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SOUTHERN COMPANY

October 20, 2016

Docket Nos.: 52-025
52-026

ND-16-1894
10 CFR 50.90

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

Southern Nuclear Operating Company
Vogtle Electric Generating Plant Units 3 and 4
Request for License Amendment:
Nondestructive Examination for Welds of Couplers to
Carbon Steel Embedment Plates (LAR-16-027)

Ladies and Gentlemen:

Pursuant to 10 CFR 52.98(c) and in accordance with 10 CFR 50.90, Southern Nuclear Operating Company (SNC), the licensee for Vogtle Electric Generating Plant (VEGP) Units 3 and 4, requests an amendment to Combined License (COL) Numbers NPF-91 and NPF-92, for VEGP Units 3 and 4, 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 carbon 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.

Enclosure 1 provides the description, technical evaluation, regulatory evaluation (including the Significant Hazards Consideration Determination) and environmental considerations for the proposed changes.

Enclosure 2 provides proprietary text excerpts that are redacted from the License Amendment Request (LAR) text in Enclosure 1. **The text excerpts in Enclosure 2 provide information that is considered to be proprietary; therefore, Enclosure 2 is requested to be withheld from disclosure to the public under 10 CFR 2.390.**

Enclosure 3 provides markups depicting the requested changes to the VEGP Units 3 and 4 UFSAR.

An affidavit from SNC supporting withholding under 10 CFR 2.390 is provided as Enclosure 4. Enclosure 5 is Westinghouse's Proprietary Information Notice, Copyright Notice and CAW-16-4483, Application for Withholding Proprietary Information from Public Disclosure and Affidavit. The affidavit sets forth the basis upon which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.390 of the Commission's regulations. Accordingly, it is respectfully requested that the information that is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the copyright or proprietary aspects of the items listed above or the supporting Westinghouse affidavit should reference CAW-16-4483 and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066. Correspondence with respect to proprietary aspects of this letter and its enclosures should also be addressed to Wesley A. Sparkman at the contact information within this letter.

This letter contains no regulatory commitments.

SNC requests staff approval of this license amendment by May 5, 2017, to support timely closure of the corrective actions surrounding the couplers welded to carbon steel embedment plates. Approval of this LAR will not affect construction activities or the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) closure schedule for VEGP Units 3 and 4. SNC expects to implement this proposed amendment (through incorporation into the licensing basis documents; e.g., the UFSAR) within 30 days of approval of the requested changes. This is a plant-specific LAR, which is not directly tied to the NRC review schedule of any LARs associated with construction of the AP1000 plants at South Carolina Electric and Gas Company's V. C. Summer Nuclear Station Units 2 and 3.

In accordance with 10 CFR 50.91, SNC is notifying the State of Georgia of this LAR by transmitting a copy of this letter and enclosures to the designated State Official.

Should you have any questions, please contact Ms. Paige Ridgway at (205) 992-7516.

(Affirmation and signature provided on the following page.)

Mr. Wesley A. Sparkman states that: he is the Regulatory Affairs Licensing Manager, Nuclear Development, of Southern Nuclear Operating Company; he is authorized to execute this oath on behalf of Southern Nuclear Operating Company; and to the best of his knowledge and belief, the facts set forth in this letter are true.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

Wesley A. Sparkman

LISA MYRICK SPEARS
MY COMMISSION EXPIRES
June 18, 2019
NOTARY PUBLIC
STATE OF ALABAMA

WAS/NH/ljs

Sworn to and subscribed before me this 20th *day of* October *, 2016*

Notary Public: Lisa Myrick Spears

My commission expires: June 18, 2019

Enclosures:

1) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Request for License Amendment: Nondestructive Examination for Welds of Couplers to Carbon Steel Embedment Plates (LAR-16-027)
2) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Proprietary Information for Request for License Amendment: Nondestructive Examination for Welds of Couplers to Carbon Steel Embedment Plates (LAR-16-027) **(Withheld Information)**
3) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Proposed Changes to the Licensing Basis Documents (LAR-16-027)
4) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Affidavit from Southern Nuclear Operating Company for Withholding Under 10 CFR 2.390 (LAR-16-027)
5) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Westinghouse Authorization Letter CAW-16-4483, Affidavit, Proprietary Information Notice and Copyright Notice (LAR-16-027)

cc:

Southern Nuclear Operating Company / Georgia Power Company

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Southern Nuclear Operating Company

ND-16-1894

Enclosure 1

Vogtle Electric Generating Plant (VEGP) Units 3 and 4

Request for License Amendment:

Nondestructive Examination for Welds of Couplers to Carbon Steel Embedment Plates

(LAR-16-027)

(Enclosure 1 consists of 45 pages, including this cover page)

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Pursuant to 10 CFR 52.98(c) and in accordance with 10 CFR 50.90, Southern Nuclear Operating Company (SNC, or the "Licensee") hereby requests an amendment to Combined License (COL) Nos. NPF-91 and NPF-92 for Vogtle Electric Generating Plant (VEGP) Units 3 and 4, respectively.

1. SUMMARY DESCRIPTION

As specified in UFSAR Tier 2* Subsection 3.8.4.5, the analysis and design of concrete and structural steel conform to American Concrete Institute (ACI), "Code Requirements for Nuclear Safety Related Structures," (ACI 349-01) and American Institute of Steel Construction (AISC), "Specification for the Design, Fabrication and Erection of Steel Safety Related Structures for Nuclear Facilities," (AISC N690-1994), respectively. Supplemental requirements for structural steel are provided in UFSAR Subsection 3.8.4.5.2.

The change proposed by this activity is to demonstrate weld quality and strength to show that the embedded #9 sized Lenton® C3J coupler partial joint penetration (PJP) welds, also described as partial penetration welds in AISC N690-1994, with fillet welds on carbon steel embedment plates that are installed in concrete are capable of performing their intended design function and remain acceptable for use-as-is using visual examination (VT), magnetic particle examination (MT), and static tension testing in lieu of nondestructive examination (NDE). The design function of these couplers is to transmit static and dynamic loads from the structural steel to the reinforced concrete. Specifically, nonconformance with AISC N690-1994, Section Q1.26.2.2, "Partial-Penetration Welds," code requirements to perform the requisite 10 percent NDE on PJP welds (i.e., not performing MT on coupler welds across the carbon steel weld manufacturer loads), is addressed in this License Amendment Request (LAR). Demonstration of the strength and quality of these coupler welds on Cives and Joseph Oat carbon steel embedment plates is satisfied through a combination of satisfactory VT of the installed population of welded couplers, and through satisfactory MT and static tension testing performed on portions of the Cives uninstalled population of welded couplers and on a supplemental uninstalled population of welded couplers from Joseph Oat. The proposed change incorporates supplemental requirements to UFSAR Subsection 3.8.4.5.2 for AISC N690-1994, Section Q1.26.2.2, "Partial-Penetration Welds." These supplemental requirements will allow for the aforementioned demonstration of the strength and quality of the coupler welds to be credited as justification for the installed coupler welds being capable of performing their intended design function in lieu of the existing AISC N690-1994, Section Q1.26.2.2 requirement for PJP welds to be 10 percent inspected.

Because the Cives carbon steel embedment plates with C3J PJP coupler welds with fillet welds were manufactured at the same fabrication facility during the same time frame, the coupler weld populations for Vogtle and V.C. Summer are combined into a single population for the demonstration of weld strength. Note that the Joseph Oat carbon steel embedment plates with C3J PJP coupler welds with fillet welds were also included in this single population for the demonstration of weld strength as both embedment plate coupler weld manufacturers used the same weld process and qualified Welding Procedure Specification (WPS), minimized variability of associated welders through the standard qualification process, and used weld qualification processes in accordance with AWS D1.1 requirements.

It is noted that AISC N690-1994, Section Q1.26.2.2 provides no specific requirement regarding when the 10 percent NDE examination must be performed to in-process PJP welds with reinforcing fillet welds (i.e., no requirement to perform NDE on PJP welds prior to completing the fillet weld reinforcement). As such, the PJP portion of the welds and the fillet portion of the welds were designed as a system and may be inspected as a system. That is, performing NDE (10 percent MT) after the reinforcing fillet weld is completed along with 100 percent VT meets the requirements of AISC N690-1994, Section Q1.26.2.

2. DETAILED DESCRIPTION

Embedment plates are fabricated in accordance with AISC N690-1994. While all welds are subjected to VT, the design specifications and AISC N690-1994 require additional NDE of PJP welds. AISC N690-1994, Section Q1.26.2.2 states,

> "*Partial penetration welds shall be 10 percent inspected by magnetic particle examination or liquid penetrant examination. The examination may be 10 percent of each weld or 100 percent of one weld in ten.*"

Contrary to this requirement, a total of 262 carbon steel embedment plates with a total of 1214 #9 sized and #11 sized C3J Lenton® weldable couplers attached via PJP welds with reinforcing fillet welds were fabricated by Cives Steel Company (Cives) and shipped to Vogtle Units 3 and 4, and accepted without the requisite NDE having been performed. Additionally contrary to the AISC N690 NDE requirement, a total of 218 carbon steel embedment plates with a total of 872 #9 sized C3J Lenton® weldable couplers attached via PJP welds were fabricated by Joseph Oat Corporation (Joseph Oat) and shipped to Vogtle Unit 3, and accepted without the requisite NDE having been performed.

Subsequent to receipt and acceptance of the 262 Cives carbon steel embedment plates at Vogtle Units 3 and 4, 233 embedment plates with a total of 869 welded couplers were installed (embedded in concrete) under the Vogtle Unit 3 CA01 module and under the Vogtle Unit 4 CA20 module. The remaining 203 welded couplers on a total of 29 carbon steel embedment plates have not been installed. Additionally, a total of 142 couplers have been removed from their associated embedment plates and replaced with direct weld rebar (1214 total couplers = 869 installed + 203 uninstalled + 142 replaced with direct weld rebar). The entire population of 869 Cives welded couplers installed (embedded in concrete) consist of #9 sized C3J weldable couplers. Note that no #11 sized C3J weldable couplers on carbon steel embedment plates were installed at Vogtle Units 3 & 4; however, these weldable couplers are presented in this LAR to support the statistical analysis discussed in the Technical Evaluation which is common to both Vogtle and V. C. Summer. V. C. Summer did install #11 sized weldable couplers on carbon steel embedment plates.

Additionally, subsequent to receipt and acceptance of the 218 Joseph Oat carbon steel embedment plates at Vogtle Unit 3, 202 embedment plates with a total of 808 welded couplers were installed (embedded in concrete) under the Vogtle Unit 3 CA20 Module. The 16 remaining spare embed plates with a total of 64 welded couplers were not installed and were scrapped and are no longer available for testing. The entire population of 808 Joseph Oat welded couplers installed (embedded in concrete) consist of #9 sized C3J weldable couplers.

Regarding the population of Cives carbon steel embedment plates with welded couplers, a sampling inspection plan was developed to perform NDE on coupler welds in accordance with AISC N690-1994, Section Q1.26.2.2 on 10 percent of the total population of the welds on carbon steel embedment plates. A sample set of 122 welded couplers was pooled to perform the requisite MT from the population of 203 welded couplers that were not embedded in concrete as this sample size is sufficient in magnitude to signify 10 percent of the total population of 1214 coupler welds received from Cives.

Regarding the population of Joseph Oat carbon steel embedment plates with welded couplers, a sampling inspection plan considering the welded couplers comprised of the installed population could not be pooled for the requisite AISC N690-1994 NDE testing as the entire population of these embedment plates with welded couplers has already been installed with the exception of the 16 spare embedment plates with 64 welded couplers which were not installed, but were scrapped and are no longer available. Therefore, Joseph Oat was contracted to fabricate and supply Vogtle Unit 3 with a supplemental population of 55 carbon steel embedment plates with a total of 220 #9 sized C3J welded couplers, not intended for installation, but which could be used to perform the requisite AISC N690-1994 NDE. Of this supplemental Joseph Oat population of 55 carbon steel embedment plates totaling 220 welded couplers, a sample set of 110 welded couplers (2 coupler welds from each of the 55 embedment plates) was pooled to perform the requisite magnetic particle examination as this sample size is sufficient in magnitude to signify 10 percent of the 1092 combined original and supplemental coupler weld populations (=872 original coupler weld population + 220 supplemental coupler weld population) received from Joseph Oat while allowing for a second 10 percent NDE sample set to be tested, if necessary, in accordance with AISC N690-1994, Section Q1.26.2.3, “Weld Samples.”

