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SCE&G®
A SCANA COMPANY

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RC-12-0154

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
REACTOR VESSEL HEAD PENETRATION WELD REPAIR UNDER WCAP-15987

Reference:
1. WCAP-15987-P-A Revision 2, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations" [ML040290246]

2. 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]

Pursuant to 10CFR50.55a(g)(6)(ii)(D), South Carolina Electric & Gas Company (SCE&G), will be conducting inservice inspections as augmented with ASME Code Case N-729-1 during the Fall 2012 refueling outage (RF20). In accordance with 10 CFR 50.55a(a)(3)(i), SCE&G, acting for itself and as an agent for South Carolina Public Service Authority (Santee Cooper), hereby submits notification of applicability to WCAP-15987-P-A Revision 2 (Reference 1).

SCE&G is acting in preparation of a potential request for 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." Specifically, the station postulates the need to perform an alternative repair technique using the embedding methodology of Reference 1 on the reactor vessel head penetration housings and J-Groove welds. The embedded flaw methodology has been approved generically by the NRC in the Reference 2 Safety Evaluation.

SCE&G proposes to use the less intrusive embedded flaw process (Reference 1) for the repair of reactor vessel head penetrations as approved by the NRC (Reference 2) as an alternative to the defect removal requirements of ASME Section XI and Section III. The alternative repair methodology is for credible indications that may be the result of primary water stress corrosion cracking (PWSCC). Embedding a flaw within PWSCC

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resistant materials (i.e., Alloy 52 weld metal) will assure structural integrity of the reactor vessel head (RVH) penetration nozzles. Additional applicable requirements for eliminating mechanical discontinuities that may become detected in the seal welds during installation are also proposed. The details of this request are contained in Enclosure 1 to this letter.

VCSNS will provide the technical basis for the use of an embedded repair methodology if a credible flaw is identified. The technical bases will provide the bounding loading conditions, fatigue crack growth predications, and fracture mechanics results required to support the use of the approved WCAP.

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

JG/TDG/bj

Enclosure 1: WCAP-15987 Applicability to VCSNS
Attachment 1: Nozzle Configuration
Attachment 2: Reactor Vessel Upper Head Nozzle Locations

c: K. B. Marsh
S. A. Byrne
J. B. Archie
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South Carolina Electric & Gas Co. (SCE&G)
Virgil C. Summer Nuclear Station Unit 1 (VCSNS)
WCAP-15987 Applicability to VCSNS

1. ASME Code Component(s) Affected

The affected VCSNS component is the reactor vessel head [XRE0001]. 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. There have been no previous repairs to the reactor vessel head penetration nozzles and J-Groove welds. The VCSNS third 10-year inservice inspection (ISI) interval ends December 31, 2013.

2. Applicable Code Edition and Addenda

ASME Code Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1998 Edition through 2000 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."

IWA-4000 of ASME Section XI 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 is being requested are as follows where ASME Section XI, states:

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 10 CFR 50.55a(b)(2)(xxv).

The applicable requirements of the Construction Code required by IWA-4421 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% 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:
ASME Section III, NB-4450 addresses repair of weld metal defects.

ASME Section III, NB-4451 states; that 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 without subsequent welding and specifies defects are to be removed 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 be conducting examinations of the reactor vessel head penetrations in accordance with Code Case N-729-1, as amended by 10 CFR 50.55a. Based on industry experience there have been base material and J-Groove weld indications found on similar plants to VCSNS that are considered "low susceptible to PWSCC of the RPV top head nozzles" (i.e. greater than 30 Effective Power Years). The susceptibility category of the reactor vessel head to PWSCC related degradation is represented by a value of Effective Degradation Years (EDY) in accordance with Code Case N-729-1.

