

SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS  
RELATED TO EXEMPTION AND AMENDMENT NO. 54  
TO THE COMBINED LICENSE NOS. NPF-93 AND NPF-94  
SOUTH CAROLINA ELECTRIC AND 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 6, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15127A177), the South Carolina Electric & Gas Company on behalf of itself and the South Carolina Public Service Authority (both hereafter called the licensee) requested that the U.S. Nuclear Regulatory Commission (NRC) amend the combined licenses (COLs) for Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3, COL Numbers NPF-93 and NPF-94, respectively. On December 15, 2015, the licensee supplemented the request (ADAMS Accession No. ML15350A193).

The license amendment request (LAR 14-18, or LAR) would add two additional hydrogen igniters to the in-containment refueling storage tank (IRWST) roof vents. The proposed changes would also remove control of the hydrogen igniters from the protection and safety monitoring system (PMS), clarify the controls available for the hydrogen igniters at the remote shutdown workstation (RSW), and make changes to the design aspects of the hydrogen igniters to maintain consistency within various licensing documents. The requested changes are in the VCSNS Updated Final Safety Analysis Report (UFSAR) including the Tier 1 UFSAR; Tier 2 UFSAR; the COL Appendix C, Inspections, Tests, Analyses and Acceptance Criteria (ITAAC); and the VCSNS Technical Requirements Manual (TRM). Of the documents previously mentioned, only the VCSNS TRM does not require prior approval of the NRC. Changes to the VCSNS TRM are controlled under the VCSNS change control program.

The licensee also requested an exemption from the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Appendix D, "Design Certification Rule for the AP1000 Design," Section III.B, "Scope and Contents," to allow a change to the corresponding portions of the certified information in Tier 1 of the generic Design Control Document (DCD).<sup>1</sup>

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<sup>1</sup> While the licensee describes the requested exemption as being from Section III.B of 10 CFR Part 52, Appendix D, the entirety of the exemption pertains to proposed changes to Tier 1 information in the generic DCD. In the remainder of this evaluation, the NRC will refer to the exemption as an exemption from Tier 1 information to match the language of Section VIII.A.4 of 10 CFR Part 52, Appendix D, which

In order to modify the (plant-specific DCD) Tier 1 UFSAR information, the NRC must find the licensee's exemption request, included in its submittal for the LAR, to be acceptable. The staff's review of the exemption request as well as the LAR, is included in this safety evaluation.

By letter dated December 15, 2015, the licensee submitted a supplement to the request that clarified the LAR. This additional information did not expand the scope of the LAR and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on September 29, 2015 (80 FR 58519).

## 2.0 REGULATORY EVALUATION

As stated in 10 CFR Part 52, Appendix D, Section VIII.B.5.a, a licensee who references this appendix may depart from Tier 2 information without prior NRC approval unless the proposed departure involves a change to or departure from Tier 1 information, Tier 2\* information, or the Technical Specifications or requires a license amendment under paragraphs B.5.b or B.5.c of this section.

As stated in 10 CFR Part 52, Appendix D, Section VIII.A.4, exemptions from Tier 1 information are governed by the requirements in 10 CFR 52.63(b)(1) and 10 CFR 52.98(f). Additionally, the Commission will deny a request for an exemption from Tier 1 if it finds that the design change will result in a significant decrease in the level of safety otherwise provided by the design.

According to 10 CFR 52.63(b)(1), a licensee who references a design certification rule may request NRC approval for an exemption from one or more elements of the certification information. The Commission may grant such a request only if it determines that the exemption will comply with the requirements of 10 CFR 52.7, which in turn points to the requirements listed in 10 CFR 50.12 for specific exemptions, and if the special circumstances present outweigh the decrease in safety due to reduction in standardization caused by the exemption. Therefore, any exemption from the Tier 1 information certified by Appendix D to 10 CFR Part 52 must meet the requirements of 10 CFR 50.12, 52.7 and 52.63(b)(1).

According to 10 CFR 52.98(f), any modification to, addition to, or deletion from the terms and conditions of a COL is a proposed amendment to the license.

10 CFR 50.44, "Combustible Gas Control for Nuclear Power Reactors" requires, in relevant part, that the licensee demonstrate capability of the steel containment of existing plants and new plants to resist those loads associated with combustible gas generation from a metal-water reaction of the fuel cladding so that there is no loss of containment structural integrity.