Ultimately, the requisite AISC N690-1994 NDE on the Cives sample set of 122 welded couplers was performed and demonstrated 100% satisfactory results via magnetic particle examination. However, it is recognized that the sample set of 122 NDE tested coupler welds is not entirely representative of the total installed population of couplers welded to Cives carbon steel embedment plates. Specifically, the 122 NDE tested coupler welds were pooled from only 3 of 11 total Cives shop fabrication loads. Moreover, review of the Cives shop fabrication loads’ VT dates confirm that the 122 coupler welds tested do not overlap with the VT dates from welded couplers in other Cives shop loads which have been installed in their entirety, thereby not allowing for any NDE to be performed on those subsets of fully installed Cives welded coupler loads. As such, it is determined that the sample set of Cives welded couplers which underwent MT is not entirely representative of the total installed population of welded couplers.

Furthermore, the requisite AISC N690-1994 NDE on the Joseph Oat supplemental sample set of 110 welded couplers was performed and demonstrated 100% satisfactory results via MT. However, it is recognized that the supplemental sample set of 110 NDE tested coupler welds is not entirely representative of the total installed population of couplers welded to Joseph Oat carbon steel embedment plates. Specifically, the 110 NDE tested coupler welds were pooled solely from the supplemental population of embedment plates with welded couplers that was fabricated more than three years post-fabrication of the Joseph Oat welded couplers from the original, fully-installed population. As such, it is determined that the sample set of Joseph Oat welded couplers which underwent MT is not entirely representative of the total installed original population of welded couplers.

AISC N690-1994, Section Q1.26.2.2 requires that PJP welds shall be 10 percent inspected by MT or PT. Because the selected 10% sample sets MT inspections were determined to be not entirely representative of the total installed populations of Cives and Joseph Oat populations of welded couplers on carbon steel embedment plates, an LAR is needed to request a change to the Tier 2* portion of UFSAR Subsection 3.8.4.5.2 to allow demonstration of weld quality and strength of embedded #9 C3J coupler manufacturer welds using VT, MT, and static tension testing in lieu of NDE for use-as-is.

Description of any Changes to Current Licensing Basis Documents

Tier 2* portions of UFSAR Subsections 3.8.4.5 and 3.8.4.5.2 are revised to supplement the requirements of AISC N690-1994 by specifying that the quality and strength of welds is demonstrated through visual examination on the installed population of welded couplers, and through satisfactory MT and static tension testing performed on portions of the Cives uninstalled population of welded couplers and on a supplemental uninstalled population of welded couplers from Joseph Oat in lieu of the requirements of AISC N690-1994, Section Q1.26.2.2 for PJP 10 percent weld inspection, for #9 sized C3J coupler welds on carbon steel embedment plates already installed and embedded in concrete.

3. TECHNICAL EVALUATION

As specified in UFSAR Subsection 3.8.4.5, the analysis and design of concrete and structural steel conform to ACI 349-01 and AISC N690-1994, respectively. Supplemental requirements for structural steel are provided in UFSAR Subsection 3.8.4.5.2.

The change proposed by this activity demonstrates weld quality and strength to show that the embedded #9 sized C3J PJP coupler welds with fillet welds on carbon steel embedment plates already installed in concrete are capable of performing their intended design function and remain acceptable for use-as-is using VT, MT, and static tension testing in lieu of NDE. Demonstration of the strength and quality of these coupler welds associated with the carbon steel embedment plates as being capable of performing their intended design function is satisfied through a combination of satisfactory VT of the installed population of coupler welds, and through satisfactory MT and static tension testing performed on portions of the Cives uninstalled population of welded couplers and on a supplemental uninstalled population of welded couplers from Joseph Oat.

Note that no #11 sized C3J weldable couplers on carbon steel embedment plates, which lack the requisite AISC N690-1994 NDE, were installed at Vogtle Units 3 and 4; however, these weldable couplers were presented in this LAR to support the statistical analysis discussed later in this Technical Evaluation which is common to both Vogtle and V. C. Summer. V. C. Summer did install #11 sized C3J weldable couplers on carbon steel embedment plates. The inclusion of the #11 sized samples in the sample population is acceptable as the statistical analysis evaluates the entire population from Vogtle and V. C. Summer, taking into consideration the variations in the data set. As the #11 sized C3J weldable couplers were installed at V. C. Summer, the population for evaluation includes #11 sized samples. For further discussion, see “Demonstration of Coupler Weld Strength via Static Tension Testing” in this Technical Evaluation.

Demonstration of Satisfactory AISC N690-1994 Visual Inspection

AISC N690-1994 is the governing code for weld design. AISC N690-1994, Section Q1.26.2, "Minimum Examination of Welds," outlines the requirements for weld visual examination. Section Q1.26.2 states,

> "*All welds shall be visually examined in accordance with Section Q1.26.1.5 for 100 percent of their length.*"

Together with AISC N690-1994, Q1.26.2.2, "Partial-Penetration Welds," the combination of satisfactory requisite visual examination and magnetic particle examination of the PJP welds provides reasonable assurance that the PJP welds and their welded structural elements that are parts of the nuclear safety-related system, would not impair the ability of these systems or components to perform their safety-related functions. The following discussions pertain to the records of visual examinations in accordance with AISC N690-1994, Section Q1.26.2 for the populations of carbon steel embedment plates with welded couplers at Vogtle Units 3 & 4.

Cives Population of Carbon Steel Embedment Plates with Welded Couplers at Vogtle Units 3 & 4

As part of the Cives manufacturing process, the carbon steel embedment plates and their associated welded couplers undergo visual examination in accordance with the AISC N690-1994 code requirements. These visual examinations are documented in inspection reports for each embedment plate piece mark (i.e., component tag number/unique plate identifier) and transmitted to the site Owner with each carbon steel embedment plate load package shipment. A total of 262 Cives carbon steel embedment plates with 1214 welded couplers was provided to Vogtle Units 3 & 4 via eleven separate load packages. Each of the eleven load packages were reviewed and their corresponding inspection reports were confirmed to contain record of dates of satisfactory visual examination for each carbon steel embedment plate piece mark with welded couplers. Because the carbon steel embedment plates and their associated welded couplers did not undergo visual examination on the same day, Table 3-1 tabulates the Cives carbon steel embedment plates' shop load number along with the total number of carbon steel embedment plates and welded couplers for each load and also tabulates the range of earliest to latest documented satisfactory manufacturer visual examination dates for each load referenced from the respective load package inspection reports.

Table 3-1: Manufacturer Record of Satisfactory Weld Visual Examinations for Cives Population

Shop Load Number	Earliest VT Inspection Date of CS Embeds with Couplers in Load	Latest VT Inspection Date of CS Embeds with Couplers in Load	CS Embeds in Load	Welded Couplers in Load
L#20	6/19/2012	8/18/2013	71	284
L#15	6/19/2012	8/14/2013	90	360
L#5046	8/7/2013	4/7/2014	18	71
L#22	8/22/2013	8/28/2013	29	116
L#23	9/1/2013	9/1/2013	12	48
L#4047	3/25/2014	3/26/2014	18	71
L#4063	5/2/2014	5/22/2014	10	116
L#5063	5/6/2014	5/6/2014	2	60
L#5059	5/21/2014	5/21/2014	2	7
L#5064	5/22/2014	5/22/2014	9	65
L#4091	8/6/2014	8/6/2014	1	16
Total			262	1214

Review of the records containing the information reported in Table 3-1 confirms that the 1214 welded couplers on each of the 262 carbon steel embedment plates manufactured by Cives and provided to Vogtle Units 3 & 4 underwent satisfactory manufacturer visual examination in accordance with AISC N690-1994, Section Q1.26.2. Documentation of these satisfactory visual examinations supports the demonstration of the quality of the Cives carbon steel embedment plates' coupler welds and their supporting welded structural elements as being capable of performing their intended design function.

Note that in addition to the aforementioned record of satisfactory manufacturer VT, additional VT was performed on-site prior to performing NDE. In 24 instances, this additional site VT documented unsatisfactory results. As such, these welds with unsatisfactory on-site VT were determined to be appropriate candidates of welds to be included in the static tension test plan. However, 22 of the 24 welded couplers with unsatisfactory on-site VT were discarded and are no longer available for static tension testing in response to a corrective action which was generated to identify these embedment plates and welded couplers to be discarded (scrapped) in an effort to preclude installation of these unsatisfactory welded couplers. Thus, the remaining 2 welded couplers that documented unsatisfactory on-site VT were included in the test sample population of welded couplers that underwent static tension testing. Detailed results of the static tension testing performed on the two Cives coupler welds with unsatisfactory on-site VT is discussed later in this Technical Evaluation.

Joseph Oat Population of Carbon Steel Embedment Plates with Welded Couplers at Vogtle Unit 3

As part of the Joseph Oat manufacturing process, the welds joining the carbon steel embedment plates and their associated welded couplers undergo visual examination in accordance with AISC N690-1994 code requirements. These visual examinations are documented in non-destructive examination reports for each Joseph Oat embedment plate Job Number (Load Number) and transmitted to the site Owner via the Certificate of Compliance in the Joseph Oat Job Packages. The Joseph Oat carbon steel embedment plates with welded couplers that were manufactured and provided to Vogtle Unit 3 totaled 218 embedment plates with 872 welded couplers (4 welded couplers per embedment plate). Each of the 218 embedment plates correspond to an individual Joseph Oat Job Number as documented in the non-destructive examination reports. The 202 embedment plates with 808 welded couplers that were installed are individually numbered from Job J-2694-6A1 through Job J-2694-6A202. Additionally, the 16 spare embedment plates with 64 welded couplers are numbered individually as J-2694-6SP1 through J-2694-SP16. Each of the 218 Job Numbers' (embedment plates') non-destructive examination reports was reviewed and was confirmed to contain record of dates of satisfactory visual examination for each carbon steel embedment plate with welded couplers. Note however, that only 202 embedment plates with 808 welded couplers were installed under CA20 at Vogtle Unit 3 (J-2694-6A1 through J-2694-6A202) while the 16 spare embedment plates with 64 welded couplers were not installed, and were scrapped and are no longer available. Documentation of these satisfactory visual examinations supports the demonstration of the quality of the Joseph Oat carbon steel embedment plates with coupler welds and their supporting welded structural elements as being capable to perform their intended design function. Table 3-2 tabulates the dates of satisfactory manufacturer VT for the original, installed population of Joseph Oat carbon steel embedment plates with welded couplers.

Table 3-2: Manufacturer Record of Satisfactory Weld Visual Examinations on the Original Installed Joseph Oat Population

Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load	Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load
J-2694-6A1	9/19/2011	1	4	J-2694-6A102	10/11/2011	1	4
J-2694-6A2	2/17/2012	1	4	J-2694-6A103	10/12/2011	1	4
J-2694-6A3	9/19/2011	1	4	J-2694-6A104	10/12/2011	1	4
J-2694-6A4	9/19/2011	1	4	J-2694-6A105	10/12/2011	1	4
J-2694-6A5	9/19/2011	1	4	J-2694-6A106	10/12/2011	1	4
J-2694-6A6	9/19/2011	1	4	J-2694-6A107	10/12/2011	1	4
J-2694-6A7	9/19/2011	1	4	J-2694-6A108	10/12/2011	1	4
J-2694-6A8	9/19/2011	1	4	J-2694-6A109	10/14/2011	1	4
J-2694-6A9	9/20/2011	1	4	J-2694-6A110	10/14/2011	1	4
J-2694-6A10	9/20/2011	1	4	J-2694-6A111	10/14/2011	1	4

Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load	Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load
J-2694-6A11	9/20/2011	1	4	J-2694-6A112	10/14/2011	1	4
J-2694-6A12	9/20/2011	1	4	J-2694-6A113	10/14/2011	1	4
J-2694-6A13	9/20/2011	1	4	J-2694-6A114	10/14/2011	1	4
J-2694-6A14	9/20/2011	1	4	J-2694-6A115	10/13/2011	1	4
J-2694-6A15	9/20/2011	1	4	J-2694-6A116	10/13/2011	1	4
J-2694-6A16	9/20/2011	1	4	J-2694-6A117	10/13/2011	1	4
J-2694-6A17	9/20/2011	1	4	J-2694-6A118	10/13/2011	1	4
J-2694-6A18	9/20/2011	1	4	J-2694-6A119	10/13/2011	1	4
J-2694-6A19	9/21/2011	1	4	J-2694-6A120	10/13/2011	1	4
J-2694-6A20	9/21/2011	1	4	J-2694-6A121	10/17/2011	1	4
J-2694-6A21	9/21/2011	1	4	J-2694-6A122	10/17/2011	1	4
J-2694-6A22	9/21/2011	1	4	J-2694-6A123	10/17/2011	1	4
J-2694-6A23	9/22/2011	1	4	J-2694-6A124	10/17/2011	1	4
J-2694-6A24	9/22/2011	1	4	J-2694-6A125	10/17/2011	1	4
J-2694-6A25	9/22/2011	1	4	J-2694-6A126	10/17/2011	1	4
J-2694-6A26	9/22/2011	1	4	J-2694-6A127	10/17/2011	1	4
J-2694-6A27	9/22/2011	1	4	J-2694-6A128	10/17/2011	1	4
J-2694-6A28	9/22/2011	1	4	J-2694-6A129	10/17/2011	1	4
J-2694-6A29	9/22/2011	1	4	J-2694-6A130	10/17/2011	1	4
J-2694-6A30	9/22/2011	1	4	J-2694-6A131	10/17/2011	1	4
J-2694-6A31	9/22/2011	1	4	J-2694-6A132	10/18/2011	1	4
J-2694-6A32	9/22/2011	1	4	J-2694-6A133	10/18/2011	1	4
J-2694-6A33	9/22/2011	1	4	J-2694-6A134	10/18/2011	1	4
J-2694-6A34	9/22/2011	1	4	J-2694-6A135	10/18/2011	1	4
J-2694-6A35	9/22/2011	1	4	J-2694-6A136	10/18/2011	1	4
J-2694-6A36	9/22/2011	1	4	J-2694-6A137	10/18/2011	1	4
J-2694-6A37	9/22/2011	1	4	J-2694-6A138	10/18/2011	1	4
J-2694-6A38	9/26/2011	1	4	J-2694-6A139	10/18/2011	1	4
J-2694-6A39	9/26/2011	1	4	J-2694-6A140	10/18/2011	1	4
J-2694-6A40	9/26/2011	1	4	J-2694-6A141	10/18/2011	1	4
J-2694-6A41	9/26/2011	1	4	J-2694-6A142	10/18/2011	1	4
J-2694-6A42	9/27/2011	1	4	J-2694-6A143	10/18/2011	1	4

Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load	Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load
J-2694-6A43	9/27/2011	1	4	J-2694-6A144	10/18/2011	1	4
J-2694-6A44	9/27/2011	1	4	J-2694-6A145	10/18/2011	1	4
J-2694-6A45	9/27/2011	1	4	J-2694-6A146	10/18/2011	1	4
J-2694-6A46	9/27/2011	1	4	J-2694-6A147	10/18/2011	1	4
J-2694-6A47	9/27/2011	1	4	J-2694-6A148	10/19/2011	1	4
J-2694-6A48	9/27/2011	1	4	J-2694-6A149	10/19/2011	1	4
J-2694-6A49	9/28/2011	1	4	J-2694-6A150	10/19/2011	1	4
J-2694-6A50	9/28/2011	1	4	J-2694-6A151	10/20/2011	1	4
J-2694-6A51	9/28/2011	1	4	J-2694-6A152	10/20/2011	1	4
J-2694-6A52	9/28/2011	1	4	J-2694-6A153	10/20/2011	1	4
J-2694-6A53	9/28/2011	1	4	J-2694-6A154	10/20/2011	1	4
J-2694-6A54	9/28/2011	1	4	J-2694-6A155	10/20/2011	1	4
J-2694-6A55	9/30/2011	1	4	J-2694-6A156	10/20/2011	1	4
J-2694-6A56	9/30/2011	1	4	J-2694-6A157	10/20/2011	1	4
J-2694-6A57	9/30/2011	1	4	J-2694-6A158	10/20/2011	1	4
J-2694-6A58	9/30/2011	1	4	J-2694-6A159	10/20/2011	1	4
J-2694-6A59	9/30/2011	1	4	J-2694-6A160	10/20/2011	1	4
J-2694-6A60	9/30/2011	1	4	J-2694-6A161	10/20/2011	1	4
J-2694-6A61	10/3/2011	1	4	J-2694-6A162	10/20/2011	1	4
J-2694-6A62	10/3/2011	1	4	J-2694-6A163	10/20/2011	1	4
J-2694-6A63	10/3/2011	1	4	J-2694-6A164	10/20/2011	1	4
J-2694-6A64	10/3/2011	1	4	J-2694-6A165	10/20/2011	1	4
J-2694-6A65	10/3/2011	1	4	J-2694-6A166	10/20/2011	1	4
J-2694-6A66	10/3/2011	1	4	J-2694-6A167	10/20/2011	1	4
J-2694-6A67	10/4/2011	1	4	J-2694-6A168	10/20/2011	1	4
J-2694-6A68	10/4/2011	1	4	J-2694-6A169	10/20/2011	1	4
J-2694-6A69	10/4/2011	1	4	J-2694-6A170	10/31/2011	1	4
J-2694-6A70	10/4/2011	1	4	J-2694-6A171	10/24/2011	1	4
J-2694-6A71	10/4/2011	1	4	J-2694-6A172	10/24/2011	1	4
J-2694-6A72	10/4/2011	1	4	J-2694-6A173	10/24/2011	1	4
J-2694-6A73	10/5/2011	1	4	J-2694-6A174	10/24/2011	1	4
J-2694-6A74	10/5/2011	1	4	J-2694-6A175	10/24/2011	1	4

Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load	Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load
J-2694-6A75	10/5/2011	1	4	J-2694-6A176	10/24/2011	1	4
J-2694-6A76	10/5/2011	1	4	J-2694-6A177	10/24/2011	1	4
J-2694-6A77	10/5/2011	1	4	J-2694-6A178	10/24/2011	1	4
J-2694-6A78	10/5/2011	1	4	J-2694-6A179	10/24/2011	1	4
J-2694-6A79	10/6/2011	1	4	J-2694-6A180	11/1/2011	1	4
J-2694-6A80	10/6/2011	1	4	J-2694-6A181	10/25/2011	1	4
J-2694-6A81	10/6/2011	1	4	J-2694-6A182	10/25/2011	1	4
J-2694-6A82	10/6/2011	1	4	J-2694-6A183	10/25/2011	1	4
J-2694-6A83	10/6/2011	1	4	J-2694-6A184	10/25/2011	1	4
J-2694-6A84	10/7/2011	1	4	J-2694-6A185	10/25/2011	1	4
J-2694-6A85	10/7/2011	1	4	J-2694-6A186	10/25/2011	1	4
J-2694-6A86	10/7/2011	1	4	J-2694-6A187	10/26/2011	1	4
J-2694-6A87	10/7/2011	1	4	J-2694-6A188	10/26/2011	1	4
J-2694-6A88	10/7/2011	1	4	J-2694-6A189	10/26/2011	1	4
J-2694-6A89	10/7/2011	1	4	J-2694-6A190	10/26/2011	1	4
J-2694-6A90	10/7/2011	1	4	J-2694-6A191	10/26/2011	1	4
J-2694-6A91	10/10/2011	1	4	J-2694-6A192	10/26/2011	1	4
J-2694-6A92	10/10/2011	1	4	J-2694-6A193	10/26/2011	1	4
J-2694-6A93	10/10/2011	1	4	J-2694-6A194	10/26/2011	1	4
J-2694-6A94	10/10/2011	1	4	J-2694-6A195	10/26/2011	1	4
J-2694-6A95	10/10/2011	1	4	J-2694-6A196	10/26/2011	1	4
J-2694-6A96	10/10/2011	1	4	J-2694-6A197	10/26/2011	1	4
J-2694-6A97	10/11/2011	1	4	J-2694-6A198	10/26/2011	1	4
J-2694-6A98	10/11/2011	1	4	J-2694-6A199	10/27/2011	1	4
J-2694-6A99	10/11/2011	1	4	J-2694-6A200	10/27/2011	1	4
J-2694-6A100	10/11/2011	1	4	J-2694-6A201	10/27/2011	1	4
J-2694-6A101	10/11/2011	1	4	J-2694-6A202	10/27/2011	1	4
Total		101	404	Total		101	404
Grand Total: 202 embedment plates; 808 welded couplers							

Joseph Oat was contracted to fabricate and supply Vogtle Unit 3 with a supplemental population of 55 carbon steel embedment plates with a total of 220 welded couplers (4 welded couplers per embedment plate), not intended for installation, but which could be

used to perform the requisite AISC N690-1994 NDE. As with the original, installed population of Joseph Oat carbon steel embedment plates with welded couplers, this supplemental population underwent visual examination in accordance with the test specifications. Again, these visual examinations are documented in the non-destructive examination reports for each Joseph Oat embedment plate Job Numbers ranging from Job J-2721-A1 through J-2721-A55. Each of the non-destructive examination reports corresponding to the 55 supplemental, uninstalled carbon steel embedment plates with 220 welded couplers was reviewed and was confirmed to contain record of dates of satisfactory visual examination. This documentation of satisfactory visual examinations further supports the demonstration of the quality of the Joseph Oat carbon steel embedment plates with coupler welds and their supporting welded structural elements as being capable of performing their intended design function. Table 3-3 tabulates the dates of satisfactory manufacturer VT for the supplemental, uninstalled population of Joseph Oat carbon steel embedment plates with welded couplers.

Table 3-3: Manufacturer Record of Satisfactory Weld Visual Examinations on the Supplemental Uninstalled Joseph Oat Population

Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load	Joseph Oat Load Serial Number	VT Inspection Date	CS Embeds in Load	Welded Couplers in Load
J-2721-A1	11/19/2015	1	4	J-2721-A28	11/19/2015	1	4
J-2721-A2	11/20/2015	1	4	J-2721-A29	11/19/2015	1	4
J-2721-A3	11/20/2015	1	4	J-2721-A30	11/19/2015	1	4
J-2721-A4	11/23/2015	1	4	J-2721-A31	11/19/2015	1	4
J-2721-A5	11/20/2015	1	4	J-2721-A32	11/19/2015	1	4
J-2721-A6	11/23/2015	1	4	J-2721-A33	11/19/2015	1	4
J-2721-A7	11/20/2015	1	4	J-2721-A34	11/19/2015	1	4
J-2721-A8	11/19/2015	1	4	J-2721-A35	11/19/2015	1	4
J-2721-A9	11/20/2015	1	4	J-2721-A36	11/19/2015	1	4
J-2721-A10	11/20/2015	1	4	J-2721-A37	11/23/2015	1	4
J-2721-A11	11/19/2015	1	4	J-2721-A38	11/23/2015	1	4
J-2721-A12	11/19/2015	1	4	J-2721-A39	11/23/2015	1	4
J-2721-A13	11/28/2015	1	4	J-2721-A40	11/23/2015	1	4
J-2721-A14	11/20/2015	1	4	J-2721-A41	11/23/2015	1	4
J-2721-A15	11/20/2015	1	4	J-2721-A42	11/23/2015	1	4
J-2721-A16	11/20/2015	1	4	J-2721-A43	11/23/2015	1	4
J-2721-A17	11/23/2015	1	4	J-2721-A44	11/23/2015	1	4
J-2721-A18	11/20/2015	1	4	J-2721-A45	11/23/2015	1	4
J-2721-A19	11/19/2015	1	4	J-2721-A46	11/19/2015	1	4
J-2721-A20	11/19/2015	1	4	J-2721-A47	11/20/2015	1	4
J-2721-A21	11/19/2015	1	4	J-2721-A48	11/20/2015	1	4
J-2721-A22	11/19/2015	1	4	J-2721-A49	11/20/2015	1	4
J-2721-A23	11/19/2015	1	4	J-2721-A50	11/19/2015	1	4
J-2721-A24	11/19/2015	1	4	J-2721-A51	11/20/2015	1	4
J-2721-A25	11/19/2015	1	4	J-2721-A52	11/20/2015	1	4
J-2721-A26	11/19/2015	1	4	J-2721-A53	11/20/2015	1	4
J-2721-A27	11/19/2015	1	4	J-2721-A54	11/20/2015	1	4
				J-2721-A55	11/20/2015	1	4
Total		27	108	Total		28	112
Grand Total: 55 embedment plates; 220 welded couplers							

Note that in addition to the aforementioned record of satisfactory manufacturer VT, additional site VT was performed on-site prior to performing NDE. In four instances, this additional site VT documented unsatisfactory results and these four coupler welds were conservatively included in the test sample population of welded couplers that underwent static tension testing. Detailed results of the static tension testing performed on these four coupler welds with unsatisfactory on-site VT is discussed later in this Technical Evaluation.

Demonstration of Coupler Weld Strength via Static Tension Testing

The demonstration of coupler weld strength is performed via static tension testing and subsequent statistical analysis of carbon steel embedment plates with welded couplers. The issue regarding lack of requisite AISC N690-1994 NDE on carbon steel embedment plates with welded couplers is common to both Vogtle Units 3 & 4 and V.C. Summer Units 2 & 3. There are differences in the sites' individual populations of carbon steel embedment plates with coupler welds (i.e., two different manufacturers at Vogtle – one manufacturer at V.C. Summer; Vogtle installed #9 sized couplers – V.C. Summer installed #9 sized and #11 sized couplers). These individual coupler populations were combined into a single population for the static tension testing statistical analysis for the following reasons:

1. Both embedment plate coupler weld manufacturers used the same weld process and a qualified Welding Procedure Specification (WPS).
2. Variability associated with welders who performed the welds is minimized through the standard qualification process.
3. Both manufacturers used weld qualification processes in accordance with AWS D1.1, "Structural Welding Code – Steel," requirements.
4. Inclusion of both #9 sized and #11 sized coupler welds provides a more robust conclusion of the actual margins of the entire population, as this represents the inclusion of an additional variable present in the combined sample set population for the statistical analysis.

