February 3, 2004

Mr. Stephen A. Byrne
Senior Vice President, Nuclear Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88
Jenkinsville, South Carolina 29065

SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION - SECOND 10-YEAR INSERVICE INSPECTION, REQUEST FOR RELIEF RR-II-20, RR-II-20 ADDENDA, AND RR-II-21 (TAC NO. MC0108)

Dear Mr. Byrne:

By a letter dated July 11, 2003, South Carolina Electric & Gas Company (the licensee) submitted Relief Request (RR)-II-15, RR-II-16, RR-II-17, RR-II-18, RR-II-19, RR-II-20, RR-II-20 Addenda, and RR-II-21 for Virgil C. Summer Nuclear Station. On September 17, 2003, the licensee provided supplemental information for RR-II-20, RR-II-20 Addenda, and RR-II-21. On November 3, 2003, the licensee provided supplemental information for RR-II-20 Addenda. The enclosed safety evaluation is a review of RR-II-20, RR-II-20 Addenda, and RR-II-21. The requests pertain to certain requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code). Specifically, the licensee requested relief from ASME Code, Section XI, Appendix VIII, Supplements 2, 3, and 10. The requests are for the second 10-year inservice inspection interval which ends December 31, 2003. Accordingly, the relief requests are authorized for the second 10-year inservice inspection interval.

This completes the NRC action for RR-II-20, RR-II-20 Addenda and RR-II-21. Request for relief numbers RR-II-15, RR-II-16, RR-II-17, RR-II-18, and RR-II-19 are addressed through separate correspondence.

The Nuclear Regulatory Commission staff has reviewed the licensee's proposed alternatives for RR-II-20, RR-II-20 Addenda, and RR-II-21 and finds them to be acceptable pursuant to 10 CFR 50.55a(a)(3)(i), on the basis that the alternatives provide an acceptable level of quality and safety.

Sincerely,

/RA/

John A. Nakoski, Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-395

Enclosure: Safety Evaluation

cc w/encl: See next page

The Nuclear Regulatory Commission staff has reviewed the licensee's proposed alternatives for RR-II-20, RR-II-20 Addenda, and RR-II-21 and finds them to be acceptable pursuant to 10 CFR 50.55a(a)(3)(i), on the basis that the alternatives provide an acceptable level of quality and safety.

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SECOND 10-YEAR INSERVICE INSPECTION INTERVAL

REQUEST FOR RELIEF RR-II-20, RR-II-20 ADDENDA, AND RR-II-21

VIRGIL C. SUMMER NUCLEAR STATION

SOUTH CAROLINA ELECTRIC AND GAS COMPANY

DOCKET NUMBER 50-395

1.0 INTRODUCTION

The inservice inspection (ISI) of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Class 1, Class 2, and Class 3 components is performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Title 10, *Code of Federal Regulation* (10 CFR) Section 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). As stated, in part, in 10 CFR 50.55a(a)(3) alternatives to the requirements of paragraph (g) may be used, when authorized by the Nuclear Regulatory Commission (NRC), if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ISI Code of record for Virgil C. Summer Nuclear Station (VCSNS) second 10-year ISI interval is the 1989 Edition which ends December 31, 2003. The components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein and subject to Commission approval.

Enclosure

By a letter dated July 11, 2003, South Carolina Electric & Gas Company (licensee) submitted Relief Request (RR)-II-15, RR-II-16, RR-II-17, RR-II-18, RR-II-19, RR-II-20, RR-II-20 Addenda, and RR-II-21 from certain requirements specified in ASME Code. In a letter dated September 17, 2003, the licensee resubmitted RR-II-20, RR-II-20 Addenda, and RR-II-21. On November 3, 2003, the licensee provided supplemental information for RR-II-20 Addenda. RR-II-20, RR-II-20 Addenda, and RR-II-21 pertain to the 1995 Edition with 1996 Addenda of the ASME Code, Section XI, Appendix VIII, Supplements 2, 3, and 10 for the remainder of the second 10-year ISI interval which ends December 31, 2003. RR-II-15, RR-II-16, RR-II-17, RR-II-18, and RR-II-19 will be addressed through separate correspondence.

