SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS

RELATED TO AMENDMENT NO. 57

TO THE COMBINED LICENSE NOS. NPF-93 AND NPF-94

SOUTH CAROLINA ELECTRIC & GAS COMPANY

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

VIRGIL C. SUMMER NUCLEAR STATION UNITS 2 AND 3

DOCKET NOS. 52-027 AND 52-028

1.0 INTRODUCTION

By letter dated May 12, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16172A194), South Carolina Electric & Gas Company, on behalf of itself and the South Carolina Public Service Authority (hereafter referred to as the licensee) requested that the U.S. Nuclear Regulatory Commission (NRC or Commission) amend the combined licenses (COL) for Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3, COL Nos. NPF-93 and NPF-94, respectively. By email dated May 27, 2016 (ADAMS Accession No. ML16148A538), the NRC provided the licensee with the results of the staff's acceptance review of license amendment request (LAR) 14-12, which concluded that the LAR is sufficient for the staff to perform the detailed technical review.

The proposed license amendment would change the listed minimum volume of the passive core cooling system core makeup tanks (CMTs) as reflected in the combined license (COL) Appendix A, Technical Specifications (TS), and Updated Final Safety Analysis Report (UFSAR) for VCSNS Units 2 and 3. Specifically, this amendment is a departure from the generic AP1000 Design Control Document (DCD) Tier 2 information as implemented in the plant-specific UFSAR, changing the minimum CMT volume from 2,500 ft^3 to 2,487 ft^3. SCE&G seeks the change to resolve an inconsistency in the licensing documents by aligning the listed minimum CMT volume with that provided in the VCSNS COL Tier 1 information. The licensee stated this change is based on and supported by a small-break loss-of-coolant accident (SBLOCA) safety analysis. No changes are proposed to COL Tier 1 information. In addition, the licensee proposed an addition to the TS Bases stating that the volume of one CMT is adequate for safety injection in the case of a SBLOCA.

1.1 Content of LAR 14-12

The LAR letter has three enclosures. Enclosure 1, "Request for Licensing Amendment Regarding Core Makeup Tank Volume Inconsistency," contains a summary description of the LAR, a detailed description of the changes, technical and regulatory evaluations for the proposed changes, environmental considerations, and applicable references. Enclosure 2, "Proposed Changes to Licensing Basis Documents," provides a markup indicating the licensee's

proposed changes to affected TS and UFSAR pages. Enclosure 3, "Conforming Technical Specifications Bases Changes (For Information Only)," provides a markup of the affected TS Bases pages.

2.0 REGULATORY EVALUATION

Under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Appendix D, "Design Certification Rule for the AP1000 Design," Section VIII.C.6, changes to plant-specific TS, such as the departure from the minimum volume of CMTs at issue, are treated as license amendments under 10 CFR Part 50.90. The NRC staff considered the following regulatory requirements and guidance in reviewing the licensee's LAR:

- 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-water Nuclear Power Reactors," prescribes acceptance criteria for emergency core cooling system (ECCS) and requirements for evaluation models.

- 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 34, "Residual Heat Removal," requires a residual heat removal (RHR) system that is capable of transferring fission product decay heat and other residual heat from the reactor core at a rate such that specified acceptable fuel design limits and the design conditions of the reactor coolant pressure boundary are not exceeded.

- GDC 35, "Emergency Core Cooling," requires a system to provide abundant emergency core cooling whose safety function is to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.

- GDC 36, "Inspection of Emergency Core Cooling System," requires the ECCS be designed to permit appropriate periodic inspection of important components.

- GDC 37, "Testing of Emergency Core Cooling System," requires that the ECCS be designed to permit appropriate periodic pressure and functional testing.

- 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," prescribes required and acceptable features of evaluation models as well as required documentation.

In addition, Section 182a. of the Atomic Energy Act (the Act) requires that applicants for nuclear power plant operating licenses will state:

> [S]uch 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 Commission established its regulatory requirements related to the content of TS. In doing so, the Commission 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 FR 18610, December 17, 1968), the Commission 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." Pursuant to 10 CFR 50.36, TS for nuclear reactors are required to include items in the following categories: (1) safety limits and limiting safety system settings; (2) limiting conditions for operation (LCO); (3) surveillance requirements (SR); (4) design features; and (5) administrative controls. However, the rule does not specify the particular requirements to be included in a nuclear reactor plant's TS.

