SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS

RELATED TO AMENDMENT NO. 3 TO THE COMBINED LICENSE NO. NPF-93

AND LICENSE NO. 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 February 14, 2013, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13050A602), South Carolina Electric & Gas Company (SCE&G/Licensee) requested that the U.S. Nuclear Regulatory Commission (NRC/Commission) amend the combined licenses (COLs) for Virgil C. Summer Nuclear Station Units 2 and 3 (VCSNS), COL Numbers NPF-93 and NPF-94, respectively. The proposed amendment will revise the structural module shear stud size and spacing requirements presented in plant-specific Design Control Document (DCD) Figure 3.8.3-8, Sheet 1, Note 2 (Part of the Updated Final Safety Analysis Report (UFSAR)).

Plant-specific DCD Figure 3.8.3-8, Sheet 1, Note 2 includes information on the size and spacing of the shear studs in the structural modules. The license amendment request (LAR) proposes to update this information to reflect the current design basis. The existing Note 2 shows welded studs for stainless steel plates with $^{3}/_{4}$-inch diameter and a spacing of 10 inches horizontal and 8 inches vertical. The design basis calculations for carbon steel plates show that it would be acceptable to increase spacing from 9.6 to 10 inches (vertical direction). For the same reason, the licensee is proposing to reduce spacing from 10 to 6 inches (horizontal direction) and from 8 to 6 inches (vertical direction) in the stainless steel plates.

The licensee is proposing to decrease the stud diameter for the stainless steel plates from $^{3}/_{4}$-inch to $^{5}/_{8}$-inch. SCE&G stated that the change is required to make Note 2 consistent with the design basis. The text of the note is changed to clarify that spacing may be changed to satisfy AISC-N690-1994, American Institute of Steel Construction (AISC), “Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for Nuclear Facilities,” and ACI-349-01, American Concrete Institute (ACI), “Building Code Requirements for Nuclear Safety Related Structures,” code provisions.

The licensee also proposed an additional change to Note 2 of Figure 3.8.3-8, Sheet 1 to clarify that the shear stud size and spacing requirements for carbon steel apply specifically to A36 steel material.

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Appendix D, Section VIII requires NRC approval for departures from Tier 2* information. The proposed amendment request does involve changes to Tier 2* information. Therefore, NRC approval is required prior to making the Tier 2* changes addressed in this departure.

10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, Design bases for protection against natural phenomena, requires structures, systems, and components (SSCs) important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

10 CFR Part 50, Appendix A, General Design Criterion (GDC) 4, Environmental and dynamic effects design basis, requires SSCs important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing and postulated accidents, including loss-of-cooling accidents.

10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," requires nuclear power plants to be designed so that, if safe-shutdown earthquake (SSE) ground motion occurs, certain SSCs will remain functional and within applicable stress, strain, and deformation limits. The required safety functions of structures, systems, and components must be assured during and after the vibratory ground motion associated with the SSE ground motion through design, testing, or qualification methods.

In performing its technical and safety review, the NRC staff evaluated the licensee's LAR for compliance with regulations, applicable regulatory codes, guides, and standards, and approved precedents. In addition, the NRC staff reviewed the licensee's current licensing and design basis, as described in its UFSAR.

3.0 TECHNICAL EVALUATION

The NRC staff found that the departure description is consistent with, and identical in technical content to the identified precedent amendment for Vogtle Electric Generating Station Units 3 and 4, which was approved by the NRC on November 6, 2012 (ADAMS Accession No. ML12297A210).

The design of the AP1000 wall modules comprising the containment internal structures (CIS) is described in VCSNS UFSAR Subsection 3.8.3.1.3. The steel composite wall modules located inside of the containment are the CA01, CA02, CA03, CA04, and CA05 modules, while the wall module in the Auxiliary Building is the CA20 module. The steel-concrete composite wall modules are comprised of steel faceplates with steel channel trusses. The primary purpose of the trusses is to stiffen and support the faceplates during handling, erection, and concrete placement. The nominal thickness of the steel faceplates is 0.5 inch and the nominal spacing of the trusses is 30 inches. Shear studs are welded to the inside faces of the module faceplates and are designed in accordance with the provisions of the AISC, Standard AISC N690-1994, "Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for Nuclear Facilities," to develop full composite action between the concrete and the steel faceplates. The concrete-filled structural wall modules are designed as reinforced concrete structures in accordance with the requirements of American Concrete Institute (ACI) code ACI-349, "Building Code Requirements for Nuclear Safety Related Structures." Module-to-

module welds are full-penetration such that full capacity of the steel plates is developed. After the wall modules are welded together, concrete is poured in-between the steel faceplates, which would serve as forms. Once the concrete in each wall module cures, the concrete, trusses, faceplates, and shear studs act as a lateral force resisting system to resist design basis demands.