2.0 DISCUSSION FOR RR-II-20

2.1 Components for Which Relief Is Requested

Pressure retaining dissimilar metal piping welds subject to examinations using procedures, personnel, and equipment qualified to the 1995 Edition with 1996 Addenda of the ASME Code, Section XI, Appendix VIII, Supplement 10, “Qualification Requirements for Dissimilar Metal Piping Welds” for the remainder of the second 10-year ISI interval.

2.2 Code Requirements

The following paragraphs or statements are from ASME Section XI, Appendix VIII, Supplement 10 and identify the specific requirements that are included in this request for relief.

Item 1 - Paragraph 1.1(b) states in part - Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent.

Item 2 - Paragraph 1.1(d) states - All flaws in the specimen set shall be cracks.

Item 3 - Paragraph 1.1(d)(1) states - At least 50% of the cracks shall be in austenitic material. At least 50% of the cracks in austenitic material shall be contained wholly in weld or buttering material. At least 10% of the cracks shall be in ferritic material. The remainder of the cracks may be in either austenitic or ferritic material.

Item 4 - Paragraph 1.2(b) states in part - The number of unflawed grading units shall be at least twice the number of flawed grading units.

Item 5 - Paragraph 1.2(c)(1) and 1.3(c) state in part - At least 1/3 of the flaws, rounded to the next higher whole number, shall have depths between 10% and 30% of the nominal pipe wall thickness. Paragraph 1.4(b) distribution table requires 20% of the flaws to have depths between 10% and 30%.

Item 6 - Paragraph 2.0 first sentence states - The specimen inside surface and identification shall be concealed from the candidate.

Item 7 - Paragraph 2.2(b) states in part - The regions containing a flaw to be sized shall be identified to the candidate.

Item 8 - Paragraph 2.2(c) states in part - For a separate length sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate.

Item 9 - Paragraph 2.3(a) states - For the depth sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate.

Item 10 - Paragraph 2.3(b) states - For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.

Item 11 - Table VIII-S2-1 provides the false call criteria when the number of unflawed grading units is at least twice the number of flawed grading units.

2.3 Licensee Proposed Alternative and Its Basis for Use

The licensee proposed the following alternatives to the selected paragraphs in the 1995 Edition with 1996 Addenda of the ASME Code, Section XI, Appendix VIII, Supplement 10, requirements for VCSNS. The proposed alternative, as stated by the licensee, will be implemented through the Performance Demonstration Initiative (PDI) Program.

Item 1 - Paragraph 1.1(b) alternative:

The specimen set shall include the minimum and maximum pipe diameters and thicknesses for which the examination procedure is applicable. Pipe diameters within a range of ½ in. (13 mm) of the nominal diameter shall be considered equivalent. Pipe diameters larger than 24 in. (610 mm) shall be considered to be flat. When a range of thicknesses is to be examined, a thickness tolerance of ±25% is acceptable.

Technical Basis - The change in the minimum pipe diameter tolerance from 0.9 times the diameter to the nominal diameter minus 0.5 inch provides tolerances more in line with industry practice. Though the alternative is less stringent for small pipe diameters they typically have a thinner wall thickness than larger diameter piping. A thinner wall thickness results in shorter sound path distances that reduce the detrimental effects of the curvature. This change maintains consistency between Supplement 10 and the recent revision to Supplement 2.

Item 2 - Paragraph 1.1(d) alternative:

At least 60% of the flaws shall be cracks, the remainder shall be alternative flaws. Specimens with intergranular stress corrosion cracking (IGSCC) shall be used when available. Alternative flaws, if used, shall provide crack-like reflective characteristics and shall be limited to the case where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. Alternative flaw mechanisms shall have a tip width of less than or equal to 0.002 in. (.05 mm). Note, to avoid confusion the proposed alternative modifies instances of the term "cracks" or "cracking" to the term "flaws" because of the use of alternative flaw mechanisms.

Technical Basis - Implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. In addition, it is important to preserve the dendritic structure present in field welds that would otherwise be destroyed by the implantation process. To resolve these issues, the proposed alternative allows the use of up to 40% fabricated flaws as an alternative flaw mechanism under controlled conditions. The fabricated flaws are isostatically compressed which produces ultrasonic reflective characteristics similar to tight cracks.

