



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 15, 2017

MEMORANDUM TO: Jennifer Dixon-Herrity, Chief
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Division of New Reactor Licensing
Office of New Reactors

FROM: Michael Orenak, Project Manager *ml Orenak*
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

SUBJECT: REPORT FOR THE AUDIT PERFORMED IN SUPPORT OF THE
REQUEST FOR LICENSE AMENDMENT AND EXEMPTION:
BORIC ACID STORAGE TANK

The U.S. Nuclear Regulatory Commission (NRC) staff conducted an audit of documents related to the Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3, and Vogtle Electric Generating Plant (VEGP) Units 3 and 4, combined licenses, specifically documents related to VCSNS license amendment requests (LAR) 15-11 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16273A557) and VEGP license amendment requests LAR 16-028 (ADAMS Accession No. ML14108A096). The audit was conducted from January 9-15-16, 2017, at NRC Headquarters in Rockville, Maryland.

The plan for this audit is documented and can be found in ADAMS under Accession No. ML17009A350. A summary of the audit is enclosed.

Docket Nos.: 52-025 and 52-026
52-027 and 52-028

Enclosure:
As stated

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(Revised 02/24/2017)

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REGULATORY AUDIT REPORT
REGARDING CHANGES TO THE BORIC ACID STORAGE TANK
SOUTHERN NUCLEAR OPERATING COMPANY
VOGTLE ELECTRIC GENERATING PLANT, UNITS 3 AND 4
DOCKET NO. 52-025 AND 52-026
AND
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
VIRGIL C. SUMMER NUCLEAR STATION, UNITS 2 AND 3
DOCKET NOS. 52-027 AND 52-028

1.0 INTRODUCTION

By letter dated September 29, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16273A557), South Carolina Electric and Gas Company (SCE&G, the licensee), submitted a license amendment request (LAR) 15-11, "Request for License Amendment and Exemption: Boric Acid Storage Tank Suction Point ITAAC Changes," in which it proposed changes to the Virgil C. Summer Nuclear Station, Units 2 and 3 (Summer) Updated Final Safety Analysis Report (UFSAR) in the form of departures from a plant-specific Design Control Document (PS-DCD) Tier 2 figure and a COL Appendix C table. Specifically, this LAR proposes changes to the boric acid storage tank (BAST) suction point. The LAR also proposes changes the Tier 1 Chemical and Volume Control System (CVS) makeup flow rate to agree with previously approved Tier 2 information.

During the review of the LAR, the U.S. Nuclear Regulatory Commission (NRC) staff identified the need for additional information regarding the changes to the BAST and the anti-vortex device to complete its evaluation of the proposed changes. The NRC staff determined that an audit of the reports and calculations supporting these LARs was the appropriate method to verify that the proposed changes align with the requirements in the inspections, tests, analyses, and acceptance criteria (ITAAC) and the underlying Tier 2 descriptions and analyses.

Although this audit report is in regard to LAR 15-11 submitted by SCE&G, the audit results are also applicable to a similar request submitted on October 26, 2016, by Southern Nuclear Operating Company (SNC) for the Vogtle Electric Generating Plant (Vogtle), Units 3 and 4, in LAR-16-028 (ADAMS Accession No. ML16300A325). Therefore, this audit report presents a summary of the NRC staff's findings concerning the audit in support of the safety review for Summer LAR 15-11 and Vogtle LAR-16-028.

2.0 AUDIT ACTIVITIES AND OBSERVATIONS

The areas of focus for this regulatory audit were the information and associated supporting documentation used by the licensee for the analysis presented in Summer LAR 15-11 and Vogtle LAR-16-028. The audit was conducted and completed through several reviews of the documents via the Westinghouse Electric Company (WEC) electronic reading room during the weeks of January 9 and 16, 2017, culminated by an audit exit conference call with the licensee on January 23, 2017. The NRC staff's audit plan is available at ADAMS Accession No. ML17009A350.

2.1 Overview

Title 10 of the *Code of Federal Regulations* (CFR), Section 52.98(f), specifies that any modification to, addition to, or deletion from the terms and conditions of a COL including any modifications to, addition to, or deletion from the ITAAC contained in the license is a proposed amendment to the license. In LAR 15-11, the licensee proposes changes to Summer, Units 2 and 3, COL Appendix C ITAAC, with corresponding changes to the associated plant-specific DCD Tier 1 information. In LAR-16-028, SNC proposes similar changes for Vogtle Units 3 and 4. Therefore, NRC approval is required prior to making the plant-specific proposed changes described in Summer LAR 15-11 and Vogtle LAR-16-028.

General Design Criterion (GDC) 29 in Appendix A to 10 CFR Part 50 requires that reactivity control systems be designed to assure an extremely high probability of accomplishing their safety functions in the event of anticipated operational occurrences. Portions of the CVS are relied upon to provide negative reactivity addition and assure that specified acceptable fuel design limits (SAFDLs) will not be exceeded. The NRC Standard Review Plan Section 9.3.4, "Chemical and Volume Control System (PWR) (Including Boron Recovery System)," (ADAMS Accession No. ML070160660) provides guidance for the NRC staff review of license applications regarding GDC 29 by specifying that the amount of boric acid stored in the CVS, such as a BAST, exceeds the amount required to borate the reactor coolant system to cold shutdown concentration, assuming that the control rod assembly with the highest reactivity worth is held in the fully withdrawn position, and to compensate for subsequent xenon decay during any part of core life.