On February 6, 1987, the Commission issued an interim policy statement (IPS) on TS improvements, "Interim Policy Statement on Technical Specification Improvements for Nuclear Power Reactors" (52 FR 3788). From 1989 to 1992, industry pressurized water reactors (PWR) and boiling water reactors (BWR) owners groups and the NRC staff developed improved standard TS (STS) (e.g., NUREG-1431, "Standard Technical Specifications, Westinghouse Plants") that would establish model TS based on the Commission's policy for each primary reactor type. In addition, representatives from the NRC, nuclear reactor plant licensees, and industry owners groups developed generic administrative and editorial guidelines in the form of a writer's guide for preparing TS (most recently issued in June 2005 as TSTF-GG-05-01, Revision 1), which gives appropriate consideration to human factors engineering principles and was used throughout the development of plant-specific improved TS (ITS).

In September 1992, the Commission issued NUREG-1431, "Standard Technical Specifications, Westinghouse Plants," Revision 0, which was developed using the guidance and criteria contained in the Commission's IPS. The STS in NUREG-1431 were established as a model for developing plant-specific ITS for Westinghouse plants, in general. The STS reflect the results of a detailed review of the application of the IPS criteria, which have been incorporated in 10 CFR 50.36(c)(2)(ii), to generic system functions, which were published in a "split report" issued to the PWR and BWR 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 LCO 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 NUREG-1431 provide an abundance of information regarding the extent to which the STS present requirements that are necessary to protect public health and safety.

On July 22, 1993, the Commission issued its final policy statement, expressing the view that satisfying the guidance in the policy statement also satisfies Section 182a. of the Act and 10 CFR 50.36. The final policy statement described the safety benefits of the STS and encouraged licensees to use the STS as the basis for plant-specific TS amendments and for complete conversions to ITS based on the STS. In addition, the final policy statement gave guidance for evaluating the required scope of the TS and defined the guidance criteria to be used in determining which of the LCOs and associated SRs should remain in the TS. The Commission noted that, in allowing certain items to be relocated to licensee-controlled documents while requiring that other items be retained in the TS, it was adopting the qualitative standard enunciated by the Atomic Safety and Licensing Appeal Board in *Portland General Electric Co.* (Trojan Nuclear Plant), ALAB-531, 9 NRC 263, 273 (1979). There, the Appeal Board observed:

> [T]here is neither a statutory nor a regulatory requirement that every operational detail set forth in an applicant's safety analysis report (or equivalent) be subject to a technical specification, to be included in the license as an absolute condition of operation which is legally binding upon the licensee unless and until changed with specific Commission approval. Rather, as best we can discern it, the contemplation of both the Act and the regulations is that technical specifications are to be reserved for those matters as to which the imposition of rigid conditions or limitations upon reactor operation is deemed necessary to obviate the possibility of an abnormal situation or event giving rise to an immediate threat to the public health and safety.

By this approach, existing LCO requirements that fall within or satisfy any of the criteria in the final policy statement should be retained in the TS; those LCO requirements that do not fall within or satisfy these criteria may be relocated to licensee-controlled documents. The Commission codified the four criteria in 10 CFR 50.36 (60 FR 36953, July 19, 1995). The four criteria, as stated in 10 CFR 50.36(c)(2)(ii) subparagraphs (A), (B), (C), and (D), are as follows:

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.

Criterion 2 — A process variable, design feature, or operating restriction that is an initial condition of a design basis accident 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 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 — A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.

The CMTs satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

The technical evaluation explains the NRC staff's review of the proposed changes of the VCSNS TS based on STS for consistency with the VCSNS licensing basis documents, the requirements and guidance of the final policy statement, and 10 CFR 50.36.

3.0 TECHNICAL EVALUATION

In its review of LAR 14-12, the NRC staff evaluated the proposed changes to the TS and the UFSAR against the regulatory requirements identified in Section 2.0 of this safety evaluation. The staff also reviewed the proposed changes to the TS Bases for consistency with the proposed changes to the TS. The proposed changes and the staff's evaluation are discussed below.

3.1 Proposed Changes

3.1.1 Proposed Changes to the TS

TS 3.5.2, "Core Makeup Tanks (CMTs) – Operating," includes SR 3.5.2.2, which requires verification that the borated water volume in each CMT is greater than or equal to a specified volume every seven days. LAR 14-12 proposes to change that minimum volume from 2,500 ft^3 to 2,487 ft^3.