Item 3 - Paragraph 1.1(d)(1) alternative:

At least 80% of the flaws shall be contained wholly in weld or buttering material. At least one and a maximum of 10% of the flaws shall be in ferritic base material. At least one and a maximum of 10% of the flaws shall be in austenitic base material.

Technical Basis - Under the current ASME Code, as few as 25% of the flaws are contained in austenitic weld or buttering material. Recent experience has indicated that flaws contained within the weld are the likely scenarios. The metallurgical structure of austenitic weld material is ultrasonically more challenging than either ferritic or austenitic base material. The proposed alternative is therefore more challenging than the current ASME Code.

Item 4 - Paragraph 1.2(b) alternative:

Personnel performance demonstration detection sets shall be selected from Table VIII-S10-1. The number of unflawed grading units shall be at least one and a half times the number of flawed grading units.

Technical Basis - Table S10-1 provides a statistically based ratio between the number of unflawed grading units and the number of flawed grading units. The proposed alternative reduces the ratio to 1.5 times to reduce the number of test samples to a more reasonable number from the human factors perspective. However, the statistical basis used for screening personnel and procedures is still maintained at the same level with competent personnel being successful and less skilled personnel being unsuccessful. The acceptance criteria for the statistical basis are in new Table VIII-S10-1.

Item 5 - Paragraph 1.2(c)(1) (detection) and 1.3(c) (length) alternative:

For flaw distribution requirements, the alternative is to use the Paragraph 1.4(b) (depth) distribution table (see below) for all qualifications.

Flaw Depth (% Wall Thickness)	Minimum Number of Flaws
10-30%	20%
31-60%	20%
61-100%	20%

Technical Basis - The proposed alternative uses the depth sizing distribution for both detection and depth sizing because it provides for a better distribution of flaw sizes within the test set. This distribution allows candidates to perform detection, length, and depth sizing demonstrations simultaneously utilizing the same test set. The requirement that at least 75% of the flaws shall be in the range of 10 to 60% of wall thickness provides an overall distribution tolerance yet the distribution uncertainty decreases the possibilities for testmanship that would be inherent to a uniform distribution. It must be noted that it is possible to achieve the same distribution utilizing the present requirements, but it is preferable to make the criteria consistent.

Item 6 - Paragraph 2.0 alternative to the first sentence:

For qualifications from the outside surface, the specimen inside surface and identification shall be concealed from the candidate. When qualifications are performed from the inside surface, the flaw location and specimen identification shall be obscured to maintain a "blind test."

Technical Basis - The current ASME Code requires that the inside surface be concealed from the candidate. This makes qualifications conducted from the inside of the pipe (e.g., pressurized water reactor nozzle-to-safe-end welds) impractical. The proposed alternative differentiates between inner diameter (ID) and outer diameter (OD) scanning surfaces and requires that they be conducted separately and that flaws be concealed from the candidate. This is consistent with the recent revision to Supplement 2.

Items 7 and 8 - Paragraph 2.2(b) and 2.2(c) alternative:

". . . containing a flaw to be sized may be identified to the candidate."

Technical Basis - The current ASME Code requires that the regions of each specimen containing a flaw to be length sized shall be identified to the candidate. The candidate shall determine the length of the flaw in each region (Note that length and depth sizing use the term "regions" while detection uses the term "grading units" - the two terms define different concepts and are not intended to be equal or interchangeable). To ensure security of the samples, the proposed alternative modifies the first "shall" to a "may" to allow the test administrator the option of not identifying specifically where a flaw is located. This is consistent with the recent revision to Supplement 2.

Items 9 and 10 - Paragraph 2.3(a) and 2.3(b) alternative:

". . . regions of each specimen containing a flaw to be sized may be identified to the candidate."

Technical Basis - The current ASME Code requires that a large number of flaws be sized at a specific location. The proposed alternative changes the "shall" to a "may" which modifies this from a specific area to a more generalized region to ensure security of samples. This is consistent with the recent revision to Supplement 2. It also incorporates terminology from length sizing for additional clarity.