As described in Section 9.3.6 of the Final Safety Evaluation Report related to certification of the AP1000 standard plant design (NUREG-1793, Volume 2, Supplement 2, ADAMS Accession No. ML11293A073), the NRC staff evaluated the BAST increase in the usable volume of the tank from 264,979 liters (L) to 278,285 L (70,000 to 73,515 gallons). The increased BAST volume would accommodate Summer, Units 2 and 3, shutting down from 100 percent power to Mode 6, plus the volume needed for normal operation and operating margin. The increased volume was calculated with updated inputs that more accurately represent the AP1000 design.

As part of the proposed changes, the licensee requests to relocate the inlet/outlet line for the BAST from the bottom of the tank to the side of the tank. The new piping line would also use a "gooseneck" piping configuration with an anti-vortex device in the tank nozzle to minimize the unusable tank volume (see revised UFSAR Figure 9.3.6-1, Sheet 2 of 2, provided in the LAR). However, the LAR did not provide the revised effective BAST volume and the basis for this volume between the internal elevations of the new suction inlet to the tank overflow. Rather, the LAR states that the usable BAST volume would be reduced by approximately 600 gallons.

Additionally, the LAR does not address how the gooseneck piping arrangement and the anti-vortex device (and its location) would prevent the potential negative effects on the CVS system once the BAST level decreases to the internal elevation of the suction inlet, resulting in gas entrainment into the CVS piping.

The NRC staff followed the Office of New Reactors Office Instruction NRO-REG-108, Revision 0, "Regulatory Audits," (ADAMS Accession No. ML081910260) to perform the audit of the reports and calculations supporting Summer LAR 15-11 and Vogtle LAR-16-028.

2.2 Audit Observations and Evaluation

The primary scope of the audit was to review the reports and calculations that support the proposed changes to the BAST suction line in Summer LAR 15-11. The specific tasks performed during the audit were:

1. Obtain sufficient information on the BAST to determine the available volume, accounting for the revised suction line configuration.
2. Obtain the dimensions including pipe lengths, bends or elbows and the pipe schedule for the gooseneck piping configuration inside the BAST.
3. For the anti-vortex device to be installed in the suction line to the CVS makeup pumps, obtain (a) a description of the anti-vortex device, (b) its material, structural, and performance characteristics, (c) quality assurance provisions, (d) the dynamic, functional, and environmental provisions, and (e) the testing plans for the CVS makeup pumps that demonstrate that they are capable of performing their intended functions with the anti-vortex device in the suction line.
4. Review the analysis of the expected operational performance of the CVS once the BAST level reaches the lowest water level elevation in relationship to the new suction point, with specific consideration for gas entrainment into the CVS. Review the description regarding how the gooseneck piping arrangement is expected to mitigate gas entrainment and the formation of a vortex inside the BAST.

The following documents were made available to the NRC staff for review during the audit either directly or in the WEC electronic reading room:

1. WEC AP1000 Calculation APP-CVS-M3C-065, "Chemical and Volume Control System (CVS) Boric Acid Storage Tank (BAST) Suction Nozzle Submergence Evaluation," Revision 1, dated September 6, 2016.
2. WEC AP1000 Drawing APP-MT5A-V0-001, "MT5A CVS Boric Acid Storage Tank Envelope Drawing," Revision 2, dated June 2, 2014.
3. WEC AP1000 Calculation APP-CVS-M3C-002, "Chemical and Volume Control System (CVS) Boric Acid Storage Tank Sizing," Revision 2, dated April 1, 2011.
4. WEC AP1000 Design Specification APP-MT50-Z0-100, "Design Specification for CVS Boric Acid Storage Tank for CVS System," Revision 0, dated June 18, 2014.

5. WEC AP1000 Engineering & Design Coordination Report (E&DCR) No. APP-MT50-GEF-004, "MT50 Design Specification, Data Sheet Report, and Envelope Drawing Modification," Revision 0, dated June 13, 2014.
6. American Petroleum Institute (API) Standard 650, "Welded Steel Tanks for Oil Storage," Seventh Edition, dated November 1980, Revision 1, dated February 1984.

2.2.1 Evaluation of the Available BAST Volume and Operational Performance

The NRC staff examined the reports and calculations relating to evaluating the operational BAST volume in support of the ITAAC criteria of having at least 70,000 gallons available. The documents reviewed for this information were Revision 1 of WEC AP1000 Calculation APP-CVS-M3C-065, Revision 2 of WEC AP1000 Drawing APP-MT5A-V0-001, and Revision 2 of WEC AP1000 Calculation APP-CVS-M3C-002. The review included the assumptions, operational requirements (e.g., CVS flow of 175 gallons per minute (gpm) in the ITAAC criteria and the prevention of gas entrainment into the CVS suction line), and the tank dimensions applied in the analysis.