Therefore, the following discussion in this Technical Evaluation related to the static tension testing and statistical analysis was developed considering the populations of carbon steel embedment plates with C3J PJP welded couplers with fillet welds from Vogtle Units 3 & 4 and V.C. Summer Units 2 & 3 as a single population.

Recognizing that the requisite NDE was not performed on a representative sample of the installed population of Cives and Joseph Oat carbon steel embedment plates with welded couplers, a demonstration of sufficient weld strength is necessary to justify the capability of the installed populations of carbon steel embedment plate coupler welds and their associated structural elements to perform their intended design function. Though demonstration of weld strength is not a specific requirement of AISC N690-1994, such a demonstration supports the justification that the installed populations of carbon steel embedment plates with welded couplers are capable of performing their intended design function and are acceptable for use-as-is.

For the populations of Cives and Joseph Oat carbon steel embedment plates with welded couplers, a static tension testing method and test sample population was determined such that the samples tested are representative of the installed population of welded couplers.

As a consideration to the static tension testing method development and in order to credit the statically tested coupler welds as having sufficient strength to perform their intended design function, it was first necessary to establish a reasonable acceptance criterion for the required tensile strength of the coupler welds. A reasonable acceptance criterion for establishing a sufficient demonstration of such weld strength is referenced from ACI 349-01. The acceptance criterion for these tests is aligned with the ACI 349-01 requirement for mechanical anchorage of reinforcing steel. As applicable to the coupler-rebar splice system, a splice made by full mechanical connection must develop 125% of the specified yield strength of the reinforcing steel as required by ACI 349-01, Section 12.14.3.4. ACI 349-01, Section 12.14.3.4 requires that:

> "*A full mechanical connection shall develop in tension or compression, as required, at least 125% of specified yield strength fy of the bar.*"

The Commentary to ACI 349-01, Section 12.14.3 (by reference to ACI 318-95) states that:

> "*The maximum reinforcement stress used in design under the Code is the specified yield strength. To ensure sufficient strength in splices so that yielding can be achieved in a member and thus brittle failure avoided, the 25 percent increase above the specified yield strength was selected as both an adequate minimum for safety and a practicable maximum for economy.*"

The coupler strength requirement is extended to the weld to demonstrate that the coupler weld is stronger than the reinforcing bar. The ACI 349-01 requirement for the mechanical connection to meet 125% of the specified strength of the reinforcing bar has been applied to the coupler body, and by extension, the coupler weld to demonstrate that the coupler weld is stronger than the reinforcing bar. The scope of AISC N690-1994, Section Q1.22 includes requirements for design of anchorage of items embedded in concrete that are in tension. AISC N690-1994, Section Q1.22.2.2.2 states:

> "*Design of welded joints shall be in accordance with the requirements of the applicable provisions of this specification.*"

The weld strength required to meet the 125% of the specified yield strength of the reinforcing bar exceeds the AISC N690-1994 weld stress limits for design loads. Because the requirement to provide 125% of the specified yield strength of the reinforcing bar is not directly included in AISC N690-1994 Table Q1.5.7.1, the additional AISC N690-1994 Section Q1.0.1 provisions for demonstrating the adequacy of a system of design by analysis or test are followed.

AISC N690-1994, Section Q1.0.1 states that:

> "*The engineers of any system of design or construction within the scope of this specification, the adequacy of which has been shown by successful use or by analysis of test, but which does not conform to or is not covered by this Specification, shall have the right to present the data on which their design is based to the Regulatory Authority for review and approval.*"

To demonstrate that the investigated installed population of #9 sized and #11 sized (installed at V. C. Summer only) C3J couplers are adequate in their ability to perform their

safety function and demonstrate that the weld strength exceeds 125% of the specified yield strength of the reinforcing bar, a representative population was evaluated experimentally in two phases. The two phases of testing and the corresponding results of the statistical evaluations are summarized below.

Phase I: System Testing

Testing was performed for #9 sized and #11 sized C3J coupler sizes by the vendors as part of initial qualification tests required in accordance with the test specification. The tests were performed on each coupler size including the reinforcing bar, coupler, and coupler weld. The tension force was applied in compliance with ASTM A370, "Standard Test Methods and Definitions for Mechanical Testing of Steel Products."

Testing was performed on four #9 sized couplers and two #11 sized couplers. The static tension tests were performed until either the rebar or the mechanical connection of the rebar to the coupler failed. The static tension test results were evaluated to obtain 90/95% confidence interval break strength for each coupler size per ACI 349-01, Section B.4.2. 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 thread fail before the coupler weld fails in the connection system. Additional detail regarding the results and analysis of Phase I testing is provided later in this Technical Evaluation.

It is noted that ACI 349-01, Section 12.14.3.4.1(b), "Cyclic Tests," requires that three specimens of the bar-to-bar connection for each reinforcing bar size and grade shall be subjected to 100 cycles of tensile stress variations from 5% to 90% of the specified minimum yield strength of the reinforcing bar. The specimens shall withstand the cyclic test without loss of static tension strength capacity when compared with like static test specimens. The cyclic testing in ACI 349-01, Section 12.14.3.4.1(b) addresses the mechanical connection, and is a low-cycle elastic load used to demonstrate that the mechanical connection is robust and not subject to disruption under elastic design loads prior to being tested to its static limit. The statistical analysis demonstrates that load cycling does not influence the static break strength for various sizes of C3J couplers. Additional tests (Phase II) were performed by pulling the C3J coupler/weld in tension to failure. The tests were performed statically. Seismic loads are not considered high-cycle events, and are evaluated to static stress limits. The purpose of the weld test is to derive the margin between the proposed static stress limits and the static ultimate strength of the coupler/weld.

Phase II: Coupler Weld Testing

Testing was performed by pulling the #9 sized and #11 sized coupler system in tension to failure. The tests were performed by sampling the population of the uninstalled couplers that is representative of those that are installed that did not meet the NDE requirements of AISC N690-1994, Section Q1.26.2.

Test fixtures were welded onto the coupler/embedment plate sample taken from production run embedment plates to aid in fit-up to the tensile testing machine. A schematic representation of the test assembly is shown in Figure 3-1. The tests were performed at a qualified laboratory using a formal quality assurance (QA) program. Qualified welders performed the welding of fixtures to test samples, following welding procedure specifications

(WPS). The tension force was applied in compliance with ASTM A370. A total of thirty #9 sized samples and three #11 sized samples were tested in Phase II. Consideration of the fixture welding potentially impacting the coupler PJP weld to the carbon steel embedment plate was evaluated. The fixture welding performed as part of the test assembly has no evident effect upon the fabrication weld as depicted by the resulting hardness traverses being similar to the original fabrication sample.

a,c

(See Enclosure 2, Proprietary INSERT 1)

Figure 3-1: Test Assembly

The following items were considered during selection of the sample population. To represent both vendors, 15 samples were taken from Joseph Oat and 18 samples from Cives. Because these embedment plates were manufactured using the same qualification standards, weld process, weld procedure specifications, and that the failure plane was the same for all samples, the two vendor coupler populations for V.C. Summer and Vogtle were treated as one population for analysis purposes in this Technical Evaluation.

- **Sample Size**

  Thirty test specimens of the #9 coupler size and three test specimens of the #11 coupler size were tested. The sample size was chosen based upon the performance of two proof-of-concept tests for each coupler size, which demonstrated that the sample size would provide the desired confidence. Additionally, a further practical need was introduced by the necessity to demonstrate the samples selected were representative of those installed. To accomplish this, the potential variability of the production runs needed to be captured within the selected sample set.

- **Weld Process**

  The same qualified weld process was used for production welding of both the installed and uninstalled coupler populations. Gas Metal Arc Welding (GMAW) was used in all of the production welds for the root and cap pass on the fillet and PJP weld. This was confirmed through review of the vendors' qualified WPS for each process. This process is American Welding Society (AWS) code approved and the WPS requires qualification by test. Macro samples are required as part of the procedure qualification. The macro sample is required to show full fusion to the root of groove per Section 6.2.6.2 of American Welding Society, "Structural Welding Code – Reinforcing Steel," D1.4-1998 (AWS D1.4-1998). Therefore, the process used demonstrates full root fusion, resulting in equivalence in theoretical effective throat area for a given weld size.

- **Semi-Automatic Process**

  The production welds of both the installed and uninstalled coupler populations were performed with the same process. The GMAW welds were performed using a semi-automatic process in the horizontal position. This is referenced through a review of the vendors' qualified WPS for each process.

- **Human Performance Factors**

  The welders who performed the production welds were required to meet qualification requirements. Records indicate that 92 percent of the work performed by listed Cives welders on production welds for both the installed and uninstalled coupler populations is captured in the selected sample. The same material specifications, design, weld procedures, and to the extent possible the same welders who had performed the original PJP and fillet production welds would be representative of the installed coupler population. All of the Joseph Oat samples that were used for MT and static tension testing were fabricated specifically for this purpose (i.e., supplemental population) because Vogtle had installed all plates that were previously produced (i.e., original production population). All of the Cives carbon steel test samples at both sites (i.e., Vogtle and V.C. Summer) came from embedment plates that were intended to be installed and were performed as part of production welding.

- **Welding Procedure Specification (WPS)**

  The welding procedures used to perform the production welds reflect AWS D1.1 requirements. The same welding procedures were used for both the installed an uninstalled populations. Applicable manufacturer documents/procedures for embedment plates with #9 sized and #11 sized C3J weldable couplers are referenced in the statistical analysis that supports this LAR.

- **Nondestructive Examination (NDE)**

  For a limited number of couplers welded to carbon steel plates, examination in accordance with Section Q1.26.2 of AISC N690-1994 was not performed for the final surface condition. A sample of uninstalled production plates with coupler welds representative of those installed was subsequently examined by MT at the site. A limited number of couplers underwent VT per Section Q1.26.2 of AISC N690-1994 and did not receive a satisfactory rating. These couplers were not tested further with other NDE (i.e., MT) due to their failed VT. The sample set selected for static tension testing contains the possible NDE examination outcomes. The following conditions are referenced in Table 3-8 to identify the NDE condition represented by each static tension test performed in Phase II:

  i. Coupler welds which received a satisfactory VT and MT rating per Section Q1.26.2 of AISC N690-1994 with the welds in the original production welded condition. No localized conditioning was performed. This condition is represented in six of the selected samples as shown in Table 3-8.

  ii. Coupler welds which received a satisfactory VT rating, but the welds did not undergo any form of MT per Section Q1.26.2 of AISC N690-1994 with the welds in the original production welded condition. No localized conditioning was performed. This condition is represented in ten of the selected samples as shown in Table 3-8.

  iii. Coupler welds which received an unsatisfactory VT rating, but the welds did not undergo any form of MT per Section Q1.26.2 of AISC N690-1994 with the welds in the original production welded condition. No localized conditioning was performed. This condition is represented in two of the selected samples as shown in Table 3-8.

  iv. Coupler welds which received a satisfactory VT and MT rating per Section Q1.26.2 of AISC N690-1994 with the welds in the fabricated for static tension testing welded condition. No localized conditioning was performed. This condition is represented in two of the selected samples as shown in Table 3-8.

  v. Coupler welds which received a satisfactory VT rating and did not undergo any form of MT per Section Q1.26.2 of AISC N690-1994 with the welds in the fabricated for static tension testing welded condition. No localized conditioning was performed. This condition is represented in nine of the selected samples as shown in Table 3-8.

  vi. Coupler welds which received an unsatisfactory VT rating and did not undergo any form of MT per Section Q1.26.2 of AISC N690-1994 with the welds in the fabricated for static tension testing welded condition. No localized conditioning was performed. This condition is represented in four of the selected samples as shown in Table 3-8.

- **Filler Metal**

  The filler metal was procured in accordance with the applicable specification for both installed and uninstalled embedment plates. Certified Material Test Reports (CMTRs) for the material includes yield, tensile, % elongation, and Charpy impact results. The filler metal meets the requirements of AWS A5.18, "Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding," for the GMAW process. The weld metal mechanical properties are summarized in Table 3-4 for the GMAW process. The filler metal properties are taken from the work packages.

Table 3-4: Weld Filler Metal Mechanical Properties for GMAW

	GMAW Filler Metal	
Property	**Specified Minimum per AWS A5.18**	**CMTR***
Yield Strength, ksi	58	60.31
Tensile Strength, ksi	72.5**	75.23
Elongation, %	22	25
Charpy V-Notch Toughness, ft-lb	20 @ -20°F	38 @ -20°F

* Reported as-welded values from entire population provided by both vendors.
** Specification specifies a minimum of 72.5 ksi. AWS A5.18 minimum is 70 ksi.