Item 11 - Table VIII-S2-1 alternative modifies the acceptance criteria as follows:

Technical Basis - The proposed alternative is identified as new Table VIII-S10-1 below. It was modified to reflect the reduced number of unflawed grading units and allowable false calls. As a part of ongoing ASME Code activities, Pacific Northwest National Laboratory (PNNL) has reviewed the statistical significance of these revisions and offered the revised Table S10-1.

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TABLE VIII-S~~2~~-1
PERFORMANCE DEMONSTRATION DETECTION TEST ACCEPTANCE CRITERIA

Detection Test Acceptance Critera		False Call Test Acceptance Criteria	
No. of Flawed Grading Units	Minimum Detection Criteria	No. of Unflawed Grading Units	Maximum Number of False Calls
~~5~~	~~5~~	~~10~~	~~0~~
~~6~~	~~6~~	~~12~~	~~1~~
~~7~~	~~6~~	~~14~~	~~1~~
~~8~~	~~7~~	~~16~~	~~2~~
~~9~~	~~7~~	~~18~~	~~2~~
10	8	~~20~~ 15	~~3~~ 2
11	9	~~22~~ 17	~~3~~ 3
12	9	~~24~~ 18	~~3~~ 3
13	10	~~26~~ 20	~~4~~ 3
14	10	~~28~~ 21	~~5~~ 3
15	11	~~30~~ 23	~~5~~ 3
16	12	~~32~~ 24	~~6~~ 4
17	12	~~34~~ 26	~~6~~ 4
18	13	~~36~~ 27	~~7~~ 4
19	13	~~38~~ 29	~~7~~ 4
20	14	~~40~~ 30	~~8~~ 5

2.4 NRC STAFF'S EVALUATION

The licensee proposed to use the program developed by PDI that is similar to the ASME Code requirements. The differences between the ASME Code and the PDI program are discussed below.

2.4.1 Item 1 - Paragraph 1.1(b)

The ASME Code requirement of "0.9 to 1.5 times the nominal diameter are equivalent" was established for a single nominal diameter. When applying the ASME Code-required tolerance to a range of diameters, the tolerance rapidly expands on the high side. Under the current ASME Code requirements, a 5-inch OD pipe would be equivalent to a range of 4.5-inch to 7.5-inch diameter pipe. Under the proposed PDI guidelines, the equivalent range would be reduced to 4.5-inch to 5.5-inch diameter. With current ASME Code requirements, a 16-inch nominal diameter pipe would be equivalent to a range of 14.4-inch to 24-inch diameter pipe. The proposed alternative would significantly reduce the equivalent range of 15.5-inch to 16.5-inch diameter pipe. The difference between ASME Code and the proposed alternative for diameters less than 5 inches is not significant because of shorter metal path and beam spread associated with smaller diameter piping. The proposed alternative is considered more conservative overall than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

2.4.2 Item 2 - Paragraph 1.1 (d)

The ASME Code requires all flaws to be cracks. Manufacturing test specimens containing cracks free of spurious reflections and telltale indicators is extremely difficult in austenitic material. To overcome these difficulties, PDI developed a process for fabricating flaws that produce UT acoustic responses similar to the responses associated with real cracks. PDI presented its process for discussion at public meetings held June 12 through 14, 2001, and January 31 through February 2, 2002, at the Electric Power Research Institute (EPRI) Nondestructive Examination (NDE) Center, Charlotte, NC. The NRC staff attended these meetings and determined that the process parameters used for manufacturing fabricated flaws resulted in acceptable acoustic responses. PDI is selectively installing these fabricated flaws in specimen locations that are unsuitable for real cracks. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

2.4.3 Item - Paragraph 1.1(d)(1)

The ASME Code requires that at least 50 percent of the flaws be contained in austenitic material, and 50 percent of the flaws in the austenitic material shall be contained fully in weld or buttering material. This means that at least 25 percent of the total flaws must be located in the weld or buttering material. Field experience shows that flaws identified during ISI of dissimilar metal welds are more likely to be located in the weld or buttering material. The grain structure of austenitic weld and buttering material represents a much more stringent ultrasonic scenario than that of a ferritic material or austenitic base material. Flaws made in austenitic base material are difficult to create free of spurious reflectors and telltale indicators. The proposed alternative of 80 percent of the flaws in the weld metal or buttering material provides a challenging testing scenario reflective of field experience and minimizes testmanship associated with telltale reflectors common to placing flaws in austenitic base material. The NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