WEC AP1000 Calculation APP-CVS-M3C-002 provided the calculations for demonstrating during the design certification review the sizing of the BAST would support the operational requirements of a useable volume of 70,000 gallons at a CVS suction flow of 175 gpm. WEC AP1000 Drawing APP-MT5A-V0-001 is the updated drawing with the revised CVS suction line configuration being proposed in the Summer LAR 15-11 and the Vogtle LAR-16-028. WEC AP1000 Calculation APP-CVS-M3C-065 determined the minimum submergence level in the BAST that would satisfy the operational requirements for the BAST utilizing information provided in WEC AP1000 Calculation APP-CVS-M3C-002 and Drawing APP-MT5A-V0-001. The key portion of the updated analysis in WEC AP1000 Drawing APP-CVS-M3C-065 was to ensure there would be a minimum level of fluid in the BAST above the suction nozzle to prevent air from being pulled into the CVS pump suction line. This calculation determined that a vortex breaker (or anti-vortex device) was necessary to be on the suction nozzle to meet the requirements of a useable volume of 70,000 gallons with sufficient submergence level to prevent air entrainment into the suction line.

The NRC staff confirmed that the results of the licensee's analysis adequately demonstrated that the BAST, as designed, would support the ITAAC criteria of 70,000 gallons with sufficient tank level remaining to prevent the occurrence of gas entrainment.

2.2.2 Evaluation of the Anti-Vortex Device

The NRC staff examined the reports and calculations related to the anti-vortex device (also referred to as a vortex breaker or collar) to be installed in the suction line to the CVS makeup pumps. The NRC staff found that the design of the anti-vortex device is indicated in WEC AP1000 Calculation APP-CVS-M3C-065 as a cross pattern of 0.25" plate welded to the vertical suction pipe. The installation of the anti-vortex device is specified in WEC AP1000 Drawing APP-MT5A-V0-001 with its location in the letdown line of the BAST. WEC AP1000 Design Specification APP-MT50-Z0-100 establishes the minimum requirements for the design, materials, fabrication, erection, inspection, testing, and documentation for the BAST for the CVS system, including the vortex breaker.

WEC AP1000 Design Specification APP-MT50-Z0-100 indicates that the BAST is an AP1000 Equipment Class D component that is nonsafety-related. The design specification notes that the quality assurance requirements in 10 CFR Part 50, Appendix B, are not applicable to the BAST. However, the design specification requires that API Standard 650 be implemented to provide assurance of the quality of the BAST, including the anti-vortex device. The NRC staff examined API Standard 650 and found that it provides specifications for the material, design, fabrication, erection, and testing requirements for welded steel tanks for various sizes and capacities. In addition, API Standard 650 includes provisions for welding, inspection, and qualification of welders.

WEC AP1000 Design Specification APP-MT50-Z0-100 requires that the environmental conditions for the BAST satisfy the WEC AP1000 Data Sheet Report APP-MT50-Z05-100. The NRC staff audited the WEC AP1000 E&DCR No. APP-MT50-GEF-004 that provided a markup of WEC AP1000 Design Specification APP-MT50-Z0-100 with the environmental conditions for the BAST that will be used to prepare the Data Sheet Report. The NRC staff finds that the specification of the environmental conditions for the BAST to be acceptable to support the LARs.

The NRC staff discussed the operation of the CVS pumps with licensee personnel. PS-DCD Tier 2, Section 14.2.9.2.3, "Chemical and Volume Control System Testing," states that the purpose of the CVS testing is to verify that the as-installed system properly performs defense-in-depth functions described in Section 9.3.6, "Chemical and Volume Control System," and the appropriate design specifications. Section 9.3.6.6.1.2, "Flow Testing," in the PS-DCD Tier 2 states that the CVS is tested to measure the flow rate from each makeup pump to the reactor coolant system with the suction aligned from the BAST. The testing will confirm the minimum flow capability from each CVS pump, and the maximum allowed makeup flow from both pumps. The NRC staff finds the CVS testing plans to be acceptable to support these LARs.

2.2.3 Results of the Audit

The NRC staff audited the documents supporting the proposed changes to the UFSAR for the departure in the DCD Tier 2 figure and a COL Appendix C table along with ITAAC changes to align Tier 1 CVS makeup flow rate with the approved Tier 2 information. The NRC staff found that the audited documents provide the necessary information to complete the four audit tasks listed in Section 2.2 of this audit report, and that the proposed changes align with the ITAAC requirements and the underlying Tier 2 descriptions and analyses.

3.0 CONCLUSION

The NRC staff concludes that the licensees have provided the necessary documentation concerning the design, materials, fabrication, erection, inspection, and testing, and documentation in support of the design changes for the BAST and the CVS system, including the vortex breaker, to support the NRC staff's review of the Summer LAR 15-11 and Vogtle LAR-16-028.

The NRC staff discussed these conclusions with the licensee in an audit exit conference call on January 23, 2017.

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REPORT FOR THE AUDIT PERFORMED IN SUPPORT OF THE REQUEST FOR LICENSE AMENDMENT AND EXEMPTION: BORIC ACID STORAGE TANK DATED MARCH 15, 2017.

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