- **Coupler Material**

  C3J couplers are procured to the requirements of the applicable specification for both the installed and uninstalled embedment plates. Minimum material properties are referenced in the statistical analysis supporting this LAR. CMTRs for the couplers identify the yield and tensile strength of the coupler material. The mechanical properties are taken from the work packages. The C3J coupler mechanical properties are detailed in Table 3-5.

Table 3-5: C3J Coupler Mechanical Properties

Vendor Load #	Coupler Diameter [in]	CMTR Yield Strength [ksi]	CMTR Tensile Strength [ksi]	Minimum Yield Strength [ksi]	Minimum Tensile Strength [ksi]
J-2721-A1/A55	1.56 (#9)	97.9	100.4		
4063	1.56 (#9)	97.9	100.4	64	90
2043	1.56 (#9)	97.9	100.4		
4091	2.00 (#11)	95.3	100.7	64	90

- **Fabrication Schedule**

  The dates at which production began and welding/inspection ended at the fabrication facility are identified in the work packages. Because the remaining embedment plates available for static tension testing were fabricated toward the end of production for both vendors, a representative population for the entire fabrication duration could not be achieved. To maximize the testing sample, one of the two vendors was contracted to duplicate fabrication efforts to simulate the original installed embedment plates (i.e., Joseph Oat supplemental population created for purposes of static tension testing since original fabrication population was completely installed). Therefore, production time was not considered, and common characteristics, as previously defined, for installed C3J couplers needed to be demonstrated within the selected testing sample in order to be representative.

Phase I Test Results and Analysis

a, c

(See Enclosure 2, Proprietary INSERT 2)

The test number, test break force, and calculated 90/95% confidence interval strengths are provided in Table 3-6. Test break forces are referenced from their respective vendor load packages.

Table 3-6: Weld Failure Test Data and Analysis for Phase I

a,c

(See Enclosure 2, Proprietary INSERT 3)

A review of the data reported in Table 3-6 confirms that the 90/95% confidence interval upper bound strength exceeds 125% of the specified yield strength of the reinforcing bar and exceeds the specified tensile strength of the reinforcing bar. The rebar or thread fails prior to weld failure in the connection system. It is noted that the vendor static tests are not associated to a specific Load number shipment, but are applicable to any coupler weld that was constructed to its specific WPS criteria. The vendors used the same approved quality plans in execution of AWS specifications for welding, and qualifications of welders, and inspection of the processes and welds was performed to confirm adherence to the requirements for each coupler size. A summary of the results of Phase I testing and analysis is provided in Table 3-7.

Table 3-7: Comparison of 125% of Specified Yield Strength of Reinforcing Bar to Static Tension Test Results for #9 and #11 Coupler Welds (Phase I Testing)

a, c

(See Enclosure 2, Proprietary INSERT 4)

<u>Phase II Test Results</u>

<u>#9 Coupler Test Results</u>

For all test samples, the failure location was within the C3J coupler body. The minimum code-predicted tensile strength of the filled-in coupler body was calculated to be approximately 172.7 kips, which is higher than the minimum code-predicted tensile strength of the weld (approximately 121.4 kips). The NDE condition of the production weld had no influence on the tested failure strength of the coupler system because all samples failed within the coupler body. In the tests, the welds developed the minimum code-predicted weld strength before failure. The average break load was 193.42 kips. Table 3-8 summarizes the test results, and provides the sample number and NDE condition as previously discussed in this Technical Evaluation.

<u>#11 Coupler Test Results</u>

For all test samples, the failure location was within the C3J coupler body. The minimum code-predicted tensile strength of the filled-in coupler body was calculated to be approximately 282.7 kips, which is higher than the minimum code-predicted tensile strength of the weld (approximately 197.7 kips). The NDE condition of the production weld had no influence on the tested failure strength of the coupler system because all samples failed within the coupler body. In the tests, the welds developed the minimum code-predicted strength before failure. The average break load was 347.42 kips. Table 3-8 summarizes the test results, and provides the sample number and NDE condition as previously discussed in this Technical Evaluation.

Table 3-8: Test Results for #9 and #11 Test Samples (Phase II)

a, c

(See Enclosure 2, Proprietary INSERT 5)

Phase II Test Results Analysis and Calculation of Safety Margin

Phase II testing was performed to investigate the strength of the coupler weld. As previously discussed, each sample failed within the coupler body, which demonstrates that the production PJP with fillet weld is stronger than the filled-in coupler body. Due to the nature of the test set-up and the tensile strengths of each component, it was not possible to force the failure point to the production weld group. Therefore, the test data demonstrates that the NDE condition of the production weld did not have any influence on the lower bound strength of the coupler system.

The tested 33 samples, the specimen numbers, and break loads are identified in Table 3-9. The tensile strength of the filled-in couplers was calculated using the CMTR tensile strength from Table 3-5. The break loads were normalized with the calculated strengths of a filled-in coupler sample, due to the coupler body being the location of sample failure. Statistical analysis was performed on the normalized value to derive a “test coefficient (c)” for the C3J coupler/welds.

The test data measured for the sample population follows a normal distribution. The one-sided tolerance limit approach can be applied to obtain a coefficient that allows 90/95% confidence interval.

Test Data

a,c

(See Enclosure 2, Proprietary INSERT 6)

The test coefficient (c) means the following equation can be used to calculate the coupler body tensile strength with a 90/95% confidence interval. The strength of the coupler weld is greater than this calculated value, but because the failure location for all test samples was within the coupler body, the strength of the system is considered as that of the coupler body.

a,c

(See Enclosure 2, Proprietary INSERT 7)

Table 3-9: Tensile Test Failure Data and Analysis

a, c

(See Enclosure 2, Proprietary INSERT 8)

Safety Margin

Safety margin was calculated using the nominal tensile strength and the test coefficient calculated based on the test data. This coefficient is penalized by lower bound failure modes and a finite sample size. The safety margin (or Factor of Safety, FoS) against the 125% yield strength of the rebar can be defined as:

a,c

(See Enclosure 2, Proprietary INSERT 9)

The minimum safety margin with respect to the 125% yield strength of the rebar and to the system strength was calculated in Table 3-10 and Table 3-11, respectively. Graphical representations of the safety margin with respect to 125% yield strength of the rebar and to the system for #9 sized and #11 sized samples is provided in Figure 3-2 and Figure 3-3, respectively.

Table 3-10: Minimum Safety Margin Compared to 125% Yield Strength of Rebar

a,c

(See Enclosure 2, Proprietary INSERT 10)

Table 3-11: Minimum Safety Margin Compared to System Strength

a,c

(See Enclosure 2, Proprietary INSERT 11)

a,c

(See Enclosure 2, Proprietary INSERT 12)

Figure 3-2: Minimum Safety Margin of #9 Coupler Weld

a,c

(See Enclosure 2, Proprietary INSERT 13)

Figure 3-3: Minimum Safety Margin of #11 Coupler Weld

Upon review of the analytical results of Phase I and Phase II testing reported in Table 3-7, Table 3-10, and Table 3-11, it is (1) demonstrated that the weakest link in the connection system is the rebar or the threads failing prior to failure of the fillet-reinforced PJP weld; and (2) static tension test results demonstrated sufficient safety margin at the 90/95% confidence level per ACI 349-01 Section B.4.2 beyond the AISC N690-1994 and ACI 349-01 125% yield strength of the reinforcing bar and the weak link (system strength) capacity of the connection system. As such, the aforementioned static tension test results and corresponding statistical analyses are sufficient to demonstrate the strength of the coupler welds installed at Vogtle Units 3 and 4. Based on this demonstration, it is concluded that the safety margin with respect to the design code requirements is met or exceeded by the installed coupler welds, and that these coupler welds are capable of performing their intended design function and are therefore acceptable for use-as-is.

Demonstration of Satisfactory AISC N690-1994 Magnetic Particle Examination

AISC N690-1994 is the governing code for weld design. AISC N690-1994, Section Q1.26.2.2, “Partial-Penetration Welds,” outlines the requirements for weld magnetic particle examination. Section Q1.26.2.2 states,

> “*Partial-penetration welds shall be 10 percent inspected by magnetic particle examination or liquid penetrant examination. The examination may be 10 percent of each weld or 100 percent of one weld in ten.*”

Together with AISC N690-1994, Section Q1.26.2, “Minimum Examination of Welds,” the combination of satisfactory requisite visual examination and magnetic particle examination of the PJP welds provides reasonable assurance that the PJP welds, and their welded structural elements which are parts of the nuclear safety-related system, would not impair the safety-related functions of these systems or components. The following discussions pertain to the records of magnetic particle examinations in accordance with AISC N690-1994, Section Q1.26.2.2 for the Cives and Joseph Oat populations of carbon steel embedment plates with welded couplers at Vogtle Units 3 & 4.

Cives Population of Carbon Steel Embedment Plates with Welded Couplers at Vogtle Units 3 & 4

A total of 262 carbon steel embedment plates with a total of 1214 #9 sized and #11 sized C3J Lenton® weldable couplers attached via PJP welds were fabricated by Cives, shipped to Vogtle Units 3 and 4, and accepted without the requisite NDE having been performed. Subsequent to receipt and acceptance of the 262 Cives carbon steel embedment plates at Vogtle Units 3 and 4, 233 embedment plates with a total of 869 welded couplers were installed (embedded in concrete) under the Vogtle Unit 3 CA01 module and under the Vogtle Unit 4 CA20 module. The remaining 203 welded couplers on a total of 29 carbon steel embedment plates have not been installed.

A sampling inspection plan was developed to perform NDE in accordance with AISC N690-1994 on 10 percent of the total population of the welds on carbon steel embedment plates. A sample set of 122 welded couplers was pooled to perform the requisite magnetic particle examination from the population of 203 welded couplers that were not embedded in concrete as this sample size is sufficient in magnitude to be representative of 10 percent of the total population of 1214 coupler welds received from Cives. Table 3-12 tabulates the results of

the magnetic particle examination performed on-site for the 10 percent sample of Cives coupler welds on carbon steel embedment plates in accordance with AISC N690-1994.

Table 3-12: AISC N690-1994 MT Results on Cives Carbon Steel Embedment Plate Coupler Welds

Shop Load Number	Embedment Plate Tag Number	Weld Number	Pass/ Fail	Shop Load Number	Embedment Plate Tag Number	Weld Number	Pass/ Fail
4047	APP-11209-CE-PF043	CW2	Pass	4063	APP-11201-CE-PF358	CW1	Pass
4047	APP-11209-CE-PF052	CW1	Pass	4063	APP-11201-CE-PF358	CW2	Pass
4047	APP-11209-CE-PF052	CW2	Pass	4063	APP-11201-CE-PF358	CW3	Pass
4047	APP-11209-CE-PF052	CW3	Pass	4063	APP-11201-CE-PF358	CW4	Pass
4047	APP-11209-CE-PF052	CW4	Pass	4063	APP-11201-CE-PF358	CW5	Pass
4047	APP-11209-CE-PF036	CW1	Pass	4063	APP-11201-CE-PF358	CW6	Pass
4047	APP-11209-CE-PF036	CW2	Pass	4063	APP-11201-CE-PF358	CW7	Pass
4047	APP-11209-CE-PF038	CW2	Pass	4063	APP-11201-CE-PF358	CW8	Pass
4047	APP-11209-CE-PF038	CW3	Pass	4063	APP-11201-CE-PF354	CW1	Pass
4047	APP-11209-CE-PF038	CW4	Pass	4063	APP-11201-CE-PF354	CW2	Pass
4047	APP-11209-CE-PF045	CW1	Pass	4063	APP-11201-CE-PF354	CW3	Pass
4047	APP-11209-CE-PF045	CW2	Pass	4063	APP-11201-CE-PF354	CW4	Pass
4047	APP-11209-CE-PF045	CW3	Pass	4063	APP-11201-CE-PF354	CW5	Pass
4047	APP-11209-CE-PF045	CW4	Pass	4063	APP-11201-CE-PF354	CW6	Pass
4047	APP-11209-CE-PF046	CW1	Pass	4063	APP-11201-CE-PF354	CW7	Pass
4047	APP-11209-CE-PF046	CW2	Pass	4063	APP-11201-CE-PF354	CW8	Pass
4047	APP-11209-CE-PF046	CW3	Pass	4063	APP-11201-CE-PF350	CW1	Pass
4047	APP-11209-CE-PF046	CW4	Pass	4063	APP-11201-CE-PF350	CW2	Pass
4047	APP-11209-CE-PF041	CW1	Pass	4063	APP-11201-CE-PF350	CW3	Pass
4047	APP-11209-CE-PF041	CW2	Pass	4063	APP-11201-CE-PF350	CW5	Pass
4047	APP-11209-CE-PF041	CW3	Pass	4063	APP-11201-CE-PF350	CW6	Pass
4047	APP-11209-CE-PF041	CW4	Pass	4063	APP-11201-CE-PF350	CW7	Pass
4047	APP-11209-CE-PF050	CW1	Pass	4063	APP-11201-CE-PF353	CW1	Pass
4047	APP-11209-CE-PF050	CW2	Pass	4063	APP-11201-CE-PF353	CW2	Pass
4047	APP-11209-CE-PF050	CW3	Pass	4063	APP-11201-CE-PF353	CW3	Pass
4047	APP-11209-CE-PF050	CW4	Pass	4063	APP-11201-CE-PF353	CW4	Pass
4047	APP-11209-CE-PF044	CW1	Pass	4063	APP-11201-CE-PF353	CW5	Pass
4047	APP-11209-CE-PF044	CW2	Pass	4063	APP-11201-CE-PF353	CW6	Pass
4047	APP-11209-CE-PF044	CW3	Pass	4063	APP-11201-CE-PF353	CW7	Pass
4047	APP-11209-CE-PF044	CW4	Pass	4063	APP-11201-CE-PF356	CW1	Pass
4047	APP-11209-CE-PF037	CW2	Pass	4063	APP-11201-CE-PF356	CW2	Pass
4047	APP-11209-CE-PF037	CW3	Pass	4063	APP-11201-CE-PF356	CW3	Pass

