification for the change. In its response dated December 12, 2008, the applicant stated that the value of 0.025 cubic meters (0.9 cubic feet) reflects the correct design value based on the final location for the alarm limit switch installed in the high-point pipe stub section. The staff finds this final value acceptable based on verification that a physical change was made in the AP1000 DCD, Section 6.3, regarding an increase in pipe size at the level switch location from 0.305 meters to 0.355 meters (12 inches to 14 inches). Therefore, the staff considers RAI-SRP16-CTSB-36 closed.

- In TS Sections 3.5.6 and 3.5.8, the applicant proposed to replace the preliminary bracketed value of 2091 cubic meters (73,900 cubic feet), for the minimum volume of borated water in the in-containment refueling water storage tank (IRWST), with a new final value of 2069 cubic meters (73,100 cubic feet). In RAI-SRP16-CTSB-37, the NRC staff asked the applicant to provide justification for the change. In its response dated December 12, 2008, the applicant stated the following:

  > The bracketed volume of 73,900 ft^3 represented a preliminary estimate of the minimum design basis IRWST water volume.
  >
  > The un-bracketed value of 73,100 ft^3 was updated based on evolving IRWST design details, is consistent with the updated IRWST volume provided in DCD Table 6.3-2 (Sheet 2), and reflects a more conservative water volume that was appropriately used in safety analyses."

  The staff finds the stated reason acceptable and considers RAI-SRP16-CTSB-37 closed.

The applicant adhered to the ECCS information as provided in the Westinghouse STS. In addition, the AP1000 GTS, Section 3.5, and its Bases do not contain "bracketed information" or "Reviewer's Notes." Therefore, except for the confirmatory items described above, the staff finds that Section 3.5 of the AP1000 GTS and Section B 3.5 of the AP1000 Bases are acceptable.

16.4.3.6 Containment Systems

Section 3.6 of the AP1000 DCD GTS and its Bases address requirements for the containment systems, which are designed to contain fission products that may exist in the containment atmosphere following accident conditions.

The specifications provided in Section 3.6: 3.6.1, Containment; 3.6.2, Containment Air Locks; 3.6.3, Containment Isolation Valves; 3.6.4, Containment Pressure; 3.6.5, Containment Air Temperature; 3.6.6, Passive Containment Cooling System (PCS) – Operating; 3.6.7, PCS Shutdown; 3.6.8, Containment Penetrations; and 3.6.9, pH Adjustment, are consistent with the STS and are found acceptable by the staff. Changes to the AP1000 GTS Section 3.6 are as follows:

- In RAI-SRP16-CTSB-15, the staff asked the applicant to correct Bases B 3.6.6 to accurately reflect the action statements in TS 3.6.6. In a letter dated October 17, 2008, the applicant acknowledged the need for the change and included a markup of the applicable sections contained in AP1000 DCD, Revision 17. The staff finds this change acceptable; however, verification that the change is correctly incorporated in the final revision of the AP1000 DCD is Confirmatory Item CI-SRP16-CTSB-15.

- In RAI-SRP16-CTSB-16, the staff asked the applicant to correct Bases B 3.6.7 to accurately reflect the action statements in TS 3.6.7. In a letter dated October 17, 2008, the applicant acknowledged the need for the change and included a markup of the applicable sections contained in AP1000 DCD, Revision 17. The staff finds this change acceptable; however, verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-16.

- In RAI-SRP16-CTSB-13, the staff asked the applicant to clarify Bases B 3.6.4 regarding maximum peak containment pressure. In a letter dated December 2, 2008, the applicant acknowledged the need for clarification and included a markup of the changes that will be incorporated. The staff finds this change acceptable; however, verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-13.

- In RAI-SRP16.1.1-SEB1-01, the NRC staff asked the applicant to provide details on the equipment hatch and bolt design to ensure that the equipment hatch can be safely installed with four bolts to meet the containment closure requirements during modes 5 and 6 (TS 3.6.8). In its response dated August 15, 2008, the applicant stated that design specification document APP-MV50-Z0-002, “Equipment Hatch Design Certification Document”, would provide final design information for the equipment hatch installation.

