February 1, 2005

Mr. David A. Christian
Sr. Vice President and Chief Nuclear Officer
Virginia Electric and Power Company
Innsbrook Technical Center
5000 Dominion Blvd.
Glen Allen, Virginia 23060-6711

SUBJECT: SURRY POWER STATION, UNIT 2 - AMERICAN SOCIETY OF MECHANICAL ENGINEERS INSERVICE INSPECTION PROGRAM THIRD 10-YEAR INTERVAL REQUESTS FOR RELIEF (TAC NOS. MC3142 AND MC3143)

Dear Mr. Christian:

By letter dated May 13, 2004, as supplemented by letter dated August 10, 2004, Virginia Electric and Power Company (VEPCO) requested relief from certain American Society of Mechanical Engineers requirements for the third 10-year Inservice Inspection (ISI) Interval at Surry Power Station, Unit 2. In its submittals, VEPCO requested approval of Relief Requests SR-036 and SR-037 for Surry, Unit 2. The Nuclear Regulatory Commission (NRC) staff has completed its review of Relief Requests SR-036 and SR-037, and our evaluations and conclusions are contained in the enclosed Safety Evaluation.

The NRC staff has reviewed Relief Request SR-037 and has concluded that VEPCO's proposed alternatives provide an acceptable level of quality and safety. Therefore, Relief Request SR-037 is authorized pursuant to Title 10 of the *Code of Federal Regulations* Section 50.55a(a)(3)(i) for the third 10-year ISI interval at Surry, Unit 2.

Regarding SR-036, the NRC staff has completed its review of Items 1 through 13. For Items 1 through 12, the NRC staff concludes that VEPCO's proposed alternative provides an acceptable level of quality and safety. As such, Items 1 through 12 of Relief Request SR-036 are authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the third 10-year ISI interval at Surry, Unit 2. For Item 13, the NRC staff has determined that compliance with the Code requirement is impractical, and that the licensee's proposed alternative will provide reasonable assurance of structural integrity. Therefore, pursuant to 10 CFR 50.55a(g)(6)(i), the NRC staff grants relief for Item 13 in Relief Request SR-036 for the remainder of the third 10-year ISI interval at Surry, Unit 2.

The granting of relief pursuant to 10 CFR 50.55a(g)(6)(i) 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.

Sincerely,

/RA/

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

Docket No. 50-281

Enclosure: As stated

cc w/encl: See next page

The granting of relief pursuant to 10 CFR 50.55a(g)(6)(i) 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.

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

SURRY POWER STATION, UNIT 2

VIRGINIA ELECTRIC AND POWER COMPANY

DOCKET NO. 50-281

1.0 INTRODUCTION

By letter dated May 13, 2004, as supplemented by letter dated August 10, 2004, Virginia Electric and Power Company (the licensee) requested relief from the requirements of the 1989 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI for the third 10-year inservice inspection (ISI) interval at Surry Power Station, Unit 2. Specifically, the licensee requested approval of Relief Requests SR-036 and SR-037 for Surry, Unit 2. The licensee's submittal dated August 10, 2004, provided superseding information for Relief Request SR-036.

Although, the third 10-year ISI interval ended on May 9, 2004, for Surry, Unit 2, the ASME Section XI Code allows for the required interval examinations to be completed within a grace period of 1-year beyond the end of the interval in order to accommodate outage scheduling. The Surry, Unit 2 reactor pressure vessel weld inspections will be completed during the spring 2005 refueling outage, which is within the 1-year grace period allowed by the ASME Code.

The NRC staff has completed its review of Relief Requests SR-036 and SR-037, and our evaluations and conclusions are discussed below.

2.0 REGULATORY REQUIREMENTS

The ISI of ASME Code Class 1, Class 2, and Class 3 components shall be performed in accordance with Section XI of the ASME Code and applicable editions and addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). 10 CFR 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) may be used, when authorized by the 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) shall 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) on the date 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. 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. The applicable ASME Code of record for the third 10-year ISI at Surry, Unit 2 is the 1989 Edition of the ASME Section XI Code. The third 10-year ISI interval ended on May 9, 2004.

3.0 SAFETY EVALUATION - Relief Request SR-036, Revision 1

3.1 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.”