VCSNS intends to follow the industry practice and use the embedded flaw technique to repair credible indications as addressed within WCAP-15987. Under the WCAP, relief is applied from the requirements of ASME Section XI, IWA-4420 to perform permanent repair of credible defects that may be identified on the base material and/or J-Groove attachment weld(s) in accordance with the rules of the ASME Section III Code. The WCAP assumes that an axial or circumferential crack has been detected in a penetration nozzle inside diameter (ID), an axial crack in the J-Groove attachment weld or an axial crack in the penetration outside diameter (OD) (below the J-groove weld). (Reference 2). Other indications that are not covered by the generically approved WCAP would require further evaluation and relief.

5. Proposed Alternative and Basis for Use

5.1 Proposed Alternative

SCE&G proposes to use the less intrusive embedded flaw process (Reference 1) for the repair of reactor vessel head penetrations as approved by the NRC (Reference 2). This methodology is an alternative to the defect removal requirements of ASME Section XI and Section III. There have been no previous in-service repairs to the reactor vessel head penetrations and J-Groove welds, therefore a proposed repair under WCAP-15987 involves one approach for VCSNS. For a proposed repair the existing weld will be overlaid with three weld passes of Alloy 52 material as bounded within WCAP-15987 and the NRC Safety Evaluation Report. All final weld surfaces will be liquid penetrant inspected.

5.2 Station History

VCSNS has installed a Westinghouse 3-loop nuclear reactor vessel. The reactor vessel head (RVH) contains a total of 66 penetrations of which 65 are control rod drive mechanism (CRDM) style nozzles and one is the reactor head vent nozzle. Of the 65 CRDM style nozzles, 48 are used for CRDM assemblies, and the remainders are used for instrumentation or are capped as spares. The reactor vessel is made of low alloy steel ASME SA-533 Gr. B Class 1 with a stainless steel liner and Inconel cladding. The nozzles were constructed of Babcock and Wilcox (B&W) material under material specification SB-167.

By letter S. A. Byrne (SCE&G) to Mr. G. E. Edison (NRC) (RC-02-0055), "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," dated April 3, 2002, [ML020950028] VCSNS provided the 15 Day Response with required information per NRC Bulletin 2001-01. Within this document VCSNS identified it was considered a "low susceptible to PWSCC of the RPV top head nozzles" (i.e. greater than 30 Effective Power Years) and reflected the future testing/inspection plan.

By letter S. A. Byrne (SCE&G) to the NRC Document Control Desk (RC-02-0114 and RC-02-0115), "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," dated September 12, 2002, [ML021900011] VCSNS provided the results of its Spring 2002 (RF14) inspection of the reactor vessel head below the insulation. VCSNS reported the best effort supplemental inspection found no indications of material degradation.

By letter S. A. Byrne (SCE&G) to the NRC Document Control Desk (RC-02-0160), "Response to NRC Bulletin 2002-002," dated September 12, 2002, [ML022590065] VCSNS indicated that it would supplement the inspection program under the EPRI Material Reliability Program (MRP-75) inspection plan. The NRC responded on December 23, 2002 under TAC NO MB5928 [ML023570406] that the staff found the planned inspection would "provide reasonable assurance of adequate protection for the public health and safety."

By letter S. A. Byrne (SCE&G) to Ms. K. R. Cotton (NRC) (RC-03-0254), "Response to NRC Bulletin 2002-02," dated December 23, 2003, [ML033630741] VCSNS reported inspection results from Fall 2003 (RF14). The inspection was conducted in accordance with EPRI Report, "Visual Examination for Leakage of PWR Reactor Head Penetrations on Top of RPV Head." The report that indicated minor boron deposits but "no evidence of boric acid leakage from the CRDM housings."

