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SCE&G®
A SCANA COMPANY

February 24, 2014
RC-14-0021

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

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
RELIEF REQUEST RR-4-05 ALTERNATIVE WELD REPAIR FOR REACTOR VESSEL UPPER HEAD PENETRATIONS

Reference:

1. WCAP-15987-P-A Revision 2, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations"

2. WCAP-17758-P, Revision 0, "Technical Basis for Westinghouse Embedded Flaw Repair for V.C. Summer Unit 1 Reactor Vessel Head Penetration Nozzles and Attachment Welds"

3. Letter from H. N. Berkow (U. S. NRC) to H. A. Sepp (Westinghouse Electric Company), "Acceptance for Referencing - Topical Report WCAP-15987-P, Revision 2, 'Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations,' (TAC NO. MB8997)," dated July 3, 2003 [ML031840237]

4. Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Reactor Vessel Head Penetration Weld Repair Under WCAP-15987," dated October 22, 2012 [ML12306A530]

5. Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Transmittal of WCAP-17758-P, Revision 0, 'Technical Basis for Westinghouse Embedded Flaw Repair for V.C. Summer Unit 1 Reactor Vessel Head Penetration Nozzles and Attachment Welds'," dated September 5, 2013 [ML13252A143]

Pursuant to 10CFR50.55a(g)(6)(ii)(D), South Carolina Electric & Gas Company (SCE&G), acting for itself and as an agent for South Carolina Public Service Authority, hereby submits a request for relief. In accordance with 10CFR50.55a(a)(3)(i), SCE&G is requesting relief from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components" in that proposed alternatives would provide an acceptable level of quality and safety.

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Specifically, this relief request proposes to perform an alternative repair technique using the embedded flaw repair of Reference 1 on the reactor vessel head penetration (VHP) nozzles. The proposed embedded flaw repair methodology has been generically approved by the NRC in Reference 3. The details of this request are contained in the Enclosure.

WCAP-17758-P, Revision 0, "Technical Basis for Westinghouse Embedded Flaw Repair for V.C. Summer Unit 1 Reactor Vessel Head Penetration Nozzles and Attachment Welds" (Reference 2) provides plant-specific technical basis for the application of the embedded flaw repair process involving the VHPs. This WCAP contains engineering evaluations to determine the maximum flaw sizes on the VHP and/or the VHP attachment weld (J-Groove weld) that can be repaired using the embedded flaw repair process.

SCE&G requests that this repair alternative be approved by April 8, 2014 in support of the upcoming Spring 2014 refueling outage (RF21).

This letter contains no commitments. Should you have any questions, please call Bruce L. Thompson at 803-931-5042.

Very truly yours,

Thomas D. Gatlin

WLT/TDG/ts

Enclosure: VCSNS Relief Request RR-4-05

c: K. B. Marsh
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File (810.19)
PRSF (RC-14-0021)

South Carolina Electric & Gas Co. (SCE&G)
Virgil C. Summer Nuclear Station Unit 1 (VCSNS)
VCSNS Relief Request RR-4-05

1. ASME Code Component(s) Affected

The affected VCSNS component is the reactor vessel head. The vessel head is required to be inspected under the augmented inspection plan conforming to 10CFR50.55a(g)(6)(ii)(D) and ASME Code Case N-729-1. The reactor vessel head is the original installed head and was constructed under ASME Section III 1971 Edition with no Addenda. In the Fall 2012 outage, nozzles 19, 31, 37, and 52 were repaired using the methodology in WCAP-15987-P-A Revision 2. The alternate repair process was accepted for these nozzles in Reference 9. VCSNS is in the fourth 10-year inservice inspection (ISI) interval which began January 1, 2014 and ends December 31, 2023.

2. Applicable Code Edition and Addenda

ASME Code Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 2007 Edition with 2008 Addenda.

3. Applicable Code Requirement

Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1."

ASME Section XI, Article IWA-4000 contains requirements for the repair/replacement activity regardless of the reason or method of identifying the need for the activity performed on ASME components. The specific Code requirements for which use of the proposed alternative are as follows:

ASME Section XI, Article IWA-4421 states that defects shall be removed or mitigated in accordance with the following requirements:

a) Defect removal by mechanical processing shall be in accordance with IWA-4462.
b) Defect removal by thermal methods shall be in accordance with IWA-4461.
c) Defect removal or mitigation by welding or brazing shall be in accordance with IWA-4400.
d) Defect removal or mitigation by modification shall be in accordance with IWA-4340.
   - Note that use of the "Mitigation of Defects by Modification" provisions of IWA-4340 is prohibited per 10CFR50.55a(b)(2)(xxv).

