Ronald A. Jones
Vice President
New Nuclear Operations

February 14, 2017
NND-17-0104
10 CFR 50.90

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3
Combined License Nos. NPF-93 and NPF-94
Docket Nos. 52-027 & 52-028

Subject: LAR 16-11 S01 Supplement to License Amendment: Nondestructive Examination for Welds of Couplers to Stainless Steel Embedment Plates

References:

1. Southern Nuclear Operating Company (SNC) Request for License Amendment: ND-16-1287 Nondestructive Examination for Welds of Couplers to Stainless Steel Embedment Plates (LAR-16-016) – August 29 2016 [ML16242A399]

2. South Carolina Electric & Gas Company (SCE&G) Request for License Amendment: NND 16-0366 Nondestructive Examination for Welds of Couplers to Stainless Steel Embedment Plates (LAR 16-11) – September 20 2016 [ML16267A163]

3. Southern Nuclear Operating Company (SNC) Supplement to Request for License Amendment: ND-17-0210 Nondestructive Examination for Welds of Couplers to Stainless Steel Embedment Plates (LAR-16-016S1) – February 13 2017

In accordance with the provisions of 10 CFR 50.90, South Carolina Electric & Gas Company (SCE&G), acting on behalf of itself and the South Carolina Public Service Authority (Santee Cooper), requests an amendment to the Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3 combined licenses (COLs) numbers NPF-93 and NPF-94, respectively. The requested amendment requires changes to the Updated Final Safety Analysis Report (UFSAR) in the form of departures from the incorporated plant-specific Design Control Document (DCD) Tier 2* information.

The proposed departures consist of changes to Tier 2* information in the UFSAR (which includes the plant-specific DCD information) to clarify how the quality and strength of a specific set of couplers welded to stainless steel embedment plates, already installed and embedded in concrete, is demonstrated through visual examination and static tension testing, in lieu of the nondestructive examination requirements of American Institute of Steel Construction (AISC) N690.

This letter supplements LAR 16-11 and is a voluntary RAI response consistent with SNC supplement to LAR-16-1016 (reference 3). Enclosure 6 address a Request for Additional Information (RAI) from the NRC Staff, which was transmitted by electronic mail (email) to SNC on January 13, 2017 [ML17017A161], to support review of reference 1 and 2. Enclosure 7 replaces the UFSAR markup provided in Enclosure 3 and is consistent with Enclosure 6.

The supplemental information provided in this letter does not impact the scope or conclusions of the Technical Evaluation, Regulatory Evaluation (including the Significant Hazards Consideration Determination), or Environmental Considerations of the LAR.

This letter contains no regulatory commitments. This letter has been reviewed and confirmed to not contain security-related information.

In accordance with 10 CFR 50.91, SCE&G is notifying the State of South Carolina of this LAR Supplement by transmitting a copy of this letter to the designated State Official.

Should you have any questions, please contact Mrs. April Rice by telephone at (803) 941-9858, or by email at arice@scana.com.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 14th day of February, 2017.

Sincerely,

Ronald A. Jones
Vice President
New Nuclear Operations

MMD/RAJ/mmd

Enclosure 1-5:	Previously submitted with the original LAR, LAR 16-11, in letter NND-16-0366
Enclosure 6:	Virgil C. Summer Nuclear Station Units 2 and 3 – Voluntary Response to NRC Request for Additional Information (LAR 16-11 S01)
Enclosure 7:	Virgil C. Summer Nuclear Station Units 2 and 3 – Revised Proposed Changes to Licensing Basis Documents (LAR 16-11 S01)

Copy (with enclosures):

Billy Gleaves
Ruth Reyes
Chandu Patel
Paul Kallan
Jennifer Dixon-Herrity
Susan E. Jenkins
Sam Lee
Shawn Williams
Tom Fredette
Tomy Nazario
Cathy Haney
Jim Reece
Stephen A. Byrne
Jeffrey B. Archie
Ronald A. Jones
Alvis J. Bynum
Kathryn M. Sutton
April Rice
Nick Kellenberger
Matt Kunkle
Mory Diané
Bryan Barwick
Dean Kersey
Margaret Felkel
Cynthia Lanier
Lisa Spears
Frederick Willis
Neil Haggerty
Pat Young
Zach Harper
Brian McIntyre
Brian Bedford
Carl Churchman
Joseph Cole
Chuck Baucom
Lisa Alberghini
Curt Castell
William M. Cherry
Rhonda O'Banion
VCSummerMail@westinghouse.com
VCSummer2&3project@westinghouse.com
VCSNNDCorrespondence@scana.com
DCRM-EDMS@SCANA.COM

South Carolina Electric and Gas Company

Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3

NND-17-0104

Enclosure 6

Voluntary Response to NRC Request for Additional Information

(LAR 16-11 S01)

(This Enclosure consists of 4 pages, including this cover page)

The following are questions provided by the NRC Staff regarding the review of Southern Nuclear Operating Company (SNC) License Amendment Request (LAR) 16-016, which was submitted via reference 1. The information below provides responses applicable to LAR 16-11 for consistency with reference 3.