2.4.4 Item 4 - Paragraph 1.2(b) and Item 11 - Paragraph 3.1

The ASME Code requires that detection sets meet the requirements of Table VIII-S2-1, which specifies the minimum number of flaws in a test set to be 5 with 100-percent detection. The current ASME Code also requires the number of unflawed grading units to be two times the number of flawed grading units. The proposed alternative would follow the detection criteria of the table beginning with a minimum number of flaws in a test set being 10, and reducing the number of false calls to 1½ times the number of flawed grading units. The changes to Table VIII-S2-1 are shown in Table VIII-S10-1. The NRC staff finds that the proposed alternative satisfies the pass/fail objective established for Appendix VIII performance demonstration acceptance criteria. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

2.4.5 Item 5 - Paragraph 1.2(c)(1) and 1.3(c)

For detection and length sizing, the ASME Code requires at least one third of the flaws be located between 10 and 30 percent through-wall thickness and one third located greater than 30 percent through-wall thickness. The remaining flaws would be located randomly throughout the wall thickness. The proposed alternative sets the distribution criteria for detection and length sizing to be the same as the depth sizing distribution, which stipulates that at least 20 percent of the flaws be located in each of the increments of 10-30 percent, 31-60 percent and 61-100 percent. The remaining 40 percent would be located randomly throughout the wall thickness. With the exception of the 10-30 percent increment, the proposed alternative is a subset of the current ASME Code requirements. The 10-30 percent increment would be in the subset if it contained at least 30 percent of the flaws. The change simplifies assembling test sets for detection and sizing qualifications and is more indicative of conditions in the field. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

2.4.6 Item 6 - Paragraph 2.0

The ASME Code requires the specimen inside surface be concealed from the candidate. This requirement is applicable for test specimens used for qualification performed from the outside surface. With the expansion of Supplement 10 to include qualifications performed from the inside surface, the inside surface must be accessible while maintaining the specimen integrity. The proposed alternative requires that flaws and specimen identifications be obscured from candidates, thus maintaining blind test conditions. The NRC staff considers this to be consistent with the intent of ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

2.4.7 Items 7 and 8 - Paragraph 2.2(b) and 2.2(c)

The ASME Code requires that the location of flaws added to the test set for length sizing shall be identified to the candidate. The proposed alternative is to make identifying the location of additional flaws an option. This option provides an additional element of difficulty to the testing process because the candidate would be expected to demonstrate the skill of detecting and sizing flaws over an area larger than a specific location. The NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

2.4.8 Items 9 and 10 - Paragraph 2.3(a) and 2.3(b)

In paragraph 2.3(a), the ASME Code requires that 80 percent of the flaws be sized in a specific location that is identified to the candidate. The proposed alternative permits detection and depth sizing to be conducted separately or concurrently. In order to maintain a blind test, the location of flaws cannot be shared with the candidate. For depth sizing that is conducted separately, allowing the test administrator the option of not identifying flaw locations makes the testing process more challenging. The NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

In paragraph 2.3(b), the ASME Code also requires that the location of flaws added to the test set for depth sizing shall be identified to the candidate. The proposed alternative is to make identifying the location of additional flaws an option. This option provides an additional element of difficulty to the testing process because the candidate would be expected to demonstrate the skill of finding and sizing flaws in an area larger than a specific location. The NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the proposed alternative will provide an acceptable level of quality and safety and, therefore, is acceptable.