  In an audit on November 30, 2009, the staff confirmed that design specification document APP-MV50-Z0-002, Revision 1, provides design criteria for Equipment Hatch bolts such that its weight can be supported with only four bolts installed. A typical vendor report prepared for the AP1000 China Sanmen Unit 1 lower equipment hatch by IHI Corporation in Japan was also provided for the staff review during this audit. The staff noted that this vendor report adequately addresses the applicable design criteria specified in APP-MV50-Z0-002. Although this vendor report was not prepared specifically for a new AP1000 plant to be built in the United States, the staff finds the applicant’s approach to address this issue acceptable. The equipment hatch is listed as an ASME Code Section III component in the AP1000 DCD Tier 1, Table 2.2.1-1, and as such ITAAC Item 2.a in Table 2.2.1-3 is applicable to it. This ITAAC item calls for the existence of a design report for the as-built component received from the equipment supplier. The design document APP-MV50-Z0-002 together with the cited ITAAC Item will ensure Equipment Hatch components will be constructed and installed in accordance with design requirements. Therefore, the staff finds the response acceptable and RAI-SRP16.1.1-SEB1-01 is closed.

- In RAI-SRP16-CTSB-61, the staff asked the applicant to specify the sections of DCD Chapter 15 that support the specific accident discussed in the "Applicable Safety Analyses" section of TS Bases B 3.6.1, B 3.6.2, and B 3.6.3. In the November 19, 2008, response letter, the applicant stated that:

  > "the level of detail provided by the B 3.6.1, B 3.6.2, and B 3.6.3 Bases references to Chapter 15 is consistent with that provided in the STS"

  The applicant made no further change to the Bases. The staff found this reason unacceptable. The staff's concern was that DCD Chapter 15 is voluminous as it contains more than 600 pages. Without references to specific sections, validation of the information discussed in the affected TS bases would require significant effort and time from the plant operators who implement TS requirements and often refer to the TS bases for clarifications needed quickly. In the July 15, 2009, response letter, the applicant provided sufficient details to support its position that reference to specific sections of Chapter 15 is not helpful in these cases for the containment boundary as a physical barrier. The containment integrity and leak tightness are applicable to a wide range of accident scenarios described in Chapter 15. The staff finds this response acceptable and RAI-SRP16-CTSB-61 is closed.

- In RAI-SRP16-CTSB-33, the staff asked Westinghouse to provide the value of the minimum TSP manufactured density that is used to convert the required TSP amount from a mass number to a volume number. In the December 12, 2008, response letter, the applicant did not provide the requested information so that the staff could verify the accuracy and completeness of supporting information provided in the TS Bases B 3.6.9. In the August 20, 2009, response letter, and the subsequent October 29, 2009, conference call, the applicant provided the requested information and agreed to revise the TS Bases B 3.6.9 to include the new details. The staff finds this response acceptable; however, verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-33.

The applicant adhered to the Containment information as provided in the Westinghouse STS, with differences to reflect AP1000 unique design features. With respect to AP1000 unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analysis. In addition, the AP1000 GTS, Section 3.6, and its Bases contain "bracketed information" and "Reviewer's Notes." The staff reviewed each piece of "bracketed information" to understand its intent and to determine whether each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the AP1000 GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, except for the confirmatory items described above, the staff finds that Section 3.6 of the AP1000 GTS and Section B 3.6 of the AP1000 Bases are acceptable.

16.4.3.7 Plant Systems

Section 3.7 of the PTS and Bases include requirements for various systems in the secondary side of the SGs (i.e., the main steam safety valves (MSSVs), the main steam isolation valves (MSIVs), the main feedwater isolation valves (MFIVs), etc.), the spent fuel pool water level and makeup systems, and the main control room habitability system. Changes to the AP1000 GTS, Section 3.7 are described as follows:

- In TS Section 3.7.1, “Main Steam Safety Valves (MSSVs),” the applicant proposed a slight increase in the relief capacity and the resulting relief setpoint for all but the first-to-open MSSV based on a minor change to the valve inlet piping to conform to ASME Code requirements. Also, the applicant replaced the bracketed values for the restriction on maximum allowable thermal power with inoperable MSSVs in Table 3.7.1-1 with new final values. The staff finds the final data in Table 3.7.1-1 acceptable since they were derived using methodology referenced in the Westinghouse STS, Revision 3.