10 CFR 50.55a(h)(3), "Safety Systems" requires, in relevant part, that applications filed on or after May 13, 1999, for a COL comply with Institute of Electrical and Electronics Engineers (IEEE) Standard 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations" and the correction sheet dated January 30, 1995.

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specifically governs the granting of exemptions from Tier 1 information.

### 3.0 TECHNICAL EVALUATION

#### 3.1 EVALUATION OF EXEMPTION

Section III.B of Appendix D to 10 CFR Part 52 requires a holder of a COL referencing Appendix D to 10 CFR Part 52 to incorporate by reference and comply with the requirements of Appendix D, including certified information in Tier 1 of the generic AP1000 DCD. As defined in Section II of Appendix D to 10 CFR Part 52, Tier 1 information includes ITAAC and design descriptions, among other things. Therefore, a licensee referencing Appendix D incorporates by reference Tier 1 information contained in the generic DCD. The Tier 1 ITAAC and design descriptions, along with the plant-specific ITAAC, were included in Appendix C of the COL at its issuance.

The licensee requests changes to Tier 1 information by departing from the description of the containment hydrogen igniters in the plant-specific DCD. An exemption is needed because Section VIII.A.4 of Appendix D to 10 CFR Part 52 requires a licensee to obtain an exemption to depart from the Tier 1 information of the generic AP1000 DCD. The end result of this exemption would be that the licensee can implement modifications to Tier 1 information described and justified in LAR 14-18 if and only if the NRC approves LAR 14-18. This exemption is permanent and limited in scope to the particular Tier 1 information specified.

As stated in Section VIII.A.4 of Appendix D to 10 CFR Part 52, an exemption from Tier 1 information is governed by the requirements of 10 CFR 52.63(b)(1) and 52.98(f). Additionally, the Commission will deny a request for an exemption from Tier 1 if it finds that the requested change will result in a significant decrease in the level of safety otherwise provided by the design. Pursuant to 10 CFR 52.63(b)(1), the Commission may, upon application by an applicant or licensee referencing a certified design, grant exemptions from one or more elements of the certification information, so long as the criteria given in 10 CFR 52.7 and 50.12 are met, and that the special circumstances as defined by 10 CFR 50.12(a)(2) outweigh any potential decrease in safety due to reduced standardization.

Pursuant to 10 CFR 52.7, the Commission may, upon application by any interested person or upon its own initiative, consider exemptions from the requirements of 10 CFR Part 52. As 10 CFR 52.7 further states, the Commission's consideration will be governed by 10 CFR 50.12, "Specific exemptions," which states that an exemption may be granted when: (1) the exemptions are authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security; and (2) special circumstances are present. Specifically, 10 CFR 50.12(a)(2) lists six special circumstances for which an exemption may be granted. It is necessary for one of these special circumstances to be present in order for the NRC to consider granting an exemption request. The licensee stated that the requested exemption meets the special circumstances of 10 CFR 50.12(a)(2)(ii). That subsection defines special circumstances as when "[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The staff's analysis of each of these findings is presented below.

##### 3.1.1 AUTHORIZED BY LAW

This exemption would allow the licensee to implement approved changes to Tier 1 of the plant-specific DCD, specifically the information related to hydrogen igniters as described in LAR 14-18. This exemption is permanent and limited in scope to particular Tier 1 information. Subsequent changes to Tier 1 information related to hydrogen igniters, or any other Tier 1 information, would be subject to the exemption process specified in Section VIII.A.4 of

Appendix D to 10 CFR Part 52. The NRC staff has determined that granting of the licensee's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations because, as stated above, 10 CFR Part 52, Appendix D, Section VIII.A.4 allows the NRC to grant exemptions from one or more elements of the Tier 1 information. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the exemption is authorized by law.

### 3.1.2 NOT PRESENT AN UNDUE RISK TO PUBLIC HEALTH AND SAFETY

Appendix D to 10 CFR Part 52 requires that the licensee construct and operate the plant based on the approved information found in the DCD incorporated by reference into the licensee's licensing basis. The changes proposed in the LAR will not impact any design function. There is no change to plant systems or the response of systems to postulated accident conditions. There is no change to the predicted radioactive releases due to postulated accident conditions. Furthermore, the plant response to previously evaluated accidents or external events is not adversely affected, and the change described does not create any new accident precursors. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the exemption poses no undue risk to the public health and safety.