RAI Question 1:

The proposed Tier 2* wording describes the testing methodology and results used to justify that the specific population of inaccessible welds that did not receive the appropriate nondestructive examination (NDE) can meet their design requirements. Currently, the proposed Tier 2* wording describes the impacted welds as:

> *The non-conforming partial penetration welds associated with reinforcement bar sizes #6 and #9 C3J couplers installed on ASTM A240 stainless steel embedment plates under CA01 that did not undergo nondestructive examination at the time of fabrication…*

While the proposed Tier 2* wording describes the impacted welds, it does not clearly state that the testing is only representative of the couplers that are referenced in the LAR. The test results represent only this specific population that have been installed under CA01; therefore the test results and conclusions in the LAR are not applicable to other populations of couplers.

a. Please clarify the proposed Tier 2* wording so that it is clear that it is only applicable to this specific population of couplers, and that it is not applicable for future welds that may not receive the appropriate NDE.

SCANA Response to RAI Question 1a:

In order to clarify that the proposed Tier 2* wording is only applicable to this specific population of couplers included as part of LAR 16-11, and that it is not applicable for future welds that may not receive the appropriate non-destructive examination (NDE), the following update to the supplemental UFSAR Section 3.8.4.5.2 language is proposed (provided in **bold**, *italic* text, below):

> *"…the non-conforming partial penetration welds associated with reinforcement bar sizes #6 and #9 C3J couplers installed on ASTM A240 stainless steel embedment plates under CA01 that did not undergo nondestructive examination at the time of fabrication**, as identified in Amendment No. [XXX] for VCSNS Units 2 and 3**, the quality and strength of the welds…"*

where "XXX" is the COL Amendment number assigned by NRC for approval of LAR 16-11, and will be inserted in this text when this amendment is approved and implemented.

RAI Question 2:

The design of the Phase II test assembly was to aid in the fit-up for the tensile testing machine, and to attempt to isolate the failure point at the test weld. The test assembly design ground out the threads of the test coupler, filled in the test coupler with weld material, and welded an oversized coupler to the test coupler with a fixture weld. The staff previously requested justification to show that this design would not have any impact on the mechanical properties of the test weld. The LAR states that hardness testing was performed. From the description in the LAR, the hardness testing only shows the potential changes to the mechanical properties at the fillet weld surface. Based on the test assembly design, it is likely that the majority of the heat input would impact the partial joint penetration (PJP) weld and the heat affected zone (HAZ).

a. Please provide additional detail related to the hardness testing that demonstrates the test assembly design had no impact on the test weld mechanical properties (particularly at the PJP and HAZ).

The LAR states that several Phase II test welds were “influenced by the fixture weld” during tensile testing and therefore they were not considered as part of the test results.

b. Please explain what “influenced by the fixture weld” means. The LAR states that there was no impact to the hardness, but some of the test samples’ failures were “influenced by the fixture weld.”

SCANA Response to RAI Question 2a:

Hardness testing, as referenced in the statistical analysis developed in support of LAR 16-11, demonstrates that the test assembly had no influence upon the coupler test weld mechanical properties. This confirmation is based on the test process, which included the examination of two specimens; one for which no modifications were made to the production coupler assembly (Specimen A) and one that had been modified for the test assembly design (Specimen B). A water-cooled abrasive cut-off saw was used to extract one cross-sectional specimen from each assembly. Each specimen was metallographically mounted and polished. In the as-polished state, a Vickers microhardness traverse was completed on each specimen using an Instron Model T2100B tester. Following hardness testing, each specimen was etched with 10% Nital. The results of the testing indicate that neither specimen showed any hardened heat affected zone (HAZ) and both specimens had similar resulting hardness traverses. Therefore, it was concluded that the test assembly welding had no impact on the test weld mechanical properties.

SCANA Response to RAI Question 2b:

It was concluded through investigation of the failure plane of each test specimen that the “fill-in” fixture weld quality contributed to the break load in some specimens. As such, an additional variable was introduced into the sample set. Two populations were pooled for calculation of the 90/95% confidence interval evaluation, in order to have normal distribution. One population includes the samples that demonstrate evidence that the “fill-in” weld quality contributed to the break. This would include instances of voids or incomplete bond to the coupler body. The other

population includes samples that demonstrate no evidence that the “fill-in” weld quality directly contributed to the break. This approach was necessary to achieve data sets with normal distributions. This ultimately resulted in a lower margin than if the “fill-in” weld quality had no influence, as it lowered the failure load and reduced the number of samples considered for determination of the k-value.