The applicable requirements of the Construction Code required by IWA-4420 for the removal or mitigation of defects by welding from which relief is requested are as follows:

Base Material Defect Repairs:
For defects in base material, ASME Section III, NB-4131 requires that the defects are eliminated, repaired, and examined in accordance with the requirements of NB-2500. These requirements include the removal of defects via grinding or machining per NB-2538. Defect removal must be verified by a Magnetic Particle (MT) or Liquid Penetrant (PT) examination in accordance with NB-2545 or NB-2546, and if necessary to satisfy the design thickness requirement of NB-3000, repair welding in accordance with NB-2539.

ASME Section III, NB-2539.1 addresses removal of defects and requires defects to be removed or reduced to an acceptable size by suitable mechanical or thermal methods.

ASME Section III, NB-2539.4 provides the rules for examination of the base material repair welds and specifies they shall be examined by the MT or PT methods in accordance with NB-2545 or NB-2546. Additionally, if the depth of the repair cavity exceeds the lesser of 3/8-inch or 10 percent of the section thickness, the repair weld shall be examined by the radiographic method in accordance with NB-5110 using the acceptance standards of NB-5320.

Weld Metal Defect Repairs (RVH Penetration J-Groove Weld):
ASME Section III, NB-4450 addresses repair of weld metal defects.

ASME Section III, NB-4451 requires unacceptable defects in weld metal shall be eliminated and, when necessary, repaired in accordance with NB-4452 and NB-4453.

ASME Section III, NB-4452 addresses elimination of weld metal surface defects by grinding or machining.

ASME Section III, NB-4453.1 addresses removal of defects in welds by mechanical means or thermal gouging processes and requires the defect removal to be verified with MT or PT examinations in accordance with NB-5340 or NB-5350 and weld repairing the excavated cavity.

4. Reason for Request

VCSNS will conduct examinations of the reactor vessel closure head penetrations in accordance with Code Case N-729-1, as amended by 10CFR50.55a. Flaw indications that require repair may be found on the VHP tube material and/or the J-Groove attachment weld(s) on the underside of the reactor vessel head.

Relief is needed from the requirements of ASME Section XI, IWA-4420 to perform permanent repair of the identified flaws in accordance with the rules of the ASME Section III Construction Code as described in this relief request.

Specifically, relief is requested from:

- The requirements of ASME Section III, NB-4131, NB-2538, and NB-2539 to eliminate and repair defects in materials.

- The requirements of ASME Section III, NB-4450 to repair defects in weld metal.

5. Proposed Alternative and Basis for Use

5.1 Proposed Alternative

SCE&G proposes to use the less intrusive embedded flaw repair process found in WCAP-15987 (Reference 1) for the repair of reactor vessel head penetrations as approved by the NRC (Reference 3). The maximum flaw sizes on the VHP and/or the VHP attachment weld (J-Groove weld) that can be repaired using the embedded flaw repair process as defined by the methodology from WCAP-17758 (Reference 2). The repair methodology in WCAP-15987 is an alternative to the defect removal requirements of ASME Section XI and Section III. Embedding a flaw within primary water stress corrosion cracking (PWSCC) resistant materials (i.e., Alloy 52 or 52M type weld metal) will assure structural integrity of the VHP nozzles as bounded within WCAP-15987 and the NRC Safety Evaluation Report (Reference 3). Further reference to the seal weld or weldment will be reflected as Alloy 52 indicating PWSCC resistant materials as approved by the NRC as reflected in WCAP-15987 and existing precedence.

5.1.1 Flaw Repair

For the repair of the unacceptable outside surface flaws at least three layers of Alloy 52 material will be deposited (360 degrees full circumference) covering the entire wetted surface of the attachment J-Groove weld as well as at least two layers of alloy 52 covering the outside surface (360 degrees full circumference) of the head penetration nozzle tube as follows:

The interface boundary between the J-Groove weld and the stainless steel cladding will be located to positively identify the weld clad interface thus ensuring that all of the Alloy 82/182 material of the J-Groove weld is seal welded during the repair.

At least three (3) beads (one layer) of 309L stainless steel buffer will be installed on the clad surface approximately 0.5 inch beyond the interface of the clad and J-groove weld metal 360 degrees around.

The J-groove weld will then be completely covered with at least three (3) layers of Alloy 52, deposited 360 degrees around the nozzle and extends over the 309L buffer.

The outside surface of the Alloy 600 penetration tube will be covered with at least two (2) layers of Alloy 52 material and extend down at least 0.5 inches beyond the flaw indication.