### 3.1.3 CONSISTENT WITH COMMON DEFENSE AND SECURITY

The proposed exemption would allow changes to elements of Tier 1 of the plant-specific DCD. This exemption is permanent and limited in scope to particular Tier 1 information. Subsequent changes to Tier 1 information related to hydrogen igniters, or any other Tier 1 information, would be subject to the exemption process in Section VIII.A.4 of Appendix D to 10 CFR Part 52. The proposed changes do not alter the design, function, or operation of any structures or plant equipment that is necessary to maintain a safe and secure plant status. In addition, the changes have no impact on plant security or safeguards. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the common defense and security is not impacted by this exemption.

### 3.1.4 SPECIAL CIRCUMSTANCES

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. The underlying purpose of the Tier 1 information is to ensure that the licensee will safely construct and operate the plant based on the certified information found in the AP1000 DCD, which was incorporated by reference into the licensee's licensing basis. The proposed changes in Tier 1 of the plant-specific DCD changes the information related to hydrogen igniters and maintains the design functions of the hydrogen ignition subsystems. These changes do not negatively impact safety or impact the ability of any structures, systems, or components to perform their functions. These changes will enable the licensee to safely construct and operate the AP1000 facility consistent with the design certified by the NRC by updating information related to hydrogen igniters in Tier 1 of the plant-specific DCD. Therefore, because the application of the specified Tier 1 information in this circumstance does not serve the underlying purpose of the rule, the staff finds that the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from the Tier 1 information exist.

### 3.1.5 SPECIAL CIRCUMSTANCES OUTWEIGH REDUCED STANDARDIZATION

This exemption would allow the implementation of changes to the information related to hydrogen igniters in Tier 1 of the plant-specific DCD, as proposed in the LAR 14-18. The design functions of the systems associated with this request will continue to be maintained. Therefore, the standardization inherent in the systems within scope of the certified design is not affected. Based on this, as required by 10 CFR Part 52.63(b)(1), the staff finds that the special circumstances outweigh the effects the departure has on the standardization of Tier 1 documentation associated with the AP1000 design.

### 3.1.6 NO SIGNIFICANT REDUCTION IN SAFETY

This exemption would allow the implementation of changes to information related to hydrogen igniters in Tier 1 of the plant-specific DCD, as proposed in the LAR 14-18. The changes do not affect any safety-related equipment or function, and the design function of the hydrogen ignition subsystem continues to be met. Therefore, as required by Section VIII.A.4 of Appendix D to 10 CFR Part 52, the staff finds that granting the exemption would not result in a significant decrease in the level of safety otherwise provided by the design.

## 3.2 EVALUATION OF PROPOSED CHANGES

### 3.2.1 Addition of Two Hydrogen Igniters

In the certified AP1000 design, the hydrogen ignition subsystem presently consists of 64 hydrogen igniters strategically distributed throughout the containment. The number of hydrogen igniters and their locations are selected considering the behavior of hydrogen in the containment during severe accidents. The hydrogen igniter siting criteria are found in DCD Table 6.2.4-6, "Igniter Location." In order to control hydrogen releases within and out of the IRWST, igniters are installed inside and outside the IRWST, at or near the IRWST vent locations. After the AP1000 design was certified, Westinghouse Engineering Company (WEC) performed a design review and recommended adding two additional igniters above the IRWST vents, as close as practical to the vents, to better satisfy the certified siting criteria. In LAR 14-18, SCE&G requested to add two hydrogen igniters to the AP1000 design, to be located above the IRWST vents at the VCSNS, Units 2 and 3. The number, location, and ITAAC of the hydrogen igniters are specified in the AP1000 DCD Tier 1, Chapter 2, Table 2.2.3-6, Table 2.3.9-2, and Table 2.3.9-3, respectively.

For the AP1000 certified design, the hydrogen combustion analysis to investigate the potential for deflagration to detonation transition (DDT) was evaluated using cell width methodology, relying in particular on the method of Sherman and Berman (NUREG/CR-4803, "The Possibility of Local Detonations During Degraded Core Accidents in the Bellefonte Nuclear Power Plant," January 1987). This analysis methodology and associated results are described in DCD Tier 2, Section 19.41.