- In addition, the applicant proposed to change the tolerance for the as-found relief setting for MSSVs in Table 3.7.1-2 from 1 percent to 3 percent. In RAI-SRP16-CTSB-11, the staff asked the applicant to provide justification for the change in Table 3.7.1-2. In its response dated December 17, 2008, the applicant proposed to change this tolerance back to the original value of 1 percent. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-11.

- In TS Section 3.7.6, “Main Control Room Habitability System,” the applicant proposed to use the preliminary bracketed value of 23,443 kPa (3,400 psig) for the required minimum pressure specified in SR 3.7.6.2, as a final value based on latest system design specifications, approved engineering calculation notes, and/or verified analysis input assumptions. The staff found the proposed final value acceptable since it is consistent with relevant information described in the AP1000 DCD, Section 6.4.2.

- In addition, the staff noted that the AP1000 GTS did not incorporate the NRC-approved TSTF-448, which was issued to address safety issues identified in GL 2003-001. In RAI-SRP16-CTSB-32, the staff asked the applicant to address these issues. In its response dated November 11, 2008, the applicant stated that it had added a new DCD Section 6.4.5.4, “Main Control Room Envelope Habitability,” under Revision 16 to address GL 2003-01. This DCD section describes the periodic testing of the main control room envelope habitability during main control room emergency habitability system operation (pressurization mode) to measure the air in-leakage in accordance with American Society for Testing and Materials E741. The applicant concluded that this periodic testing commitment in DCD Section 6.4.5.4, combined with the existing LCO 3.7.6 requirements, adequately addresses the GL 2003-01 issues and provides requirements equivalent to those approved in TSTF-448. The applicant proposed no further changes to the AP1000 DCD or the AP1000 GTS. The staff disagreed with this conclusion. In the May 4, 2009, response letter to RAI-SRP6.4-SPCV-01, the applicant proposed to revise TS 3.7.6 and its associated bases to fully incorporate all TSTF-448 requirements. The staff finds this latest response acceptable: however, verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-32. Also in response to RAI-SRP6.4-SPCV-06, the applicant proposed additional design changes to the control room habitability system. As a result, further changes are proposed to TS 3.7.6 and a new administrative control TS 5.5.13 is added to the AP1000 GTS for testing of the new passive filtration unit. Additional open items to TS 3.7.6 and TS 5.5.13 were identified and documented as part of the staff's evaluation of these design changes in SER Section 6.4. Verification that satisfactory closures of the noted open items are addressed in the FSER Section 6.4 is CI-SRP6.4-SPCV-06.

- In TS Section 3.7.9, “Fuel Storage Pool Makeup Water Source,” the applicant provided additional information to the precautionary Note 1 in LCO 3.7.9 for clarification. The staff finds the added text acceptable since it is consistent with relevant information described in the AP1000 DCD, Section 9.1.3.

- At the end of TS Section 3.7, the applicant proposed to add TS 3.7.11, "Fuel Storage Pool Boron Concentration," and TS 3.7.12, "Spent Fuel Pool Storage," to reflect the final design of the spent fuel storage racks. The staff finds the added TS requirements and associated information in the TS bases acceptable since they were formulated in accordance with guidance provided in the Westinghouse STS 3.7.16 and 3.7.17, respectively, and are consistent with relevant information in the AP1000 DCD, Section 9.1. Section 9.1 of this SER presents a separate evaluation of the final design of the spent fuel storage racks.

The applicant adhered to the Plant Systems information as provided in the Westinghouse STS, with differences to reflect AP1000 unique design features. With respect to AP1000 unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analysis. In addition, the AP1000 GTS, Section 3.7, and its Bases do not contain "bracketed information" or "Reviewer's Notes." Therefore, except for the confirmatory items described above, the staff finds that Section 3.7 of the AP1000 GTS and Section B 3.7 of the AP1000 Bases are acceptable.

16.4.3.8 Electrical Power Systems

Section 3.8 of the AP1000 GTS and Bases include requirements for the plant electrical systems that provide redundant, diverse and dependable power sources for all plant operating conditions. In the event of a total loss of off-site power, on-site diesel generators and batteries are provided to supply electrical power equipment necessary for the safe shutdown of the plant. Changes to the AP1000 GTS, Section 3.8 are as follows:

- Section 3.8, "Electrical Power Systems," of the AP1000 DCD, Revision 15, was approved by the staff in the certified design. In the AP1000 DCD, Revision 16, and TR-134, "AP1000 DCD Impacts to Support COLA Standardization," Revisions 0 through 5, the applicant made minor editorial changes and updated technical information. The staff finds these editorial changes acceptable.