2.5 Conclusion

The NRC staff has determined that the proposed alternative to Supplement 10, as administered by the EPRI-PDI Program, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternative described in the licensee's letter dated July 11, 2003, for RR-II-20 as supplemented by letter dated September 17, 2003, for the remainder of the second 10-year ISI interval at VCSNS.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this RR remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

3.0 DISCUSSION FOR RR-II-20 ADDENDA

3.1 Components for Which Relief Is Requested:

Pressure retaining dissimilar metal piping welds CGE-1-4100A-33DM, CGE-1-4100A-334DM, CGE-1-4100A-16DM, CGE-1-4200A-1DM, CGE-1-4200A-16DM, CGE-1-4300A-1DM, CGE-1-4300A-16DM subject to examinations using procedures, personnel, and equipment qualified to the 1995 Edition with 1996 Addenda of the ASME Code, Section XI, Appendix VIII, Supplement 10, "Qualification Requirements for Dissimilar Metal Piping Welds" for the remainder of the second 10-year ISI interval.

3.2 Code Requirements:

The 1995 Edition with 1996 Addenda of the ASME Code, Section XI, Appendix VIII, Supplement 10, Paragraph 3.2(b), states that the examination procedures, equipment, and personnel are qualified for depth sizing when the root mean square (RMS) error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 inch RMS error.

3.3 Licensee Proposed Alternative and Its Basis for Use:

In the letters dated September 17 and November 3, 2003, the licensee proposed using either root mean square error (RMSE) or root mean square percent (RMSP) as the depth sizing tolerance. The ASME Code, Section XI, Appendix VIII flaw depth sizing acceptance tolerance for dissimilar metal welds is 0.125 inch RMSE. The parameter RMSP is simply the RMSE achieved during the performance demonstration expressed as a percentage of the through-wall thickness. The motivation for using RMSP is that flaw evaluation procedures and flaw acceptance criteria are expressed in terms of a/t, where "a" is the flaw through-wall size and "t" is the wall thickness. Thus, RMSP relates the sizing error to a parameter more meaningful to structural integrity analysis rather than as an absolute error. The parameter RMSP provides the same fundamental information on sizing performance, as does the absolute error RMS.

Section XI, Appendix VIII, Supplement 10, “Qualification Requirements for Dissimilar Metal Piping Welds,” performance demonstrations include both field and shop weld configurations. The procedure that will be used for V. C. Summer hot and cold leg weld examinations achieved an RMS depth sizing error of 0.189 inches when sizing from the inside surface, which is equivalent to 7.38% RMSP for the wall thickness range in the demonstration test set. The demonstration consisted of approximately twenty measurements of depth in field weld configurations and a similar number of measurements in shop weld configurations.

Configuration	RMS (inches)
Shop welds	0.146
Field welds	0.218
Shop and Field welds Combined	0.189

The proposed procedure to address sizing of flaws that may be found during the examination is to add to the measured flaw size the difference between the achieved sizing error and the 0.125-inch RMS Appendix VIII acceptance tolerance.

3.4 <u>NRC Staff Evaluation:</u>

Supplement 10 of Appendix VIII to ASME Section XI requires that examination procedures, equipment, and personnel meet specific criteria for flaw depth sizing accuracy. The Code specifies that the maximum error of flaw depth measurements, as compared to the true flaw depths, must be less than or equal to 0.125-inch RMSE. The industry is in the process of qualifying personnel to Supplement 10 as implemented by the PDI program. However, for demonstrations performed from the inside surface of a pipe weldment, personnel have been unsuccessful at achieving the 0.125-inch RMSE depth sizing criterion. At this time, achieving the 0.125 inch RMSE appears impractical. Personnel have only been capable of achieving an accuracy of 0.189 inch RMSE which calculates to 7.38 percent RMSP.

The licensee proposed using either 7.38 percent RMSP or 0.189-inch RMSE to size any detected flaws during the current outage. The licensee would add the difference between the Code required RMSE (0.125-inch) and the demonstrated accuracy (0.189-inch RMSE or 7.38 percent RMSP) to the measurements acquired from flaw sizing.

The use of RMSP is a concept which suggests that the depth sizing error should increase the deeper a flaw penetrates into the weldment. The staff with technical assistance from its contractor, PNNL, visited the EPRI NDE Center to review the vendor’s performance demonstration data. The RMSE was plotted against flaw depth which showed RMSE values clustered along a fitted (regression) line and showed that the RMSE values were independent of flaw depth size. Therefore, the appropriate adjustment to the measured flaw depth size must be 0.189-inch RMSE. The use of 0.189-inch RMSE as an adjustment to the measured flaw will ensure a conservative bounding flaw depth value.