By letter Jeffery B. Archie (SCE&G) to Rulemakings and Adjudication Staff (NRC) (RC-07-0006), "60 Day Examination Report Following Startup from Refueling Outage 16," dated January 18, 2007, VCSNS reported inspection results from Fall 2006 (RF16). VCSNS inspected the reactor vessel head consistent with the First Revised NRC Order EA-03-009 issued February 20, 2004. VCSNS obtained full coverage for all reactor vessel head penetration (VHP) nozzles. VCSNS performed an analysis that limits the examination zone to 1 inch below the lowest point of the J-Groove weld and all additional nozzle penetration surfaces below the weld that have an operating stress level of 20ksi tension and greater. Each CRDM penetration was scanned starting from the taper to cylinder transition at the bottom of each nozzle up to at least two inches above the highest point of the J-Groove weld. An ID chamfer on the end of each nozzle precludes coverage to the very end of the nozzle. Coverage was obtained over the

required distance below the lowest point of the J-Groove weld up to at least 2 inches above the highest point of the J-Groove weld.

VCSNS has inspected the reactor vessel head penetrations (VHP) nozzles during the Fall 2009 (RF18) under 10CFR50.55a(g)(6)(ii)(D) and Code Case N-729-1. The results were reported by letter from Thomas D. Gatlin to L. A. Reyes (NRC) (RC-10-0032), "Eighteenth Refueling Inservice Inspection (ISI) Report," dated March 8, 2010. VCSNS conducted the examination to satisfy Code Case N-729-1, table 1 "Examination Categories," Item B4-10. The results were no boric acid found during the VT-2 examination that was conducted by qualified personnel.

5.3 Safety Evaluation Compliance

VCSNS intends to follow WCAP-15987-NP-Revision 2-NP-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.

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 identified by Figure 2 of ASME Code Case N-729-1 (provided as Attachment 1). 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 the next refueling (RF-20) scheduled for Fall 2012 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]
VCSNS will follow 10CFR50.55a(g)(6)(ii)(D) and Code Case N-729-1. There have been no previous repairs to the reactor vessel head penetrations nozzles and J-Groove welds. Inservice volumetric and surface examinations will comply with the acceptance criteria of ASME Code Case N-729-1 paragraph -3130 or -3140. Specifically, any volumetric or surface examination that reveals a leak or flaw not acceptable for continued service in accordance with the provisions of -3132.3 is unacceptable for continued service. Additional exams of -2430 are required to be satisfied and the component corrected by a repair or replacement activity to the extent necessary to meet the acceptance standards of -3000.</td></tr>
</table>

5.4 Technical Basis for Proposed Alternative

As discussed in WCAP-15987, 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.

VCSNS will provide the plant-specific analysis performed for WCAP-15987 under a subsequent relief request if a credible flaw is confirmed and reported. VCSNS will provide the technical basis and analysis that will evaluate only those postulated repair scenarios to the reactor vessel head penetrations nozzles and J-Groove welds. The potential repairs will be relative to ASME Code requirements for allowable size and service life.

6. Duration of Proposed Alternative:

This request is applicable to the V. C. Summer Unit 1 inservice inspection program for the third and fourth 10-year inspection intervals.

7. Precedents:

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 Unit 2. On March 28, 2011, Byron Station Unit 1 received verbal authorization for use of the seal weld repairs methodology on P-64 and P-76, and again on April 10, 2011, for P-31 and P-43. (Reference 10 and 11)