- In the AP1000 DCD, Revision 17, the applicant replaced all preliminary information in the brackets with the final information. The applicant documented the basis for these changes in TR-74, APP-GW-GLR-064, Revision 1, April 13, 2007, "AP1000 Generic Technical Specifications Completion Update on Open Items." The staff finds these changes acceptable due to the justifications found in the reference report.

- The applicant initially proposed retaining brackets [ ] around all preliminary AP1000 DCD values associated with the battery float current. COL applicants referencing the AP1000 DCD would replace preliminary information, provided in brackets [ ], with final plant specific values. In the AP1000 DCD, Revision 17, the applicant replaced all preliminary information in the brackets with the final information. The staff finds this acceptable since it is consistent with the guidance provided in the IEEE references.

- The applicant inadvertently omitted the "7 days" completion time in TS Section 3.8.1 B.3 and has added it into AP1000 DCD, Revision 17, and Revision 4 of TR-134. The staff finds this editorial change acceptable.

The applicant adhered to the Electrical Power Systems information as provided in the Westinghouse STS. In addition, the AP1000 GTS, Section 3.8, and its Bases do not contain

"bracketed information" or "Reviewer's Notes." Therefore, the staff finds that Section 3.8 of the AP1000 GTS and Section B 3.8 of the AP1000 Bases are acceptable.

16.4.3.9 Refueling Operations

Section 3.9 of the AP1000 GTS and Bases includes requirement for boron concentration, unborated water sources, nuclear instrumentation, containment penetrations, and water inventory in the refueling pool during Mode 6. Changes to the AP1000 GTS Section 3.9 include the following:

- In TS Section 3.9.5, "Containment Penetrations," the applicant proposed to use the preliminary bracketed information as a final value for the required number of bolts (four) to keep the equipment hatch in place to meet the containment closure requirements during movement of irradiated fuel assemblies within the containment, based on latest system design specifications, approved engineering calculation notes, and/or verified analysis input assumptions. In RAI-SRP16.1.1-SEB1-01, the staff asked the applicant to provide additional details on the bolt design to ensure the safe installation of the equipment hatch with only four bolts. In its response dated August 15, 2008, the applicant stated that design specification document APP-MV50-Z0-002 would provide final design information for the equipment hatch installation. The discussion and closure of RAI-SRP16.1.1-SEB1-01 is found above in subsection 16.4.3.6.

- Also, in TS Sections 3.9.5, "Containment Penetrations," and 3.9.6, "Containment Air Filtration System (VFS)," the applicant proposed to use the preliminary bracketed value of -0.0311 kPa (-0.125 inches water gauge) relative to outside atmospheric pressure for VFS subsystem testing in SR 3.9.5.3 and SR 3.9.6.3. The applicant proposed using the preliminary value as a final value based on latest system design specifications, approved engineering calculation notes, and/or verified analysis input assumptions. In RAI-SRP16-CTSB-59, the staff asked the applicant to explain the basis for the selected value. In its response dated August 15, 2008, the applicant stated the following:

  > This pressure was chosen based on ASHRAE Applications, which recommends at least 0.0124 kPa to 0.0149 kPa (0.05 to 0.06 inches of water) across boundaries when exfiltration or infiltration is minimized. Conservatively, Westinghouse chose a higher pressure difference of 0.0311 kPa (0.125 inches of water).

  The staff finds the stated reason acceptable since the selected value is more conservative than the value used in normal industry practices. Therefore, the staff considers RAI-SRP16-CTSB-59 closed.

- In TS Section 3.9.7, "Decay Time," the applicant proposed to change the minimum decay time of 100 hours to 48 hours to make it consistent with the analysis of the fuel handling accident as described in the AP1000 DCD, Section 15.7.4. The staff finds this change acceptable for the stated reason.

The applicant adhered to the Refueling Operations information as provided in the Westinghouse STS. In addition, the AP1000 GTS, Section 3.9, and its Bases do not contain "bracketed information" or "Reviewer's Notes." Therefore, the staff finds that Section 3.9 of the AP1000 GTS and Section B 3.9 of the AP1000 Bases are acceptable.