Note that the NDE condition of the production weld did not have any influence on the break strength of the coupler system, as all samples failed through the coupler body.

South Carolina Electric and Gas Company

Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3

NND-17-0104

Enclosure 7

Revised Proposed Changes to Licensing Basis Documents

(LAR 16-11)

Note:
Added text is shown as bold **Blue Underline**
Deleted text is shown as bold ~~**Red Strikethrough**~~
Omitted text is shown as three asterisks (* * *)
Revision depicted with a change bar

(This Enclosure consists of 3 pages, including this cover page)

UFSAR Subsection 3.8.4.5 "Structural Criteria" – Revise to add the following Tier 2* text.

[*The analysis and design of concrete conform to ACI-349 as supplemented below and with clarifications provided in Subsection 3.8.4.4.1. The analysis and design of structural steel conform to AISC-N690 as supplemented below and with clarifications provided in Subsection 3.8.4.5.2. The analysis and design of cold-formed steel structures conform to AISI. The margins of structural safety are as specified by those codes.*]*

UFSAR Subsection 3.8.4.5.2 "Supplemental Requirements for Steel Structures" - Revise to add Tier 2* text after the existing Tier 2 text in this subsection, as shown below:

* * *

- *Sections Q1.24 and Q1.25.10 are supplemented as follows:*

  Shop painting is in accordance with Section M of the Manual of Steel Construction, Load and Resistance Factor Design, First Edition. Exposed areas after installation are field painted in accordance with the applicable portion of Chapter M of the Manual of Steel Construction, Load and Resistance Factor Design, First Edition.]* See Subsection 6.1.2.1 for additional description of the protective coatings.

- [*In Sections Q1.26.2.2, Q1.26.2.3, and Q1.26.3 for the non-conforming partial penetration welds associated with reinforcement bar sizes #6 and #9 C3J couplers installed on ASTM A240 stainless steel embedment plates under CA01 that did not undergo nondestructive examination at the time of fabrication, as identified in Amendment No. [XXX] for VCSNS Units 2 and 3, the quality and strength of the welds is demonstrated through visual examination and through static tension testing of an uninstalled representative population as follows:*

  - *Visual Examination: Coupler welds from the production fabrication population underwent visual examination by the manufacturer. The manufacturer visual examinations provided satisfactory results.*

  - *Static Tension Testing: Weldable coupler connections of reinforcing bar to structural steel shall develop 125% of the specified yield strength of the bar in accordance with ACI 349-01, Section 12.14.3.4. The mechanical connection strength requirement is applied to the weld to demonstrate that the coupler weld is stronger than the reinforcing bar strength requirement, thereby satisfying provisions for design limits outlined in AISC N690-1994. To determine that the population of #6 and #9 C3J coupler welds on ASTM A240 stainless steel embedment plates are adequate in their ability to perform their intended design function, static tension testing of an uninstalled representative population of production welds is evaluated experimentally in two phases.*

UFSAR Subsection 3.8.4.5.2 (cont.)

Phase I: Static tension testing has been performed on a total of six #9 sized couplers and a total of fifteen #6 sized couplers. The static tension tests results were evaluated to obtain the 90/95% confidence interval break strength for both coupler sizes. The Phase I test results demonstrate that the 90/95% confidence interval break strength exceeds 125% of the specified yield strength of the reinforcing bar and demonstrate that the rebar or coupler thread is the weak link in the mechanical connection system.

Phase II: Testing was performed to investigate the strength of the coupler weld. A total of 47 samples were tested, 37 #6 sized couplers and 10 #9 sized couplers. The statically-tested samples failed within the coupler body, and demonstrate that the production PJP with fillet weld is stronger than the coupler body. To confirm that the statically-tested sample population is representative of the installed population of coupler welds, the test sample population considered factors such as sample size, weld process, automatic/manual processes, human performance factors, welding procedure specifications, non-destructive examination, fabrication schedule, filler metal, and coupler material.

*Safety margin was calculated using the nominal tensile strength and the 90/95% confidence interval test coefficient based on the test samples and is penalized by lower bound failure modes and a finite sample size. The safety margin, or Factor of Safety (FoS), was calculated against both the 125% yield strength of the rebar and against the system strength (i.e., weakest link of the system, rebar or coupler thread). The minimum safety margin with respect to the 125% yield strength of the rebar was calculated to be 2.91 for the #6 sized couplers and 2.26 for the #9 sized couplers. The minimum safety margin with respect to the system strength was calculated to be 2.16 for the #6 sized couplers and 1.68 for the #9 sized couplers.]**