3.5 Conclusion:

Based on the above evaluation, the staff has determined that requiring the licensee to qualify procedures, personnel, and equipment to meet the maximum error of 0.125-inch RMSE for crack depth sizing is impractical. Therefore, pursuant to 10 CFR 50.55a(g)(6)(i), relief is granted for VCSNS for the remainder of the second 10-year ISI interval which ends December 31, 2003. This grant of relief is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this RR remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

4.0 DISCUSSION FOR RR-II-21

4.1 Components for Which Relief Is Requested:

Pressure retaining welds in piping examined from the inside surface of pressurized water reactors that are subject to 1995 Edition with 1996 Addenda of the ASME Code, Section XI, Appendix VIII, Supplement 2, “Qualification Requirements for Wrought Austenitic Piping Welds,” and Supplement 3, “Qualification Requirements for Ferritic Piping Welds,” for the remainder of the second 10-year ISI interval.

4.2 Code Requirements:

Relief is requested from the qualification requirements for piping welds contained in the 1995 Edition/1996 Addenda of the ASME Code, Section XI, Appendix VIII, Table VIII-3110-1, Supplement 2 and Supplement 3 for the remainder of the second 10-year ISI interval.

4.3 Licensee Proposed Alternative and Its Basis for Use:

In lieu of the requirements listed in the 1995 Edition/1996 Addenda of the ASME Code, Section XI, Appendix VIII, Table VIII-3110-1, Supplement 2 and Supplement 3 for the remainder of the second 10-year ISI interval, the licensee’s proposed alternative is to use the industry’s PDI program for implementation of Appendix VIII, Supplement 2 and Supplement 3 as coordinated with the alternative PDI Supplement 10 implementation program (Reference RR-II-20 Section 2.0 above). The PDI program is described in the submittal as supplemented.

Technical Basis - Depending upon the particular design, the nozzle to main coolant piping may be fabricated using ferritic, austenitic, or cast stainless components and assembled using ferritic, austenitic, or dissimilar metal welds. Additionally, differing combinations of these assemblies may be in close proximity, which typically means the same ultrasonic essential variables are used for each weld and the most challenging ultrasonic examination process is employed (e.g., the ultrasonic examination process associated with a dissimilar metal weld would be applied to a ferritic or austenitic weld). At VCSNS, the applicable weld joint is the reactor vessel nozzle-to-pipe, dissimilar metal weld.

Separate qualifications to Supplements 2, 3, and 10 are redundant when done in accordance with the PDI Program. For example, during a personnel qualification to the PDI Program, the candidate would be exposed to a minimum of 10 flawed grading units for each individual supplement. Personnel qualification to Supplements 2, 3, and 10 would, therefore, require a total of 30 flawed grading units. Test sets this large and tests of this duration are impractical. Additionally, a full procedure qualification (i.e. 3 personnel qualifications) to the PDI Program requirements would require 90 flawed grading units. This is particularly burdensome for a procedure that will use the same essential variables or the same criteria for selecting essential variables for all 3 supplements.

To resolve these issues, the PDI Program recognizes the Supplement 10 qualification as the most stringent and technically challenging ultrasonic application. The essential variables used for the examination of Supplements 2, 3, and 10 are equivalent. A coordinated add-on implementation would be sufficiently stringent to qualify Supplements 2 and 3 if the requirements used to qualify Supplement 10 are satisfied as a prerequisite. The basis for this conclusion is the fact that the majority of the flaws in Supplement 10 are located wholly in austenitic weld material, which is known to be challenging for ultrasonic techniques due to the variable dendritic structure of the weld material. Conversely, flaws in Supplements 2 and 3 are located in fine-grained base materials, which are known to be less challenging.

Additionally, the proposed alternative is more stringent than current ASME Code requirements for a detection and length sizing qualification. For example, the current ASME Code would allow a detection procedure, personnel, and equipment to be qualified to Supplement 10 with 5 flaws, Supplement 2 with 5 flaws, and Supplement 3 with 5 flaws, for a total of 15 flaws. The proposed alternative of qualifying Supplement 10 using 10 flaws and adding on Supplement 2 with 5 flaws and Supplement 3 with 3 flaws results in a total of 18 flaws which will be multiplied by a factor of 3 for the procedure qualification.