Shop Load Number	Embedment Plate Tag Number	Weld Number	Pass/ Fail	Shop Load Number	Embedment Plate Tag Number	Weld Number	Pass/ Fail
4047	APP-11209-CE-PF051	CW1	Pass	4063	APP-11201-CE-PF356	CW5	Pass
4047	APP-11209-CE-PF051	CW3	Pass	4063	APP-11201-CE-PF356	CW6	Pass
4047	APP-11209-CE-PF051	CW5	Pass	4063	APP-11201-CE-PF356	CW7	Pass
4047	APP-11209-CE-PF048	CW2	Pass	4063	APP-11201-CE-PF351	CW1	Pass
4047	APP-11209-CE-PF048	CW5	Pass	4063	APP-11201-CE-PF351	CW2	Pass
4047	APP-11209-CE-PF048	CW7	Pass	4063	APP-11201-CE-PF351	CW5	Pass
4047	APP-11209-CE-PF039	CW1	Pass	4063	APP-11201-CE-PF351	CW6	Pass
4047	APP-11209-CE-PF039	CW2	Pass	4063	APP-11201-CE-PF351	CW7	Pass
4047	APP-11209-CE-PF039	CW3	Pass	4063	APP-11201-CE-PF351	CW8	Pass
4047	APP-11209-CE-PF039	CW4	Pass	4063	APP-11201-CE-PF352	CW1	Pass
4047	APP-11209-CE-PF047	CW1	Pass	4063	APP-11201-CE-PF352	CW2	Pass
4047	APP-11209-CE-PF047	CW2	Pass	4063	APP-11201-CE-PF352	CW3	Pass
4047	APP-11209-CE-PF040	CW1	Pass	4063	APP-11201-CE-PF352	CW4	Pass
4047	APP-11209-CE-PF040	CW2	Pass	4063	APP-11201-CE-PF352	CW5	Pass
4047	APP-11209-CE-PF040	CW3	Pass	4063	APP-11201-CE-PF352	CW6	Pass
4047	APP-11209-CE-PF040	CW4	Pass	4063	APP-11201-CE-PF349	CW1	Pass
4063	APP-11201-CE-PF355	CW1	Pass	4063	APP-11201-CE-PF349	CW23	Pass
4063	APP-11201-CE-PF355	CW2	Pass	4063	APP-11201-CE-PF349	CW28	Pass
4063	APP-11201-CE-PF355	CW3	Pass	4063	APP-11201-CE-PF349	CW13	Pass
4063	APP-11201-CE-PF355	CW5	Pass	4063	APP-11201-CE-PF349	CW36	Pass
4063	APP-11201-CE-PF355	CW6	Pass	4063	APP-11201-CE-PF349	CW20	Pass
4063	APP-11201-CE-PF355	CW7	Pass	4063	APP-11201-CE-PF349	CW42	Pass
4063	APP-11201-CE-PF357	CW1	Pass	4063	APP-11201-CE-PF349	CW22	Pass
4063	APP-11201-CE-PF357	CW2	Pass	4063	APP-11201-CE-PF349	CW44	Pass
4063	APP-11201-CE-PF357	CW3	Pass	4091	APP-11201-CE-PF359	CW1	Pass
4063	APP-11201-CE-PF357	CW5	Pass	4091	APP-11201-CE-PF359	CW2	Pass
4063	APP-11201-CE-PF357	CW6	Pass	4091	APP-11201-CE-PF359	CW3	Pass
4063	APP-11201-CE-PF357	CW7	Pass	4091	APP-11201-CE-PF359	CW4	Pass
				4091	APP-11201-CE-PF359	CW9	Pass
				4091	APP-11201-CE-PF359	CW10	Pass

A review of the MT results tabulated in Table 3-12 indicates that the NDE performed on the Cives sample set of 122 welded couplers demonstrated 100% satisfactory results. However, it is recognized that the sample set of 122 NDE tested coupler welds is not entirely representative of the total installed population of couplers welded to Cives carbon steel embedment plates, because the 122 NDE tested coupler welds were pooled from only 3 of 11 total Cives shop fabrication loads. Despite the limited number of pooled loads, similarities exist between loads tested and loads untested such as being manufactured by the same fabricator

and using the same WPS and weld processes. Though it is determined that the sample set of Cives welded couplers that underwent MT is not entirely representative of the total installed population of welded couplers, documentation of these satisfactory magnetic particle examinations supports the demonstration of the quality of the Cives carbon steel embedment plates' coupler welds and their supporting welded structural elements as being capable to perform their intended design function.

Joseph Oat Population of Carbon Steel Embedment Plates with Welded Couplers at Vogtle Unit 3

A total of 218 carbon steel embedment plates with a total of 872 #9 sized C3J Lenton® weldable couplers attached via PJP welds with fillet weld reinforcement were fabricated by Joseph Oat and shipped to Vogtle Unit 3, and accepted without the requisite NDE having been performed. Subsequent to receipt and acceptance of the 218 Joseph Oat carbon steel embedment plates at Vogtle Unit 3, 202 embedment plates with a total of 808 welded couplers were installed (embedded in concrete) under the Vogtle Unit 3 CA20 module. The 16 remaining spare embedment plates with a total of 64 welded couplers were not installed and were scrapped and are no longer available for testing.

A sampling inspection plan considering the 808 welded couplers in the installed population could not be pooled for the requisite NDE testing as the entire population of these embedment plates with welded couplers had already been installed with the exception of the 16 spare embedment plates with 64 welded couplers that were not installed, but are no longer available. Therefore, Joseph Oat was contracted to fabricate and supply Vogtle Unit 3 with a supplemental population of 55 carbon steel embedment plates with a total of 220 #9 sized C3J welded couplers, not intended for installation, but which could be used to perform the requisite AISC N690-1994 NDE. Of this supplemental Joseph Oat population of 55 carbon steel embedment plates with 220 welded couplers, a sample set of 110 welded couplers (2 coupler welds from each of the 55 embedment plates) was pooled to perform the requisite magnetic particle examination. This sample size is sufficient in magnitude to be representative of 10 percent of the 1092 combined original and supplemental coupler weld populations received from Joseph Oat while allowing for a second 10 percent NDE sample set to be tested, if necessary, in accordance with AISC N690-1994, Q1.26.2.3. Table 3-13 tabulates the results of the magnetic particle examination performed on-site for the 10 percent sample of Joseph Oat coupler welds on carbon steel embedment plates in accordance with AISC N690-1994.

Table 3-13: AISC N690-1994 MT Results on Joseph Oat Carbon Steel Embedment Plate Coupler Welds

Joseph Oat Load Serial Number	Weld Number	Pass/Fail	Joseph Oat Load Serial Number	Weld Number	Pass/Fail
J-2721-A1	A-01-2	Pass	J-2721-A28	A-28-2	Pass
J-2721-A1	A-01-4	Pass	J-2721-A28	A-28-4	Pass
J-2721-A2	A-02-2	Pass	J-2721-A29	A-29-2	Pass
J-2721-A2	A-02-4	Pass	J-2721-A29	A-29-4	Pass
J-2721-A3	A-03-2	Pass	J-2721-A30	A-30-2	Pass
J-2721-A3	A-03-4	Pass	J-2721-A30	A-30-4	Pass
J-2721-A4	A-04-2	Pass	J-2721-A31	A-31-2	Pass
J-2721-A4	A-04-4	Pass	J-2721-A31	A-31-4	Pass
J-2721-A5	A-05-2	Pass	J-2721-A32	A-32-2	Pass
J-2721-A5	A-05-4	Pass	J-2721-A32	A-32-4	Pass
J-2721-A6	A-06-2	Pass	J-2721-A33	A-33-2	Pass
J-2721-A6	A-06-4	Pass	J-2721-A33	A-33-4	Pass
J-2721-A7	A-07-2	Pass	J-2721-A34	A-34-1	Pass
J-2721-A7	A-07-4	Pass	J-2721-A34	A-34-2	Pass
J-2721-A8	A-08-2	Pass	J-2721-A35	A-35-2	Pass
J-2721-A8	A-08-4	Pass	J-2721-A35	A-35-4	Pass
J-2721-A9	A-09-2	Pass	J-2721-A36	A-36-3	Pass
J-2721-A9	A-09-4	Pass	J-2721-A36	A-36-4	Pass
J-2721-A10	A-10-2	Pass	J-2721-A37	A-37-2	Pass
J-2721-A10	A-10-4	Pass	J-2721-A37	A-37-4	Pass
J-2721-A11	A-11-2	Pass	J-2721-A38	A-38-2	Pass
J-2721-A11	A-11-4	Pass	J-2721-A38	A-38-4	Pass
J-2721-A12	A-12-2	Pass	J-2721-A39	A-39-2	Pass
J-2721-A12	A-12-4	Pass	J-2721-A39	A-39-4	Pass
J-2721-A13	A-13-2	Pass	J-2721-A40	A-40-2	Pass
J-2721-A13	A-13-4	Pass	J-2721-A40	A-40-4	Pass
J-2721-A14	A-14-2	Pass	J-2721-A41	A-41-2	Pass
J-2721-A14	A-14-4	Pass	J-2721-A41	A-41-4	Pass
J-2721-A15	A-15-2	Pass	J-2721-A42	A-42-2	Pass
J-2721-A15	A-15-4	Pass	J-2721-A42	A-42-4	Pass
J-2721-A16	A-16-2	Pass	J-2721-A43	A-43-2	Pass
J-2721-A16	A-16-4	Pass	J-2721-A43	A-43-4	Pass
J-2721-A17	A-17-2	Pass	J-2721-A44	A-44-2	Pass
J-2721-A17	A-17-4	Pass	J-2721-A44	A-44-4	Pass

Joseph Oat Load Serial Number	Weld Number	Pass/Fail	Joseph Oat Load Serial Number	Weld Number	Pass/Fail
J-2721-A18	A-18-2	Pass	J-2721-A45	A-45-2	Pass
J-2721-A18	A-18-4	Pass	J-2721-A45	A-45-4	Pass
J-2721-A19	A-19-2	Pass	J-2721-A46	A-46-2	Pass
J-2721-A19	A-19-4	Pass	J-2721-A46	A-46-4	Pass
J-2721-A20	A-20-2	Pass	J-2721-A47	A-47-2	Pass
J-2721-A20	A-20-4	Pass	J-2721-A47	A-47-4	Pass
J-2721-A21	A-21-2	Pass	J-2721-A48	A-48-2	Pass
J-2721-A21	A-21-4	Pass	J-2721-A48	A-48-4	Pass
J-2721-A22	A-22-2	Pass	J-2721-A49	A-49-2	Pass
J-2721-A22	A-22-4	Pass	J-2721-A49	A-49-4	Pass
J-2721-A23	A-23-2	Pass	J-2721-A50	A-50-1	Pass
J-2721-A23	A-23-4	Pass	J-2721-A50	A-50-4	Pass
J-2721-A24	A-24-2	Pass	J-2721-A51	A-51-2	Pass
J-2721-A24	A-24-4	Pass	J-2721-A51	A-51-4	Pass
J-2721-A25	A-25-2	Pass	J-2721-A52	A-52-2	Pass
J-2721-A25	A-25-4	Pass	J-2721-A52	A-52-4	Pass
J-2721-A26	A-26-2	Pass	J-2721-A53	A-53-2	Pass
J-2721-A26	A-26-4	Pass	J-2721-A53	A-53-4	Pass
J-2721-A27	A-27-2	Pass	J-2721-A54	A-54-2	Pass
J-2721-A27	A-27-4	Pass	J-2721-A54	A-54-4	Pass
			J-2721-A55	A-55-2	Pass
			J-2721-A55	A-55-4	Pass

A review of the MT results tabulated in Table 3-13 indicates that the NDE performed on the Joseph Oat supplemental sample set of 110 welded couplers demonstrated 100% satisfactory results. However, it is recognized that the supplemental sample set of 110 NDE tested coupler welds is not entirely representative of the total installed population of couplers welded to Joseph Oat carbon steel embedment plates from Joseph Oat Load Numbers J-2694-6A1 through J-2694-6A202 because the 110 NDE tested coupler welds were pooled solely from the supplemental population of embedment plates with welded couplers which were fabricated more than three years post-fabrication of the Joseph Oat welded couplers from the original, fully-installed population. However, documentation of these satisfactory magnetic particle examinations supports the demonstration of the quality of the Joseph Oat carbon steel embedment plates' coupler welds and their supporting welded structural elements as being capable to perform their intended design function due to similarities in the weld processes used to fabricate the Loads J-2694-6A1 through J-2694-6A202 and the supplemental population in Loads J-2721-A1 through J-2721-A55 (e.g., same fabricator, same weld procedures).