For the addition of the two new igniters near the IRWST vents, the staff was under the impression that WEC had reevaluated the potential for DDT in or near the IRWST. The staff believed this revised combustion analysis used the cell width methodology as seen in the Organization for Economic Co-operation and Development (OECD) State-of-the-Art Report (SOAR) "Flame Acceleration and Deflagration-to-Detonation Transition in Nuclear Safety" (W. Breitung, C. Chan, S. B. Dorofeev, et al., NEA/CSNI/R(2000)7, August 2000) instead of the Sherman and Berman cell width methodology.

In order to verify the staff's understanding of the evaluation method, on August 17, 2015, the staff issued a request for additional information (RAI) (ADAMS Accession No. ML15229A468) to the Vogtle Electric Generating Plant, for a similar LAR, requesting a comparison of the original analysis (licensing basis) with the new hydrogen combustion analysis results and identification of any differences, with respect to local hydrogen concentration, local potential for DDT, credit for inerting, and assumptions related to reliance on hydrogen igniter performance.

VCSNS, because of the Vogtle RAI, by supplemental letter dated December 15, 2015 (ADAMS Accession No. ML15350A193), stated that the two additional igniters proposed to be added in the upper compartment outside the IRWST vents were located solely on the basis of the igniter placement criteria that are outlined in DCD Table 6.2.4-6. The licensee stated that need for the igniters was identified during a design review, not by a failure observed in any DDT analyses that had been performed previously or since. They stated that there are no analyses that support specific igniter placement other than demonstrating that the design siting criteria are met. The licensee stated that the methodology and analysis presented in DCD Tier 2, Section 19.41 remain unchanged by the proposed addition of two igniters above the IRWST vents. VCSNS also stated that the DDT analysis performed using the SOAR methodology identified above, was not utilized to support this LAR and is not requested to be reviewed in conjunction with the licensing basis at this time. The DDT analysis using the OECD SOAR methodology was performed in support of the ongoing update of the Probabilistic Risk Assessment (PRA) as documented in APP-PRA-GSC-402, "AP1000 Evaluation of DDT Potential," Revision 0. This updated DDT analysis includes the new igniters proposed in LAR 14-18. However, the analysis was performed with the MAAP4 code and the fidelity of the lumped parameter modeling of the upper compartment control volume does not distinguish the new igniters from the existing igniters that were already located above the IRWST vents. This updated analysis is not utilized to support or justify the proposed igniter placement because the staff is able to base its conclusions on the original analysis and methodology supporting the certified design.

For the certified design, the staff found that the combustible gas control system, with the 64 hydrogen igniters, met the requirements of 10 CFR 50.44, as described in NUREG-1793, Supplement 2, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Plant Design", Section 6.2.5. This staff conclusion was based on the hydrogen combustion analysis using the Sherman and Berman cell width methodology. Because the licensing basis of the combustible gas control design has not changed with the proposed addition of the two new hydrogen igniters and the analysis and methodology supporting the certified design were and continue to be found acceptable, the addition of two more igniters above the IRWST vents is found to be more conservative and therefore acceptable.

### 3.2.2 Hydrogen Igniter Control

As described in Section 7.1.1 "The AP1000 Instrumentation and Control Architecture" of the UFSAR, the PMS controls safety-related components and initiates reactor trip and actuation of engineered safety features in response to plant conditions. In COL Appendix C and related plant-specific Tier 1, Table 2.5.2-5, "Minimum Inventory of Displays, Alerts, and Fixed Position Controls in the MCR [Main Control Room]," the nonsafety-related hydrogen igniters are listed as having the PMS provide manual fixed position control in the MCR. The licensee proposed to delete this manual control of hydrogen igniters from the PMS in the MCR. The manual control of containment hydrogen igniters is not safety-related. The hydrogen igniter signals are not processed through the PMS and their fixed position controls are not provided in the PMS. In addition, the nonsafety-related manual control function of hydrogen igniters does not interface

with any safety function in the PMS. Therefore, the staff finds that the proposed elimination of the manual control of hydrogen igniters from the PMS is acceptable.