3.1.2 Proposed Changes to the TS Bases

LAR 14-12 proposes to add the following text to the "Applicable Safety Analyses" portion of Bases 3.5.2: "In the case of a small break LOCA, the borated water volume of one CMT is adequate for reactor coolant system (RCS) safety injection, where one CMT completely spills via the pipe break."

3.1.3 Proposed Changes to the UFSAR

LAR 14-12 proposes to change the minimum CMT volume from 2,500 ft^3 to 2,487 ft^3 in the following UFSAR locations:

- Section 5.4.13.2, "Design Description"
- Table 6.3-2, "Component Data – Passive Core Cooling System"
- Table 14.3-2, "Design Basis Accident Analysis"

3.2 Evaluation of Proposed Changes

3.2.1 Overall Evaluation of Proposed Changes

The VCSNS Units 2 and 3 UFSAR consists of the information incorporated by reference from the AP1000 DCD, Revision 19, along with VCSNS site-specific information, including supplements and departures from the generic AP1000 DCD. Similarly, the VCSNS Units 2 and 3 TS, which were issued with the VCSNS COLs, consist of the AP1000 generic TS (DCD Tier 2, Chapter 16, Revision 19) and the VCSNS site-specific TS. The AP1000 generic TS were modeled after Revision 2 of NUREG-1431, dated June 30, 2001, and were incorporated by reference into the VCSNS plant-specific TS.

The AP1000 design includes two CMTs as part of the passive core cooling system, which serves as the ECCS for the AP1000. The CMTs store borated water for high pressure reactor coolant makeup. The CMT inlet nozzle is connected to cold leg piping, and the outlet nozzle is connected to direct vessel injection (DVI) piping. The licensee stated that the basis for the change in minimum CMT volume from 2,500 ft^3 to 2,487 ft^3 is the assumption in the SBLOCA analysis that one CMT provides adequate safety injection. According to the licensee, the value of 2,487 ft^3 was established during inspections, tests, analyses, and acceptance criteria (ITAAC) development to permit a 0.5 percent construction tolerance to the design tank volume of 2,500 ft^3 and is the minimum volume required to accomplish the CMT design function. The staff confirmed the minimum CMT volume to be 2,487 ft^3 in the AP1000 ITAAC, which the VCSNS Units 2 and 3 COLs incorporate by reference.

In addition, the licensee stated that the safety analyses were performed with a CMT volume of 2,500 ft^3 or greater except for the SBLOCA analyses, which assumed a CMT volume of

2,487 ft^3. To ensure no impacts to the ECCS functions required by 10 CFR 50.46 and GDC 35 or RHR functions required by GDC 34, the staff verified that the assumptions made in the AP1000 transient and accident analyses are valid and conservative relative to a minimum CMT volume of 2,487 ft^3.

The CMTs provide RCS makeup and boration for non-LOCAs when normal makeup is not available or insufficient. During non-LOCAs involving RCS heatup or inventory increase, the CMTs primarily provide cooldown and decay heat removal capability. The larger CMT volume is conservative for these cases because the additional volume that may be added to the RCS makes pressurizer overfill more likely. For non-LOCAs that involve RCS cooldown, the major function of the CMTs is to provide borated water to mitigate the reactivity transient due to a negative moderator temperature coefficient. The licensee stated that CMT volume is not a critical parameter to shutdown margin for these events. The staff agrees, noting that the change in boron worth due to a 0.5 percent smaller CMT volume is small enough to be negligible.

The purpose of the CMTs during LOCAs is to provide borated makeup water to the RCS. During large-break LOCAs (LBLOCAs), the core depressurizes rapidly enough to allow injection from lower-pressure makeup sources. In contrast, SBLOCAs move much more slowly, so not all ECCS features are available to mitigate the SBLOCA due to slower depressurization. Therefore, the staff agrees with the licensee's statement that the analyses most affected by CMT volume are the SBLOCA analyses. The staff confirmed that the SBLOCA analyses include a double-ended rupture of the DVI line, which shows that only one CMT - and only half of the ECCS - is sufficient to mitigate the SBLOCA. However, the staff was unable to verify the licensee's claim that the CMT volume assumed for the SBLOCA analyses is 2,487 ft^3. As a result, the staff audited an SBLOCA calculation note on June 22, 2016, and confirmed, as documented in the Audit Plan and Audit Report for Vogtle and Summer (WEC83) Core Makeup Tank Volume Inconsistency (ADAMS Accession No. ML16179A342), that the SBLOCA analyses conservatively incorporate a CMT volume of 2,487 ft^3.