Conclusion

Based upon the evaluation of the coupler welds, the following conclusions are drawn:

- The requisite AISC N690-1994 100% visual examination regarding entire population (installed and uninstalled) of Cives coupler welds on carbon steel embedment plates performed by the manufacturer is satisfactory in accordance with Section Q1.26.2.
- The requisite AISC N690-1994 100% visual examination regarding the entire population of installed Joseph Oat coupler welds on carbon steel embedment plates from Loads J-2694-6A1 through J-2694-6A202 performed by the manufacturer is satisfactory in accordance with Section Q1.26.2.
- The requisite AISC N690-1994 100% visual examination regarding the entire population of uninstalled, supplemental Joseph Oat coupler welds on carbon steel embedment plates from Loads J-2721-A1 through J-2721-A55 performed by the manufacturer is satisfactory in accordance with Section Q1.26.2.
- The Phase I static tension tests confirm that the reinforcing bar or the threads in the coupler fail before the PJP weld with fillet weld reinforcement fails.
- The Phase II static tension tests confirm that there is a minimum FoS of 2.08 (for the #9 sized samples) between the calculated tensile strength of the coupler at the 90/95% confidence interval against the 125% minimum yield strength of the reinforcing bar. This FoS was calculated including results from some static tension test samples which had on-site VT indications.
- The Phase II static tension tests confirm that there is a minimum FoS of 1.42 (for the #9 sized samples) between the calculated tensile strength of the coupler at the 90/95% confidence interval against the weak link (i.e., system strength, rebar/coupler threads) in the connection system. This FoS was calculated including results from some static tension test samples which had on-site VT indications.
- The Phase II samples all failed under tension within the coupler body, and demonstrate that the production PJP with fillet weld reinforcement is stronger than the filled-in coupler body. Due to the nature of the test setup and the tensile strengths of each component, it was not possible to force the failure point to the production weld group. Therefore, the test data demonstrates that the NDE condition of the production weld did not have any influence on the lower bound strength of the coupler system.
- Demonstration of 100% satisfactory magnetic particle testing on a 10% sample of the uninstalled population of Cives coupler welds on carbon steel embedment plates was performed per AISC N690-1994, Section Q1.26.2.2 which supports the determination that the Cives coupler welds are capable of performing their intended design function, though recognizing that the 10% tested sample did not pool coupler welds from all Cives shop fabrication loads.
- Demonstration of 100% satisfactory magnetic particle testing on a 10% sample of the uninstalled, supplementary population of Joseph Oat coupler welds on carbon steel

embedment plates was performed per AISC N690-1994, Section Q1.26.2.2 which supports the determination that the Joseph Oat coupler welds are capable of performing their intended design function. Though it is recognized that the 10% test sample did not pool coupler welds from the installed Joseph Oat coupler weld population, similarities between the manufacturers weld processes between fabrication of Loads J-2694-6A1 through J-2694-6A202 and Loads J-2721-A1 through J-2721-A55 (i.e., same fabricator, same weld procedures) supports the crediting of the MT tested weld samples in assuring that the installed Joseph Oat coupler welds are capable of performing their intended design function.

Change Evaluation

The proposed change demonstrates weld quality and strength of uninstalled production and supplemental populations of #9 sized C3J coupler PJP welds with reinforcing fillet welds using VT, MT, and static tension testing in lieu of NDE as being sufficient for the installed coupler welds to perform their intended design function.

The proposed change does not change the support, design, or operation of mechanical or fluid systems. The proposed change does not impact the support, design, or operation of any safety-related structures. The proposed change does not affect the ability of seismic Category I structures to resist design basis loadings. The change to the evaluation of the coupler welds does not change the capacity, function, or response to anticipated transients or postulated accident conditions of any system, structure, or component (SSC). There is no change to plant systems or the response of systems to postulated accident conditions. The proposed change does not affect the prevention or mitigation of abnormal events; e.g., accidents, anticipated operational occurrences, earthquakes, floods and turbine missiles, or their safety or design analyses. There is no change to the predicted radioactive releases due to normal operation or postulated accident conditions. The plant response to previously evaluated accidents or external events is not adversely affected, nor does the proposed change described create any new accident precursors.

The proposed change does not adversely affect any safety-related equipment, design code, design code allowable value, function or design analysis, nor does the proposed change adversely affect any safety analysis input or result, or design/safety margin. The proposed change does not interface with or affect safety-related equipment or a fission product barrier. The change does not result in a new failure mode, malfunction or sequence of events that could adversely affect a radioactive material barrier or safety-related equipment. The proposed change does not allow for a new fission product release path, result in a new fission product barrier failure mode, or create a new sequence of events that would result in significant fuel cladding failures.

The proposed change does not affect the radiological source terms (i.e., amounts and types of radioactive materials released, their release rates and release durations) used in the accident analyses, thus, the consequences of accidents are not affected. This change does not affect the containment, control, channeling, monitoring, processing or releasing of radioactive or non-radioactive materials. The location and design of penetrations and the permeability and waterproofing of the concrete in the exterior walls are not changed. The interface between the nuclear island and the external surrounding environment is not impacted by the proposed change. The types and quantities of expected effluents are not changed. No effluent release

path is affected. The functionality of the design and operational features that are credited with controlling the release of effluents during plant operation is not diminished. Therefore, neither radioactive nor non-radioactive material effluents are affected. Plant radiation zones, controls required by 10 CFR Part 20, and expected amounts and types of radioactive materials, are not affected by the proposed change. Therefore, individual and cumulative radiation exposures do not change.

The proposed change does not involve, nor interface with, any SSC accident initiator or initiating sequence of events, and thus, the probabilities of the accidents evaluated in the UFSAR are not affected.

The proposed change has no adverse effect on the ex-vessel severe accident. The overall design, geometry, and strength of the containment internal structures and other seismic Category I structures are not adversely affected. The design and material selection of the concrete floor beneath the reactor vessel is not altered. The response of the containment to a postulated reactor vessel failure, including direct containment heating, ex-vessel steam explosions, and core concrete interactions is not altered by the change to the evaluation of coupler welds used in structural modules. The design of the reactor vessel and the response of the reactor vessel to a postulated severe accident are not altered by the proposed change.

The proposed change has no adverse impact on the Aircraft Impact Assessment (AIA). The change described is internal to the structures and does not impact the design or response of the containment vessel or shield building because the failure mechanism remains ductile yield of the rebar, as analyzed in the AIA, and not of the weld. There is no change to protection of plant SSCs against aircraft impact provided by the design of the shield building. There is no change to the conclusion that a strike upon the auxiliary building would not result in a loss of spent fuel pool liner integrity. There is no change to the design of key design features described in UFSAR Appendix 19F.

The proposed change does not adversely impact the design of critical sections described in UFSAR Appendix 3H.

The change activity has no impact on the emergency plans or the physical security evaluation because there are no changes to the configuration of walls, doors, or access to the Nuclear Island.

<u>Summary</u>

The proposed change would revise UFSAR Subsection 3.8.4.5.2 Tier 2* information to specify the supplemental requirements of American Institute of Steel Construction (AISC) N690-1994, "*American National Standard Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities*," (AISC N690-1994), Section Q1.26.2.2, "Partial-Penetration Welds," for the demonstration of sufficient strength and quality of the carbon steel embedment plate coupler welds to be credited as justification for the demonstration that the installed coupler welds are capable of performing their intended design function.

The proposed change does not adversely affect the design functions of the weldable couplers or the structures in which the couplers are used.

The proposed change provides adequate protection for design basis events, does not adversely affect any safety-related equipment, design code and standard allowable value, safety-related function or design analysis, nor does the change adversely affect any safety analysis input or result, radioactive missile barrier, or design/safety margin.

4. REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

10 CFR Part 52, Appendix D, VIII.B.6, requires prior NRC approval for the departure from Tier 2* information. This change, which includes changes to supplemental requirements for steel structures, includes a Tier 2* departure and thus requires NRC approval. Therefore, a license amendment request (LAR) (as supplied herein) is required.

10 CFR Part 50, Appendix A, General Design Criterion (GDC) 1 requires that structures be designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety functions to be performed. The proposed change does not adversely change the criteria for the design, analysis, and construction of nuclear island structures. These structures remain in conformance with the code requirements identified in the UFSAR (i.e., applicable portions of ACI 349-01 and AISC N690-1994) and the supplemental requirements identified in UFSAR Section 3.8, as supplemented by this proposed LAR. Therefore, it is concluded that compliance with 10 CFR Part 50, Appendix A, GDC 1 is not impacted as part of the proposed LAR.

10 CFR Part 50, Appendix A, GDC 2 requires that structures withstand the effects of earthquakes and appropriate combinations of the effects of normal and accident conditions, including the effects of environmental loadings, such as earthquakes and other natural phenomena. The proposed change has no impact on the seismic motions to which the nuclear island structures are subjected, no impact on the response of the nuclear island structures to seismic motions, and no impact on the ability of the structures to resist seismic loads. Therefore, it is concluded that compliance with 10 CFR Part 50, Appendix A, GDC 2 is not impacted as part of the proposed LAR.

10 CFR Part 50, Appendix A, GDC 4 requires that systems, structures and components can withstand the dynamic effects associated with missiles, pipe whipping, and discharge fluids, excluding dynamic effects associated with pipe ruptures, the probability of which is extremely low under conditions consistent with the design basis for the piping. The proposed change does not change the configuration of the walls and floors which provide separation between sources and potential targets. The proposed change has no impact on the capability of the systems, structures and components to withstand dynamic effects associated with missiles, pipe whipping, and discharging fluids as required by the criterion. The proposed change does not change the requirements for anchoring safety-related components and supports to seismic Category I structures. Therefore, it is concluded that compliance with 10 CFR Part 50, Appendix A, GDC 4 is not impacted as part of the proposed LAR.

4.2 Precedent

No precedent is identified.

4.3 Significant Hazards Consideration Determination

The requested amendment proposes a change to Updated Final Safety Analysis Report (UFSAR) Tier 2* information to specify the supplemental requirement of American Institute of Steel Construction (AISC) N690-1994, "American National Standard Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities," (AISC N690-1994), Section Q1.26.2.2, "Partial-Penetration Welds," for the demonstration of sufficient strength and quality of the carbon steel embedment plate coupler welds to be credited as justification for the determination that the installed coupler welds are capable of performing their intended design function.

The requested amendment proposes a change to Tier 2* information.

An evaluation to determine whether or not a significant hazards consideration is involved with the proposed amendment was completed by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

4.3.1 Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No

The proposed change describes how evaluation of coupler strength, and by extension, weld strength and quality are used to demonstrate the capacity of partial joint penetration (PJP) welds with fillet weld reinforcement joining weldable couplers to carbon steel embedment plates as being able to perform their intended design function in lieu of satisfying the American Institute of Steel Construction (AISC) N690-1994, Section Q1.26.2.2 requirement for non-destructive examination (NDE) on 10 percent weld populations. The proposed change does not affect the operation of any systems or equipment that initiate an analyzed accident or alter any structures, systems, and components (SSCs) accident initiator or initiating sequence of events.

The change has no adverse effect on the design function of the mechanical couplers or the SSCs to which the mechanical couplers are welded. The probabilities of the accidents evaluated in the Updated Final Safety Analysis Report (UFSAR) are not affected.

The change does not impact the support, design, or operation of mechanical or fluid systems. The change does not impact the support, design, or operation of any safety-related structures. 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 normal operation or postulated accident conditions. The plant response to previously evaluated accidents or external events is not adversely affected, nor does the proposed change create any new accident precursors.

Therefore, the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

4.3.2 Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No

The proposed change describes how evaluation of coupler strength, and by extension, weld strength and quality are used to demonstrate the capacity of PJP welds with fillet weld reinforcement joining weldable couplers to carbon steel embedment plates as being able to perform their design function in lieu of satisfying the AISC N690-1994, Section Q1.26.2.2 requirement for non-destructive examination on 10 percent weld populations. The proposed change does not affect the operation of any systems or equipment that may initiate a new or different kind of accident, or alter any SSC such that a new accident initiator or initiating sequence of events is created.