5.1.2 Reporting Requirements and Conditions on Use

VCSNS will notify NRC of the Division of Component Integrity or its successor of changes in indication(s) or findings of new indication(s) in the penetration nozzle or J-Groove weld beneath a seal weld repair, or new linear indications in the seal weld repair, prior to commencing repair activities in subsequent inspections.

5.2 Technical Basis for Proposed Alternative

As discussed in WCAP-15987-P, the embedded flaw repair technique is considered a permanent repair. As long as a PWSCC flaw remains isolated from the Primary Water (PW) environment, it cannot propagate. Since an Alloy 52 weldment is considered highly resistant to PWSCC, a new PWSCC flaw should not initiate and grow through the Alloy 52 seal weld to reconnect the PW environment with the embedded flaw. Structural integrity of the affected J-Groove weld and/or nozzle will be maintained by the remaining unflawed portion of the weld and/or the VHP. Alloy 690 and Alloy 52 are highly resistant to stress corrosion cracking initiation, as demonstrated by multiple laboratory tests, as well as over ten years of service experience in replacement steam generators.

The residual stresses produced by the embedded flaw technique have been measured and found to be relatively low because of the small seal weld thickness. This provides the basis that no new flaws will initiate and grow in the area adjacent to the repair weld. There are no other known mechanisms for significant flaw propagation in the reactor vessel head and penetration tube region since cyclic loading is negligible, as described in WCAP-15987-P. Therefore, fatigue driven crack growth should not be a mechanism for further crack growth after the embedded flaw repair process is implemented.

The thermal expansion properties of Alloy 52 weld metal are not specified in the ASME Code. In this case the properties of the equivalent base metal (Alloy 690) should be used. For Alloy 690, the thermal expansion coefficient at 600 degrees Fahrenheit is 8.2E-6 in/in/degrees F as found in ASME Section II, part D "Properties." The Alloy 600 base metal has a coefficient of thermal expansion of 7.8E-6 in/in/degrees F, a difference of about 5 percent. The effect of this small difference in thermal expansion is that the weld metal will contract more than the base metal when it cools, thus producing a compressive stress on the Alloy 600 tube or J-Groove weld. This beneficial effect has already been accounted for in the residual stress measurements reported in the technical basis for the embedded flaw repair, as noted in the WCAP-15987-P.

The above proposed embedded flaw repair process is supported by applicable generic and plant specific technical bases, and is therefore considered to be an alternative to Code requirements that provides an acceptable level of quality and safety, as required by 10CFR50.55a(a)(3)(i). The plant-specific analysis performed for VCSNS Unit 1 using the same methodology as WCAP-15987-P was provided as an attachment in Reference 6.

WCAP-17758-P, Revision 0 (Reference 2) provides the plant-specific analysis performed for VC Summer Nuclear Station Unit 1 using the same methodology as WCAP-15987-P. This analysis provides the means to evaluate a broad range of postulated repair scenarios to the reactor vessel head penetrations and J-Groove welds relative to ASME Code requirements for allowable size and service life.

5.3 Safety Evaluation Compliance

VCSNS intends to follow WCAP-15987-P-Revision 2-P-A, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations." Below VCSNS has provided the applicability and compliance with each item of the NRC Safety Evaluation.

Item	Description
1	***Licensees must follow the NRC flaw evaluation guidelines.***
[VCSNS Response] VCSNS will follow 10CFR50.55a(g)(6)(ii)(D) and Code Case N-729-1. The inspection plan consists of performing volumetric and/or surface examination of essentially 100 percent of the required volume or equivalent surfaces of the nozzle housings. As stated within 10CFR50.55a(g)(6)(ii)(D)(1), once a licensee has implemented the requirements of ASME Code Case N-729-1 "the First Revised NRC Order EA-03-009 no longer applies to that licensee and shall be deemed to be withdrawn." VCSNS has implemented the first inspection under ASME Code Case N-729-1 during Fall 2009 (RF18).	
2	***The crack growth rate is not applicable to Alloy 600 or Alloy 690 weld material, i.e., Alloy 52, 82, 152, and 182 filler material.***
[VCSNS Response] Any cracks identified during subsequent inspections will be evaluated as directed by 10CFR50.55a(g)(6)(ii)(D) and Code Case N-729-1.	