16.4.4 Design Features

Section 4.0 of the AP1000 GTS includes other design features not covered in TS Section 3-series such as the site location, the site maps, and other information related to core design and fuel storage design. Changes to the AP1000 GTS, Section 4.0 are as follows:

- In TS Section 4.3, "Fuel Storage," the applicant proposed various changes to the description of the fuel storage area to reflect the final design for new and spent fuel storage racks and an increase of the maximum capacity of the spent fuel storage racks from 616 to 889 fuel assemblies. Evaluation of the final design modification is provided separately in Section 9.1 of this SER. Furthermore, in RAI-SRP16-CTSB-38 and 39, the applicant was asked to address inconsistencies between information provided in TS Section 4.3 and DCD Section 9.1. In its response dated December 2, 2008, the applicant proposed revisions to TS Section 4.3 and DCD Section 9.1 to revolve these inconsistencies. Verification that changes are correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-38 and CI-SRP16-CTSB-39.

The applicant adhered to the design features information as provided in the Westinghouse STS, with differences to reflect AP1000 unique design features. With respect to AP1000 unique design features, the GTS are sufficient to assure operation of these features within the bounds of the safety analysis. In addition, the AP1000 GTS, Section 4.0 contains "bracketed information" and "Reviewer's Notes." The staff reviewed each piece of "bracketed information" to understand its intent and to determine whether each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the AP1000 GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, except for the confirmatory item described above, the staff finds that Section 4.0 of the AP1000 GTS is acceptable.

16.4.5 Administrative Controls

Section 5.0 of the AP1000 GTS includes provisions which address various administrative controls related to plant key personnel responsibilities, plant procedures, special programs and reports, etc., to ensure the plant is safely operated. Changes to the AP1000 GTS, Section 5.0 are described as follows:

- In TS Section 5.4, "Procedures," the applicant proposed to adopt GL 1982-33, "Supplement 1 to NUREG-0737—Emergency Response Capabilities," dated December 17, 1982, as guidance to be used in the development of the plant emergency operating procedures. This is consistent with the STS and acceptable to the staff.

- In TS 5.5, "Programs and Manuals," and in TS 5.6, "Reporting Requirements," the applicant proposed changes to TS 5.5.4, "Steam Generator Program," and to TS 5.6.8, "Steam Generator Tube Inspection Report," to reflect the implementation of the NRC-approved TSTF-449, Revision 4. The staff finds these changes acceptable since implementing TSTF-449 is one acceptable option for addressing safety issues identified in GL 2006-001. However, since TSTF-449 was prepared to address issues involving SG replacements at current operating plants, in RAI-SRP16-CTSB-76, the staff asked the applicant to make one minor adjustment to its proposed changes in TS 5.5.4 to also accommodate SG initial installations at new nuclear power plants regarding the 100-percent tube inspection during the first refueling outage. In its response dated December 2, 2008, the applicant agreed to make the suggested adjustment in a future

DCD revision. Verification that the change is correctly incorporated in the final revision of the AP1000 DCD is CI-SRP16-CTSB-76.

- In TS 5.5.8, the applicant proposed to use the preliminary bracketed numerical values as final values for acceptance criteria used in various tests on the containment air locks. The staff finds these final selected values acceptable since they are consistent with recommendations provided in the Westinghouse STS.

- In connection to TS 3.7.6 regarding implementation of TSTF-448, Revision 3, to address safety issues identified in GL 2003-01, in RAI-SRP16-CTSB-32, the staff asked the applicant to include the description of the Control Room Habitability Program into the AP1000 GTS, Section 5.5. Discussions and closure of RAI-SRP16-CTSB-32 are addressed in subsection 16.4.3.7 above.

- Also, in TS 5.5.11, "Battery Monitoring and Maintenance Program," the applicant proposed to adopt the preliminary bracketed texts that are applicable to "vented lead-acid" batteries, as the final texts based on latest system design specifications. The staff finds this acceptable since it is consistent with recommendations provided in the Westinghouse STS.