Based on the above, the use of a limited number of Supplement 2 or 3 flaws is sufficient to access the capabilities of procedures and personnel who have already satisfied Supplement 10 requirements. The statistical basis used for screening personnel and procedures is still maintained at the same level with competent personnel being successful and less skilled personnel being unsuccessful. The proposed alternative is consistent with other coordinated qualifications currently contained in Appendix VIII.

The proposed alternative program is attached and is identified as Supplement 14. It has been submitted to the ASME Code for consideration as new Supplement 14 to Appendix VIII and as of September 2002 had been approved by the Subcommittee on Nuclear Inservice Inspection.

4.4 NRC Staff Evaluation:

The licensee requests relief from the qualification requirements of ASME Section XI, Appendix VIII, Supplements 2 and 3 criteria. The ASME Code currently requires separate qualifications for Supplement 2 for austenitic piping, Supplement 3 for ferritic piping, and Supplement 10 for dissimilar metal piping. Qualifications for each supplement would entail a minimum of 10 flaws each for a total of 30 flaws minimum. The minimum number of flaws per supplement established a statistical-based pass\fail objective. The process of a single qualification for each supplement would greatly expand the minimum number of ferritic and austenitic flaws required to be identified which would also raise the pass\fail acceptance criteria.

The ASME Code recognized that flaws in austenitic material are more difficult to detect and size than flaws in ferritic material. The prevailing reasoning concluded that a Supplement 3 qualification following a Supplement 2 qualification had diminishing returns on measuring personnel skills and procedure effectiveness. Therefore, in lieu of separate Supplement 2 and Supplement 3 qualifications, the ASME Code developed Supplement 12 which provides for a Supplement 3 add-on to a Supplement 2 qualification. The add-on consists of a minimum of three flaws in ferritic material. A statistical evaluation of Supplement 12 acceptance criteria satisfied the pass\fail objective established for Appendix VIII performance demonstration acceptance criteria.

The proposed alternative builds upon the experiences of Supplement 12 by starting with the most challenging Supplement 10 qualifications, as implemented by the PDI program (RR-II-20, Section 2.0 above), and adding a sufficient number of flaws to demonstrate the personnel skills and procedure effectiveness of the less challenging Supplement 2 and Supplement 3 qualifications. A PDI Supplement 10 performance demonstration has at least one flaw with a maximum of 10 percent of the total number of flaws being in the ferritic material. The rest of the flaws are in the more challenging austenitic material. When expanding the PDI Supplement 10 qualification to include Supplement 2 and Supplement 3, the proposed alternative would add a minimum of five flaws in austenitic material and three flaws in ferritic material to the performance demonstration. Therefore, a combined Supplement 2, Supplement 3, and Supplement 10 qualification requires a minimum of 18 flaws in the performance demonstration test. The performance demonstration results added to the appropriate PDI Supplement 10 results must satisfy the acceptance criteria of the PDI Supplement 10. A statistical evaluation performed by the Pacific Northwest National Laboratories, an NRC contractor, showed that the proposed alternative acceptance criteria satisfied the pass\fail objective established for Appendix VIII for an acceptable performance demonstration.

The staff has determined that use of a limited number of flaws to qualify Supplement 2 or Supplement 3 as coordinated with the PDI developed alternative to Supplement 10, will provide equivalent flaw detection performance to that of the ASME Code-required qualification for piping welds. As such, the licensee’s proposed alternative provides an acceptable level of quality and safety.

4.5 <u>Conclusion</u>

The NRC staff has determined that the proposed alternative to use the industry’s PDI program for implementation of Appendix VIII, Supplements 2 and 3 as coordinated with the PDI program for implementation of Appendix VIII, Supplement 10, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternative described in the licensee’s letter dated July 11, 2003, for RR-II-21 as supplemented by letter dated September 17, 2003 for the remainder of the second 10-year ISI interval at VCSNS. All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

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