The nonsafety-related plant control system in the certified AP1000 standard design provides manual component soft level controls, which is described in Section 7.1.3.3 "Operator Controls and Indication" of the UFSAR, for nonsafety-related components including the hydrogen igniters at workstations in the MCR and the remote shutdown room. In Section 7.1.3.3 of the UFSAR, the plant control operator interface is a set of soft control devices that replace conventional switch/light or potentiometer/meter assemblies used for operator interface with control systems. The licensee proposed to add one clarification note to Tier 1, Table 2.5.4-1, "Minimum Inventory of Controls, Displays, and Alert at the RSW," for the manual containment hydrogen igniter that defines the hydrogen igniter control as soft control. This proposed change does not have any impact on the plant safety functions. The added clarifying note is also consistent with the description in the UFSAR for the manual component soft level controls for non-safety-related components. Therefore, the staff finds that the additional clarification note proposed by licensee is acceptable.

### 3.2.3 Plant-Specific Tier 1 Consistency Related Changes

The minimum surface temperature of hydrogen igniters is stated as "exceeds 1700° F" in COL Appendix C and associated Plant-specific Tier 1 Table 2.3.9-3, Inspection, Tests, Analyses, and Acceptance Criteria. However, this value is not consistent throughout the UFSAR. The proposed changes will make the surface temperature value consistent in all documents including the TRM. The minimum surface temperature is specified to be equal to or greater than 1700° F. This clarification is acceptable to the staff.

The location of igniters are shown in COL Appendix C and associated plant-specific Tier 1 Table 2.3.9-2 and on Tier 2 figures. However, the room location for hydrogen igniter APP-VLS-EH-30 (Igniter 30) is not consistent in all documents. The UFSAR Figure 6.2.4-9 location has been verified as the correct location by the licensee. The proposed changes will make the location of Igniter 30 consistent in all documents. This correction is acceptable to the staff.

## SUMMARY

The staff has reviewed the proposed changes submitted in LAR 14-18 that would add two new hydrogen igniters. Because the two additional igniters comply with the certified igniter siting criteria, their addition is acceptable to the staff. The hydrogen igniter signals are not processed through the PMS and their fixed position controls are not provided in PMS. In addition, the non-safety-related manual control function of hydrogen igniters does not interface with any safety function in the PMS. Therefore, the staff finds that the proposed elimination of the manual control of hydrogen igniters from the PMS is acceptable. In addition, the plant-specific consistency related changes and addition of clarification note in Tier 1, Table 2.5.4-1, are acceptable to the staff.

## 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 comments.

## 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, and that 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 (80 FR 58519; published on September 29, 2015). 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 the issuance of the amendment.

Because the exemption is necessary to allow the changes proposed in the license amendment, and because the exemption does not authorize any activities other than those proposed in the license amendment, the environmental consideration for the exemption is identical to that of the license amendment. Accordingly, the exemption meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of the exemption.

## 6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed in Section 3.2 and staff's confirmation that these changes do not change an analysis methodology, assumptions, or the design itself, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that 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 to the health and safety of the public. Therefore, the staff finds the changes proposed in this LAR acceptable.

The NRC staff has determined that pursuant to Section VIII.A.4 of Appendix D to 10 CFR Part 52, the exemption (1) is authorized by law, (2) presents no undue risk to the public health and safety, (3) is consistent with the common defense and security, (4) is a special circumstance that outweighs the reduction in standardization, and (5) does not significantly reduce the level of safety at the licensee's facility. Therefore, the staff grants the licensee an exemption from the Tier 1 information specified by the licensee.

## 7.0 REFERENCES

1. Request for License Amendment and Exemption 14-18: Containment Hydrogen Igniter Changes, letter from SCE&G, dated May 6, 2015 (ADAMS Accession No. ML15127A177).
2. Response to Request for Additional Information Related to Request for License Amendment and Exemption: Containment Hydrogen Igniter Changes, letter from SCE&G, dated December 15, 2015 (ADAMS Accession No. ML15350A193).
3. V.C. Summer Nuclear Station Updated Final Safety Analysis Report, Revision 4, dated July 1, 2016 (ADAMS Accession No. ML16193A096).
4. AP1000 Design Control Document, Revision 19, dated June 13, 2011 (ADAMS Accession No. ML11171A500).



5. V.C. Summer Nuclear Station, Final Safety Evaluation Report dated August 18, 2011 (ADAMS Accession No. ML110450305).
6. Final Safety Evaluation Report Related to Certification of the AP1000 Standard Plant Design, NUREG-1793, Supplement 2, dated August 5, 2011 (ADAMS Accession No. ML112061231).