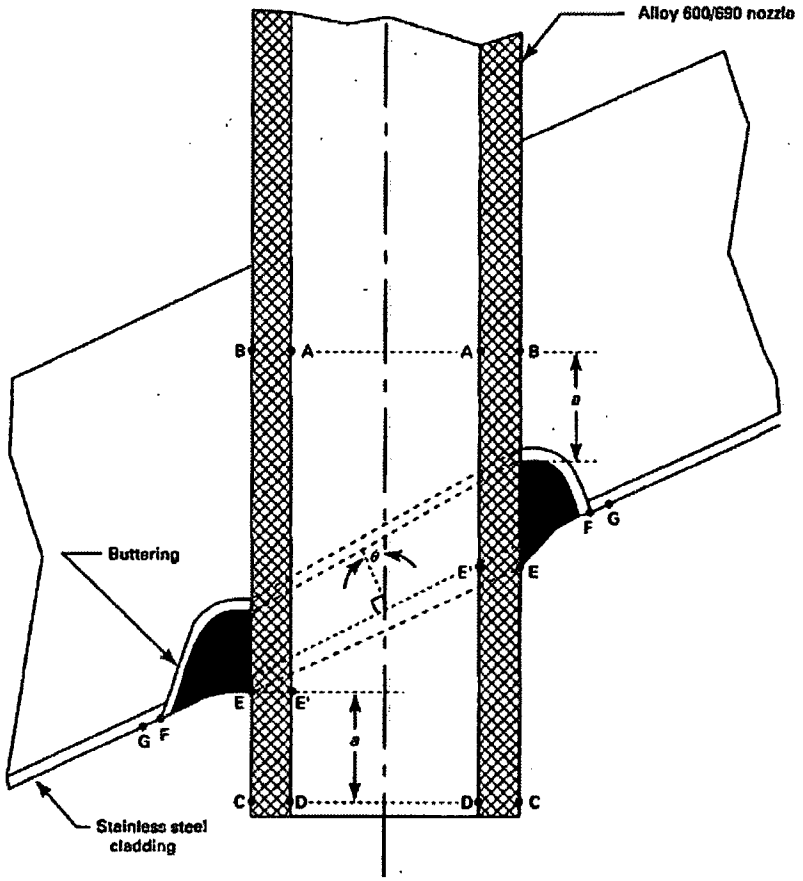
8. References:

1. WCAP-15987-NP-A Revision 2, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations" [ML040290246]
2. Letter 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 Penetration,' (TAC NO. MB8997)," dated July 3, 2003 [ML031840237]
3. 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."
4. Letter S. A. Byrne (SCE&G) to Mr. G. E. Edison (NRC) (RC-02-0055), "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," dated April 3, 2002, [ML020950028]
5. By letter S. A. Byrne (SCE&G) to the NRC Document Control Desk (RC-02-0114 and RC-02-0115), "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," dated September 12, 2002, [ML021900011]
6. Letter S. A. Byrne (SCE&G) to the NRC Document Control Desk (RC-02-0160), "Response to NRC Bulletin 2002-002," dated September 12, 2002, [ML022590065]
7. Letter S. A. Byrne (SCE&G) to Ms. K. R. Cotton (NRC) (RC-03-0254), "Response to NRC Bulletin 2002-02," dated December 23, 2003, [ML033630741]
8. Letter Jeffery B. Archie (SCE&G) to Rulemakings and Adjudication Staff (NRC) (RC-07-0006), "60 Day Examination Report Following Startup from Refueling Outage 16," dated January 18, 2007
9. Letter Thomas D. Gatlin to L. A. Reyes (NRC) (RC-10-0032), "Eighteenth Refueling Inservice Inspection (ISI) Report," dated March 8, 2010
10. NRC Memorandum, "Byron Station, Unit No. 1 - Verbal Authorization of Relief Request 13R-19 - Alternative Requirements for Repair of Reactor Vessel Head Penetrations 64 and 76 (TAC No. ME5877)," dated March 29, 2011
11. NRC Memorandum, "Byron Station Unit No. 1 - Verbal Authorization of Relief Request 13R-19 - Alternative Requirements for Repair of Reactor Vessel Head Penetrations Nos. 31 and 43 (TAC No. ME5948)," dated April 13, 2011

South Carolina Electric & Gas Co. (SCE&G)
Virgil C. Summer Nuclear Station Unit 1 (VCSNS)