The LAR on shear stud size and spacing proposes to revise Note 2 to plant-specific DCD Figure 3.8.3-8, Sheet 1, to be consistent with design basis calculations. Note 2 of DCD Figure 3.8.3-8 is designated as Tier 2* information, and indicates size and spacing of welded shear studs for stainless steel (SS) plate and carbon steel (CS) plates (reference Figure 1 below). The licensee is proposing to (a) make revisions to welded stud size and spacing for both SS and CS plate materials, (b) add clarification that stud spacing will be in accordance with relevant codes and standards, and (c) add clarification that the indicated stud spacing on CS plates pertains to A36 steel. The proposed changes in the LAR are indicated in Table 1 of this report.

To perform its evaluation, the staff considered the licensee's design criteria described in VCSNS UFSAR Subsection 3.8.3, "Concrete and Steel Internal Structures of Steel Containment," which requires that containment internal structures be designed in accordance with AISC N690-94 and ACI 349-01 code provisions. The staff also reviewed the relevant portions of NUREG-1793 Supplement 2, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Plant Design," and "Final Safety Evaluation Report for the Virgil C. Summer Nuclear Station Units 2 & 3 Combined License Application," documenting the staff's technical evaluation of containment internal structures.

The staff focused its review on the potential effects of these changes on the structural behavior of the CIS and CA20 steel composite modules. LAR, Section 3, states that stud spacing and sizing are such that stud loadings are within acceptable AISC-N690 code limits and that the design is consistent with the UFSAR Section 3.8.3.

On February 28, 2012, staff performed an audit of the technical basis for the proposed change which was documented in Westinghouse Electric Company report APP-1100-SUC-003, "Design of Shear Studs for Structural Modules for Inside Containment and CA20." The purpose of the audit was to verify that the licensee's design changes were performed in accordance with UFSAR commitments and relevant code provisions. This calculation note included an assessment of stud break-out, stud pull-out, horizontal shear, vertical shear, liner plate tension, liner plate compression, liner plate stability, and shear transfer.

Staff review of the licensee's calculation confirmed that the assumed loads, load combinations, and analysis procedures were consistent with that described in UFSAR Subsections 3.7 and 3.8.3. Staff also noted that both A36 and A572 steel materials were considered for the analysis of CS plates. The staff reviewed the calculation results which indicated that, for the materials, stud sizes, and stud spacing considered (reference Table 1 below), the design capacities exceeded demands with considerable margin. Staff review also confirmed that the design was performed in accordance with relevant ACI-349 and AISC-N690 code provisions.

Plate	Stud Diameter	Horizontal Spacing	Vertical Spacing
A36 (CS)	$^{3}/_{4}$″	10″	10″
A572 (CS)	$^{3}/_{4}$″	6″	6″
Duplex 2101 (SS)	$^{5}/_{8}$″	6″	6″

Table 1: Plate, stud diameter, and spacing for AP1000 Steel Composite Structures

The LAR stated that ASTM A572, Grade 60 plate material may be used in lieu of A36 for certain modules. Staff review of the proposed changes to Note 2 as part of a precedence review found that the note did not identify the physical extent to which other, higher-strength, plate materials (e.g., A572) could be used and whether modules could be comprised of plates with different strength properties. A request was sent for the licensee to identify what modules or portions thereof would use higher strength material in lieu of A36 steel plate material, and to clarify which steel materials are covered by the specific shear stud size/spacing specified in Note 2.

In the LAR Enclosure 3, the licensee stated that the higher strength A572 material will be used in place of the lower strength A36 material in the face plates of wall modules. Specifically, A572 steel will be used for the face plates of modules CA01, CA02, CA05, and CA20. The licensee stated that A36 material will no longer be used for the face plate material of these structural wall modules, thus mixing of A36 and A572 wall faceplate materials would not occur. The licensee also clarified Note 2 to indicate that the specified spacing pertains to A36 material. Based on the licensee's information which (a) indicated the locations where A572 material will be used, (b) clarified that shear stud spacing as indicated in Note 2 for CS plate is applicable to A36 material, and (c) identified that spacing for other steel materials will be developed in accordance with relevant codes and standards, the staff considers the licensee's information provided to be acceptable.