The proposed change does not adversely affect the design function of the mechanical couplers, the structures in which the couplers are used, or any other SSC design functions or methods of operation in a manner that results in a new failure mode, malfunction, or sequence of events that affect safety-related or non-safety-related equipment. This activity does not allow for a new fission product release path, result in a new fission product barrier failure mode, or create a new sequence of events that result in significant fuel cladding failures.

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

4.3.3 Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No

The proposed change describes how evaluation of coupler strength, and by extension, weld strength and quality are used to demonstrate the capacity of PJP welds with fillet weld reinforcement joining weldable couplers to carbon steel embedment plates as being able to perform their design function in lieu of satisfying the AISC N690-1994, Section Q1.26.2.2 requirement for non-destructive examination on 10 percent weld populations. The proposed change satisfies the same design functions in accordance with the same codes and standards as stated in the UFSAR. This change does not adversely affect compliance with any design code, function, design analysis, safety analysis input or result, or design/safety margin. No safety analysis or design basis acceptance limit/criterion is challenged or exceeded by the proposed change.

Because no safety analysis or design basis acceptance limit/criterion is challenged or exceeded by this change, no significant margin of safety is reduced.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, it is concluded that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

4.4 Conclusions

This assessment addresses the considerations discussed above. The plant licensing bases, safety analyses, and design bases evaluations demonstrate that the requested change is accommodated without an increase in the probability or consequences of an accident previously evaluated, without creating the possibility of a new or different kind of accident from any accident previously evaluated, and without a significant reduction in a margin of safety. In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (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 to the health and safety of the public. Having arrived at negative declarations with regard to the criteria in 10 CFR 50.92, this assessment determined that the requested change does not involve a Significant Hazards Consideration.

5. ENVIRONMENTAL CONSIDERATIONS

This review supports a request to amend the Combined License (COL) to allow departure from various elements of the certification information in the Updated Final Safety Analysis Report (UFSAR) Tier 2*. The proposed amendment specifies the supplemental requirement of American Institute of Steel Construction (AISC) N690-1994, "American National Standard Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities," (AISC N690-1994), Section Q1.26.2.2, "Partial-Penetration Welds," for the demonstration of sufficient strength and quality of the couplers, and by extension, coupler welds on carbon steel embedment plates to be credited in justification for the installed coupler welds being capable of performing their intended design function.

Sections 2 and 3 of this license amendment request (LAR) provide the details of the proposed change.

The Licensee has determined that the anticipated construction and operational effects of the proposed amendment meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9), in that:

(i) There is no significant hazards consideration.

As documented in Section 4.3, Significant Hazards Consideration Determination, of this LAR, an evaluation was completed to determine whether or not a significant hazards consideration is involved by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment." The Significant Hazards Consideration determined that (1) the requested amendment does not involve a significant increase in the probability or

consequences of an accident previously evaluated; (2) the requested amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated; and (3) the requested amendment does not involve a significant reduction in a margin of safety. Therefore, it is concluded that the requested amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly, a finding of "no significant hazards consideration" is justified.

(ii) There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

The proposed change revises how evaluation of coupler strength, and by extension, weld strength and quality are used to demonstrate the capacity of PJP welds joining weldable couplers to carbon steel embedment plates satisfies the AISC N690-1994, Section Q1.26.2.2 requirement for non-destructive examination on 10 percent weld populations. Therefore, the proposed change is unrelated to any aspect of plant construction or operation that would introduce any change to effluent types (e.g., effluents containing chemicals or biocides, sanitary system effluents, and other effluents), or affect any plant radiological or non-radiological effluent release quantities. Furthermore, the proposed change does not affect any effluent release path or diminish the functionality of any design or operational features that are credited with controlling the release of effluents during plant operation.

Therefore, it is concluded that the requested amendment does not involve a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite.

(iii) There is no significant increase in individual or cumulative occupational radiation exposure.

The proposed change revises how evaluation of coupler strength, and by extension, weld strength and quality are used to demonstrate the capacity of PJP welds joining weldable couplers to carbon steel embedment plates satisfies the AISC N690-1994, Section Q1.26.2.2 requirement for non-destructive examination on 10 percent weld populations. Plant radiation zones (addressed in UFSAR Section 12.3) are not affected, and controls under 10 CFR 20 preclude a significant increase in occupational radiation exposure. Therefore, the requested amendment does not involve a significant increase in individual or cumulative occupational radiation exposure.

Based on the above review of the proposed amendment, it has been determined that anticipated construction and operational impacts of the proposed amendment do not involve, (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in the individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment 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 need be prepared in connection with the proposed amendment.

6. REFERENCES

None.

Southern Nuclear Operating Company

ND-16-1894

Enclosure 2

Vogtle Electric Generating Plant (VEGP) Units 3 and 4

Proprietary Information for Request for License Amendment: Nondestructive Examination for Welds of Couplers to Carbon Steel Embedment Plates

(LAR-16-027)

(Withheld Information)

(Enclosure 2 consists of 13 pages, including this cover page)

Southern Nuclear Operating Company

ND-16-1894

Enclosure 3

Vogtle Electric Generating Plant (VEGP) Units 3 and 4

Proposed Changes to the Licensing Basis Documents

(LAR-16-027)

Note:
Added text is shown as bold **Blue Underline**
Deleted text is shown as bold ~~**Red Strikethrough**~~

Omitted text is shown as three asterisks (* * *)

(Enclosure 3 consists of 4 pages, including this cover page)

UFSAR Subsection 3.8.4.5 "Structural Criteria" – Revise to add the following Tier 2* text. (NOTE: Text identical to the proposed change to Subsection 3.8.4.5 is also proposed for incorporation by LAR-16-016 [ADAMS Accession Nos. ML16242A399 and ML16242A400.] The order of incorporation of either change, following NRC approval, will not impact review, approval, or incorporation of the change in the other LAR.)

[*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 Section Q1.26.2.2, for the non-conforming partial penetration welds associated with reinforcement bar size #9 C3J couplers installed on carbon steel embedment plates under CA20 at Vogtle Unit 3 and Unit 4 and under CA01 at Vogtle Unit 3 that did not undergo non-destructive examination at the time of fabrication, the strength and quality of the welds is demonstrated through non-destructive examination and static tension testing of portions of the original production and supplemental, uninstalled populations and through visual examination of the production populations as follows:*
  - *Visual Examination: Coupler welds from the production fabrication populations underwent visual examination by the manufacturers. The manufacturers' 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 populations of #9 sized C3J coupler welds on carbon steel embedment plates is adequate in the ability to perform their intended design function, static tension testing of portions of the original production and supplemental, uninstalled populations of welds is evaluated experimentally in two phases.*

    Phase I: Static tension testing has been performed on a total of four #9 sized couplers. The static tension test results were evaluated to obtain the 90/95% confidence interval break strength. 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 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 30 #9 sized couplers was tested. 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 populations of coupler welds, the test sample population

considered factors such as sample size, weld process, semi-automatic processes, human performance factors, welding procedure specification, non-destructive examination, 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 thread). The minimum safety margin with respect to the 125% yield strength of the rebar was calculated to be 2.08 for the #9 sized couplers. The minimum safety margin with respect to the system strength was calculated to be 1.42 for the #9 sized couplers.

- *Non-destructive examination of portions of the original production and supplemental, uninstalled populations: Magnetic particle examination was performed on 10% of the total populations of welds from the uninstalled original production population and from the uninstalled supplemental population. The magnetic particle examinations provided satisfactory results.]**

Southern Nuclear Operating Company

ND-16-1894

Enclosure 4

Vogtle Electric Generating Plant (VEGP) Units 3 and 4

Affidavit from Southern Nuclear Operating Company for Withholding Under 10 CFR 2.390

(LAR-16-027)

(Enclosure 4 consists of 2 pages, plus this cover page)

Affidavit of Wesley A. Sparkman

1. My name is Wesley A. Sparkman. I am the Regulatory Affairs Licensing Manager, Nuclear Development, for Southern Nuclear Operating Company (SNC). I have been delegated the function of reviewing proprietary information sought to be withheld from public disclosure and am authorized to apply for its withholding on behalf of SNC.
2. I am making this affidavit on personal knowledge, in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations, and in conjunction with SNC's filing on dockets 52-025 and 52-026, Vogtle Electric Generating Plant Units 3 and 4, Request for License Amendment: Nondestructive Examination for Welds of Couplers to Carbon Steel Embedment Plates (LAR-16-027), also referred to as SV0-FSAR-GLN-011, Revision 0, AP1000 Licensing Applicability Determination and 10 CFR 50.59 / 10 CFR 52 Appendix D Section VIII Screening: CAPAL Issue ID 100361145; V7; LAR-134. I have personal knowledge of the criteria and procedures used by SNC to designate information as a trade secret, privileged or as confidential commercial or financial information.
3. Based on the reason(s) at 10 CFR 2.390(a)(4), this affidavit seeks to withhold from public disclosure Enclosure 2 of SNC letter ND-16-1894 for Vogtle Electric Generating Plant Units 3 and 4, Request for License Amendment: Nondestructive Examination for Welds of Couplers to Carbon Steel Embedment Plates (LAR-16-027).
4. The following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.
    a. The information sought to be withheld from public disclosure has been held in confidence by SNC and Westinghouse Electric Company.

b. The information is of a type customarily held in confidence by SNC and Westinghouse Electric Company and not customarily disclosed to the public.

c. The release of the information might result in the loss of an existing or potential competitive advantage to SNC and/or Westinghouse Electric Company.

d. Other reasons identified in Enclosure 5 of SNC letter ND-16-1894 for Vogtle Electric Generating Plant Units 3 and 4, Request for License Amendment: Nondestructive Examination for Welds of Couplers to Carbon Steel Embedment Plates (LAR-16-027), and those reasons are incorporated here by reference.

5. Additionally, release of the information may harm SNC because SNC has a contractual relationship with the Westinghouse Electric Company regarding proprietary information. SNC is contractually obligated to seek confidential and proprietary treatment of the information.
6. The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.
7. To the best of my knowledge and belief, the information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method.

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

Wesley A. Sparkman

Executed on 10-20-16
Date

Southern Nuclear Operating Company

ND-16-1894

Enclosure 5

Vogtle Electric Generating Plant (VEGP) Units 3 and 4

**Westinghouse Authorization Letter CAW-16-4483, Affidavit,
Proprietary Information Notice and Copyright Notice**

(LAR-16-027)

(Enclosure 5 consists of 10 pages, plus this cover page.)

Westinghouse

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CAW-16-4483

October 10, 2016

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: Transmittal of License Amendment Request SV0-FSAR-GLN-011, Revision 0 (Westinghouse LAR-134, Southern LAR-16-027) (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-16-4483 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The Affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying Affidavit by Southern Nuclear Company.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the Westinghouse Affidavit should reference CAW-16-4483, and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

Very truly yours,

Paul A. Russ, Director
Licensing & Regulatory Support

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Enclosures to CAW-16-4483

1. AFFIDAVIT CAW-16-4483
2. PROPRIETARY INFORMATION NOTICE and COPYRIGHT NOTICE
3. Southern Nuclear Company, Letter for Transmittal to the NRC
4. SV0-FSAR-GLN-011, Revision 0, "*AP1000* Licensing Applicability Determination and 10 CFR 50.59 / 10 CFR 52 Appendix D Section VIII Screening: CAPAL Issue ID 100361145; V7; LAR-134"

ENCLOSURE 1

CAW-16-4483

AFFIDAVIT

CAW-16-4483
October 10, 2016

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

I, Paul A. Russ, am authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.

Paul A. Russ, Director
Licensing & Regulatory Support

(1) I am Director, Licensing & Regulatory Support, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Westinghouse policy and provide the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(iii) There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iv) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.

(v) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(vi) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in SV0-FSAR-GLN-011, Revision 0, "*AP1000* Licensing Applicability Determination and 10 CFR 50.59 / 10 CFR 52 Appendix D Section VIII Screening: CAPAL Issue ID 100361145; V7; LAR-134," for submittal to the Commission, being transmitted by Southern Nuclear Company letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with the NRC review of the License Amendment Request SV0-FSAR-GLN-011, Revision 0 (Westinghouse LAR-134, Southern LAR-16-027), and may be used only for that purpose.

(a) This information is part of that which will enable Westinghouse to:

   (i) Manufacture and deliver products to utilities based on proprietary designs.

(b) Further this information has substantial commercial value as follows:

   (i) Westinghouse plans to sell the use of similar information to its customers for the purpose of licensing of new nuclear power stations.

   (ii) Westinghouse can sell support and defense of industry guidelines and acceptance criteria for plant-specific applications.

   (iii) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

ENCLOSURE 2

PROPRIETARY INFORMATION NOTICE and COPYRIGHT NOTICE

CAW-16-4483
October 10, 2016

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the Affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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