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>3</td><td>
The NDE requirements listed in the Table below must be implemented for examinations of repairs made using the embedded flaw process.
<table>
<tr><th>Repair Location</th><th>Flaw Orientation</th><th>Repair Weld</th><th>Repair NDE</th><th>ISI NDE of the Repair Note 2</th></tr>
<tr><td>VHP Nozzle ID</td><td>Axial</td><td>Seal</td><td>UT and Surface</td><td>UT or Surface</td></tr>
<tr><td>VHP Nozzle ID</td><td>Circumferential</td><td>Note 1</td><td>Note 1</td><td>Note 1</td></tr>
<tr><td>VHP Nozzle OD above j-groove weld</td><td>Axial or Circumferential</td><td>Note 1</td><td>Note 1</td><td>Note 1</td></tr>
<tr><td>VHP Nozzle OD below j-groove weld</td><td>Axial or Circumferential</td><td>Seal</td><td>UT or Surface</td><td>UT or Surface</td></tr>
<tr><td>j-groove weld</td><td>Axial</td><td>Seal</td><td>UT and Surface, Note 3</td><td>UT and Surface, Note 3</td></tr>
<tr><td>j-groove weld</td><td>Circumferential</td><td>Seal</td><td>UT and Surface, Note 3</td><td>UT and Surface, Note 3</td></tr>
</table>
Notes:

Repairs must be reviewed and approved separately by the NRC.
Inspection consistent with the NRC Order EA-03-009 dated February 11, 2003 and any subsequent changes.
Inspect with personnel and procedures qualified with UT performance-based criteria. Examine the accessible portion of the repaired region. The UT coverage plus surface coverage must equal 100 percent.

</td></tr>
<tr><td colspan="2">[VCSNS Response]

Notes 2 and 3 are modified as follows:

(2) Preservice and Inservice Inspection to be consistent with 10CFR50.55a(g)(6)(ii)(D), which requires implementation of Code Case N-729-1 with conditions.

(3) UT personnel and procedures qualified in accordance with 10CFR50.55a(g)(6)(ii)(D), which requires implementation of Code Case N-729-1 with conditions. Examine the accessible portion of the J-groove repaired region. The UT plus surface examination coverage equals 100%.</td></tr>
</table>

6. Duration of Proposed Alternative:

VCSNS is in the fourth 10-year inservice inspection (ISI) interval which began January 1, 2014 and ends December 31, 2023. The duration of the proposed alternative is for the fourth ISI interval.

7. Precedents:

In Reference 2, the NRC generically approved the embedded flaw repair process described in Reference 1. Requests to use the embedded flaw technique to repair cracks have been previously approved by the NRC on a plant specific basis. The NRC approved a similar repair for Byron Station Units 1 and 2 as well as Braidwood Units 1 and 2 in Reference 8. The NRC has also approved prior repairs to V.C. Summer Nuclear Station Unit 1 vessel head in References 9 and 11.

8. References:

1. WCAP-15987-P-A Revision 2, "Technical Bases for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations"
2. WCAP-17758-P, Revision 0, "Technical Basis for Westinghouse Embedded Flaw Repair for V.C. Summer Unit 1 Reactor Vessel Head Penetration Nozzles and Attachment Welds"
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5. Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Transmittal of WCAP-17758-P, Revision 0, 'Technical Basis for Westinghouse Embedded Flaw Repair for V.C. Summer Unit 1 Reactor Vessel Head Penetration Nozzles and Attachment Welds'," dated September 5, 2013 [ML13252A143]
6. Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Relief Request RR-III-09 Alternative Weld Repair for Reactor Vessel Head Penetration," dated October 30, 2012 [ML12319A255]
7. Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1"

8. Letter from Jacob Zimmerman (NRC) to Michael J. Pacilio, "Braidwood Station, Units 1 and 2 and Byron Station, Unit Nos. 1 and 2 - Relief Requests 13R-09 and 13R-20 Regarding Alternative Requirements for Repair of Reactor Vessel Head Penetrations (TAC NOS. ME6071, ME6072, ME6073 and ME6074) [ML120790647]," dated March 29, 2012
9. NRC Memorandum, "Virgil C. Summer Nuclear Station, Unit No.1, Verbal Approval of Alternative for Overlay Repair of Reactor Vessel Head Penetrations (TAC NO. ME9851)," dated November 26, 2012
10. Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Relief Request RR-III-09 Supplemental Information," dated November 5, 2012 [ML12319A255]
11. Letter from Robert J. Pascarelli (NRC) to T. D. Gatlin (VCSNS), "Virgil C. Summer Nuclear Station, Unit 1, Alternative RR-III-09-Alternative Weld Repair for Reactor Vessel Head Penetration (TAC NO. ME9851)(RC-12-0165)," dated April 19, 2013 [ML13101A333]