The licensee stated in its license amendment request that, for LBLOCAs, assuming a smaller CMT volume would not have an effect on peak cladding temperature (PCT). The staff noted that the LBLOCA analysis in the AP1000 DCD shows that, while the CMTs inject for a very short time at the beginning of the transient, they do not begin injecting again until long after PCT occurs. Therefore, the staff agrees that modeling a slightly smaller CMT volume would not affect the LBLOCA analysis. The staff also considered the impacts of a slightly smaller assumed CMT volume on long-term cooling following a LBLOCA. The staff concludes that the reduction in containment floodup level would be negligible; as a result, there would be no adverse impacts on long-term cooling analyses.

During a steam generator tube rupture, the CMT plays a role, along with the passive RHR heat exchanger, startup feedwater, and chemical and volume control system, to remove decay heat for RCS cooldown and depressurization. The staff concludes that modeling a 0.5 percent smaller CMT volume would have a negligible impact on RCS cooldown and depressurization due to the other systems that also provide heat sink functions.

Regarding containment peak pressure analyses, the staff notes that modeling a larger CMT volume is conservative since it leads to greater mass and energy release into containment. Therefore, the staff concludes that the current containment peak pressure analyses bound a 0.5 percent smaller CMT volume.

In conclusion, the staff finds that the existing transient and accident analyses are consistent with or are conservative with respect to a CMT volume of 2,487 ft^3. Based on this, the staff concludes that the proposed changes continue to meet 10 CFR 50.46 with regard to ECCS performance, GDC 34, and GDC 35. In addition, the staff agrees with the licensee that no other additional corresponding changes are required related to the tank construction and design requirements; design and safety evaluation methods; tests, experiments, and procedures; inspection requirements; or ex-vessel severe accident assessment. Therefore, the staff concludes that the proposed changes meet 10 CFR 50.46 with respect to evaluation models; 10 CFR Part 50, Appendix K; and GDC 36 and 37.

3.2.2 Evaluation of Proposed TS Change

The staff evaluated the proposed change to the TS and reviewed the provided markups for completeness and accuracy. The staff noted that SR 3.5.2.2 in the AP1000 STS requires verification that the CMT volume is greater than or equal to 2,500 ft^3. However, for the reasons described above, and because the change would align the TS value with the ITAAC value, the staff finds the proposed change from 2,500 ft^3 to 2,487 ft^3 to be acceptable.

3.2.3 Review of Proposed Change to the TS Bases

The staff reviewed the proposed change to the TS Bases as well as the provided markups. The markup adds clarification to the "Applicable Safety Analyses" portion of TS Bases 3.5.2. As previously discussed, the staff confirmed that one CMT provides sufficient RCS makeup for a SBLOCA. Therefore, the staff concludes that the proposed change to the TS Bases is consistent with the proposed change to the TS.

3.2.4 Evaluation of Proposed Changes to the UFSAR

The staff evaluated the proposed UFSAR changes and the accuracy and completeness of the associated markups. For the reasons already described above, the proposed changes, in the form of departures from AP1000 DCD Tier 2 information, are technically acceptable and consistent with the Tier 1 information, and the markups accurately reflect the proposed changes. Therefore, the staff concludes that the proposed UFSAR departures are acceptable.

3.2.5 Evaluation Summary

Based on the technical evaluation of the proposed changes to the VCSNS Units 2 and 3 TS and UFSAR and the review of the proposed changes to the TS Bases above, the NRC staff concludes that the VCSNS Units 2 and 3 COLs meet the requirements of 10 CFR 50.36; 10 CFR 50.46; 10 CFR Part 50, Appendix K; and GDC 34, 35, 36, and 37. Therefore, the proposed changes to the VCSNS Units 2 and 3 TS and UFSAR are acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission regulations in 10 CFR 50.91(b), the designated South Carolina State official was notified of the proposed issuance of the amendment. The State of South Carolina had no comment.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR Part 20, *Standards for Protection Against Radiation*. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite. Also, there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (*Federal Register* dated July 5, 2016 (81 FR 43646)). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with issuing the amendment.

6.0 CONCLUSION

Based on the considerations discussed above, the staff concludes that there is reasonable assurance that (1) the proposed operation will not endanger public health and safety, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or public health and safety. Therefore, the staff finds the proposed changes to be acceptable.