Conclusions:

The NRC staff has reviewed the licensee's analysis provided in Section 3 of the LAR and its supplements. Based on the staff's technical evaluation, the staff found that:

1. The licensee's proposed design changes for CIS and CA20 shear stud (size and spacing) were performed in accordance with AISC-N690-1994 and ACI-349-01 code provisions and the supporting calculations indicated significant margin to code limits.

2. The licensee's technical basis supporting the change in shear stud spacing, which considered Duplex 2101 (SS), A36 (CS), and A572 (CS) plate materials, was performed in accordance with AISC-N690-1994 and ACI-349-01 code provisions and is therefore acceptable.

3. The proposed change clarifies that the shear stud spacing in DCD Figure 3.8.3-8, Sheet 1, Note 2 for CS plate is applicable to A36 material and that stud spacing for other steel materials will be developed in accordance with AISC-N690-1994 and ACI-349-01 code provisions.

For the reasons specified above, the NRC staff finds that the proposed amendment and the supporting analysis meets relevant code provisions and reduces potential for misinterpretation at the detailed design stage. Based on these findings, the NRC staff concludes that there is reasonable assurance that the requirements of GDC 2 and GDC 4 for 10 CFR 50 Appendix A, and Appendix D to 10 CFR 52 will continue to be met. Therefore, the staff finds the proposed change to be acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations 10 CFR 50.91(b), the South Carolina State official was notified of the proposed issuance of the amendment. The State official 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. The NRC staff has determined that the amendment involves no significant change in the types, or no significant increase in the amounts 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 (78 FR 14126) published on March 4, 2013). 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.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, 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.

7.0 REFERENCES

1. Request for License Amendment - Structural Modules Shear Stud Size and Spacing (LAR 13-05), letter from South Carolina Electric & Gas dated February 14, 2013 (Accession No. ML13050A602).

2. Issuance of License Amendment No. 3 For Vogtle Units 3 and 4, November 6, 2012 (ADAMS Accession No. ML12297A210)

3. Virgil C. Summer Nuclear Station, Updated Final Safety Analysis Report, Revision 0, dated July 3, 2012 (Accession No. ML12201A130).

4. AP1000 Design Control Document, Revision 19, dated June 13, 2012 (Accession No. ML11171A500).

5. Virgil C. Summer Nuclear Station, Final Safety Evaluation Report, dated August 17, 2011 (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 (Accession No. ML112061231).

7. American Institute of Steel Construction, “Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for Nuclear Facilities,” AISC-N690-1994.

8. American Concrete Institute, “Building Code Requirements for Nuclear Safety Related Structures,” ACI-349-01.

Figure 1: Current Licensing Basis, Requested Departure, and Supplemental Changes to Note 2 of Figure 3.8.3-8, Sheet 1, of the VCSNS UFSAR

Current Licensing Basis:

2. WELDED STUDS SHALL BE SPACED AS FOLLOWS, UNLESS NOTED OTHERWISE:

   ¾″ Ø x 6″ @ 9.6″ VERTICAL FOR CS

   ¾″ Ø x 6″ @ 10″ HORIZONTAL FOR CS

   ¾″ Ø x 6″ @ 8″ VERTICAL FOR SS

   ¾″ Ø x 6″ @ 10″ HORIZONTAL FOR SS

Requested Departure per LAR-12-001, dated March 12, 2012:

2. WELDED STUDS SHALL BE SPACED AS FOLLOWS, UNLESS OTHERWISE REQUIRED BY THE SPECIFIC CODES AND STANDARDS INVOKED:

   ¾″ Ø x 6″ @ 10″ VERTICAL FOR CS

   ¾″ Ø x 6″ @ 10″ HORIZONTAL FOR CS

   5/8″ Ø x 6″ @ 6″ VERTICAL FOR SS

   5/8″ Ø x 6″ @ 6″ HORIZONTAL FOR SS

Supplemental Change per response to RAI 03.08.03-1, Question 2 (double underlining indicates supplemental change):

2. WELDED STUDS SHALL BE SPACED AS FOLLOWS, UNLESS OTHERWISE REQUIRED BY THE SPECIFIC CODES AND STANDARDS INVOKED:

   ¾″ Ø x 6″ @ 10″ VERTICAL FOR A36 CS

   ¾″ Ø x 6″ @ 10″ HORIZONTAL FOR A36 CS

   5/8″ Ø x 6″ @ 6″ VERTICAL FOR SS

   5/8″ Ø x 6″ @ 6″ HORIZONTAL FOR SS