Attachment 1
Nozzle Configuration

CASE (continued)
N-729-1



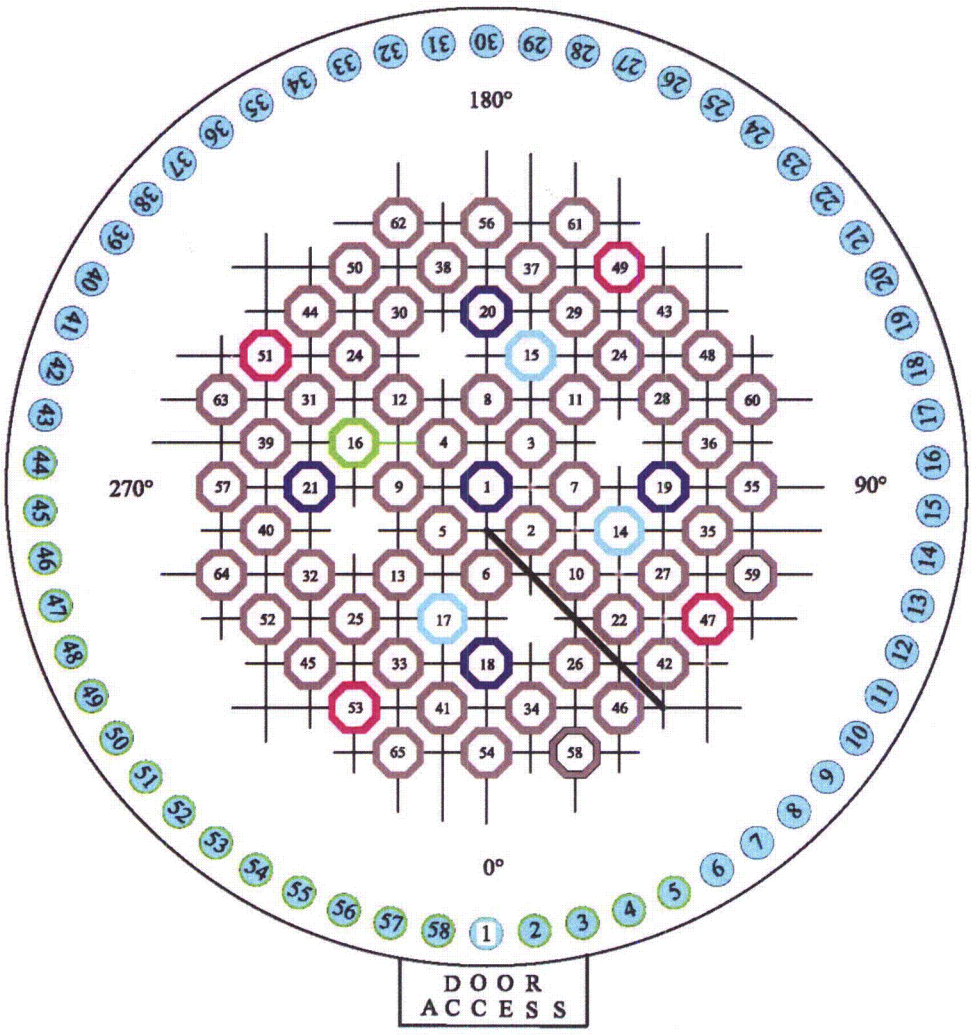
a = 1.5 in. (38 mm) for Incidence Angle, θ, ≤ 30 deg and for all nozzles ≥ 4.5 in. (115 mm) OD or 1 in. (25 mm) for Incidence Angle, θ, > 30 deg; or to the end of the tube, whichever is less
A-B-C-D = Extent of volumetric examination for the tube (base metal)
A-D = Extent of surface examination for the tube inside surface
G-F = ¼ in. (6 mm) from the theoretical point "F" in accordance with the design drawings, including tolerances, unless the point "F" can be physically determined.
G-F-E-C = Extent of surface examination for the J-groove weld (filler metal and buttering) and tube outside surface below the weld
G-F-E = Extent of surface examination zone for the J-groove weld (filler metal and buttering)

FIG. 2 EXAMINATION VOLUME FOR NOZZLE BASE METAL AND EXAMINATION AREA FOR WELD AND NOZZLE BASE METAL

South Carolina Electric & Gas Co. (SCE&G)
Virgil C. Summer Nuclear Station Unit 1 (VCSNS)

Attachment 2
Reactor Vessel Upper Head Nozzle Locations

V.C. Summer Reactor Vessel Head Inspection Status Map - Fall 2012



VIEW FROM UNDER HEAD LOOKING UP