- As stated in subsection 16.4.3.3 above, in response to RAI-SRP16.3-CTSB-SCP-1, the applicant stated that all values specified for trip setpoints and allowable values in Tables 3.3.1-1 and 3.3.2-1 will be determined via a setpoint control program (SCP) specified in Administrative Controls Section 5.5.21. This is in accordance with COL/DC-ISG-8, "Technical Specification Information that Combined License Applicants Must Provide in Combined License Application," in determining instrumentation trip setpoints and allowable values in TS. After selection of specific instrumentation, the trip setpoints can be calculated using the setpoint methodology specified in the SCP; in WCAP-16361, APP-PMS-JEP-001, Revision 0, "Westinghouse Setpoint Methodology for Protection Systems—AP1000," issued May 2006. The staff finds the applicant's response to RAI-SRP16.3-CTSB-SCP-1 acceptable. The staff received the applicant's proposed SCP in an RAI response letter dated February 19, 2010. Initally the staff found the proposed SCP unacceptable, and communicated their concerns to the applicant. On May 6, 2010, a revised program was submitted to the staff for review. The staff reviewed the revised SCP and found it to be consistent with the recommendations provided in COL/DC-ISG-8. Based on the comprehensive nature of the SCP, the staff believes a COL applicant can calculate all values necessary to complete information found in Section 3.3 of the TS. The staff will verify the proposed SCP is correctly incorporated in the final revision of the AP1000 DCD with CI-SRP16.3-CTSB-SCP-1.

The applicant adhered to the Administrative Controls information as provided in the Westinghouse STS, with differences noted above and in NUREG-1491. In addition, the AP1000 GTS, Section 5.0 contains "bracketed information" and "Reviewer's Notes." The staff reviewed each piece of "bracketed information" to understand its intent and to determine whether each was site-specific and appropriately deferred to applicants for construction permits or COLs that reference the AP1000 GTS. The staff concluded that each such item was indeed plant- or site-specific. Therefore, except for the confirmatory items described above, the staff finds that Section 5.0 of the AP1000 GTS is acceptable.

16.5 Conclusion

The NRC staff concludes that the changes to the AP1000 GTS and Bases contain design-specific parameters and additional TS requirements considered appropriate by the staff. In addition, the staff has compared the additional TS requirements to the relevant NRC regulations, acceptance criteria defined in NUREG-0800, Section 16.0, and other guidance and concludes that the application is in compliance with NRC regulations.

The confirmatory items in the following specifications need to be verified:

TS 1.1, CI-SRP16-CTSB-01
TS 1.4, CI-SRP16-CTSB-02
TS 2.1.1, CI-SRP16-CTSB-66
TS 3.1.1, CI-SRP16-CTSB-34
TS 3.1.4/8, CI-SRP16-CTSB-67
TS 3.1.4/5/6, CI-SRP16-CTSB-05
TS 3.1.7, CI-SRP16-CTSB-60
TS 3.1.8, CI-SRP16-CTSB-43
TS Bases B 3.1.8, CI-SRP16-CTSB-20
TS Bases B 3.2.3, CI-SRP16-CTSB-68
TS 3.2.5 and Bases B 3.2.5, CI-SRP16-CTSB-23
TS Table 3.3.1-1, CI-SRP16-CTSB-44
TS Table 3.3.1-1, CI-SRP16-CTSB-45
TS Table 3.3.3-1/DCD Table 7.5-1, CI-SRP16-CTSB-52
TS 3.4.1, CI-SRP16-CTSB-25
TS 3.4.4, CI-SRP16-CTSB-55
TS 3.4.6, CI-SRP16-CTSB-08
TS 3.4.11/12, CI-SRP16-CTSB-07
TS 3.4.14, CI-SRP16-CTSB-54
TS Bases B 3.6.4, CI-SRP16-CTSB-13
TS Bases B 3.6.6, CI-SRP16-CTSB-15
TS Bases B 3.6.7, CI-SRP16-CTSB-16
TS Bases B 3.6.9, CI-SRP16-CTSB-33
TS Table 3.7.1-2, CI-SRP16-CTSB-11
TS 3.7.6/5.5, CI-SRP16-CTSB-32 & CI-SRP6.4-SPCV-06
TS 4.3, CI-SRP16-CTSB-38 & CI-SRP16-CTSB-39
TS 5.5.4, CI-SRP16-CTSB-76
TS 5.5.21, CI-SRP-16.3-CTSB-SCP-1

For the reasons set forth above, and with the noted exceptions, the staff finds the changes to AP1000 FSAR, Chapter 16, GTS and Bases, are acceptable and satisfy the requirements of 10 CFR 50.36, 10 CFR 50.36a, and 10 CFR 52.47(a)(11).