ASME Section XI, Class I, Examination Category R-A, Risk-Informed Piping Examinations, Item R1.11, Elements Subject to Thermal Fatigue (formerly B-F, Pressure-Retaining Dissimilar Metal Welds in Vessel Nozzles, Item B5.10, nominal pipe size (NPS) 4 or Larger Nozzle-to-Safe End Butt Welds) at Surry, Unit 2 subject to examination using procedures, personnel, and equipment qualified to the 1995 Edition with 1996 Addenda of the ASME Code, Section XI, Appendix VIII, Supplement 10 criteria. The specific welds involved are listed in the table below.

Weld No.	ID	Wall Thickness	Base Metal	Weld Metal
29”-RC-1-2501R-1-01DM (loop A hot leg)	29”	2.70”	SA508 Class 2 / ASTM A-376 TP 316	austenitic stainless steel
27-1/2”-RC-3-2501R-1-17DM (loop A cold leg)	27-1/2”	2.56”	SA508 Class 2 / ASTM A351 CF8M	austenitic stainless steel
29”-RC-4-2501R-1-01DM (loop B hot leg)	29”	2.70”	SA508 Class 2 / ASTM A-376 TP 316	austenitic stainless steel
27-1/2”-RC-6-2501R-1-17DM (loop B cold leg)	27-1/2”	2.56”	SA508 Class 2 / SA351 CF8M	austenitic stainless steel
29”-RC-7-2501R-1-01DM (loop C hot leg)	29”	2.70”	SA508 Class 2 / ASTM A-376 TP 316	austenitic stainless steel
27-1/2”-RC-9-2501R-1-17DM (loop B cold leg)	27-1/2”	2.56”	SA508 Class 2 / SA351 CF8M	austenitic stainless steel

3.2 Code Requirements

The following paragraphs or statements are from the ASME Code 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 - Paragraphs 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.

Item 12 - Paragraph 3.1 states – Examination procedures, equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls.

Item 13 – Paragraph 3.2(b) states – Examination procedures, equipment, and personnel are qualified for depth sizing when the root mean square error (RMSE) of the flaw depth measurement, as compared to the true flaw depth, is less than or equal to 0.125 in.

3.3 Licensee's Proposed Alternative and Its Basis for Relief

In its superseding submittal dated August 10, 2004, the licensee proposed the following 13 alternatives to the selected paragraphs in the 1995 Edition with 1996 Addenda of the ASME Code, Section XI, Appendix VIII, Supplement 10 requirements for Surry, Unit 2. The licensee's proposed alternative will be implemented through the Performance Demonstration Initiative (PDI) Program.

Item 1 - The proposed alternative to Paragraph 1.1(b) states:

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. Although 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 - The proposed alternative to Paragraph 1.1(d) states:

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. The sound beam, which normally passes only through base material, must now travel through weld material on at least one side, thereby 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 - The proposed alternative to Paragraph 1.1(d)(1) states:

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. Based on recent experience, the flaws are not likely to be contained within the weld. 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 - The proposed alternative to Paragraph 1.2(b) states:

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 a 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 Table VIII-S10-1.

Item 5 - The proposed alternative to the flaw distribution requirements of Paragraph 1.2(c)(1) (detection) and 1.3(c) (length) 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 - The proposed alternative to Paragraph 2.0 first sentence states:

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

Items 7 and 8 - The proposed alternatives to Paragraph[s] 2.2(b) and 2.2(c) state:

“. . . containing a flaw to be sized may be identified to the candidate.”

Technical Basis - The current 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 - The proposed alternative to Paragraph[s] 2.3(a) and 2.3(b) states:

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

Technical Basis - The current 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 - The proposed alternative modifies the acceptance criteria of Table VIII-S2-1 as follows:

Technical Basis - The proposed alternative is identified as Table [VIII-S10-1] [below]. It was modified to reflect the reduced number of unflawed grading units and allowable false calls. The revised table was developed as a part of ongoing Code activities involving Pacific Northwest National Laboratory (PNNL), which reviewed the statistical significance of these revisions and offered the revised acceptance criteria in Table [VIII-S10-1].

TABLE [VIII-S10-1]
PERSONNEL PERFORMANCE DEMONSTRATION DETECTION TEST
ACCEPTANCE CRITERIA

Detection Test Acceptance Criteria		False Call Acceptance Criteria	
No. of Flawed Grading Units	Minimum Detection Criteria	No. of Unflawed Grading Units	Maximum No. of False Calls
10	8	15	2
11	9	17	3
12	9	18	3
13	10	20	3
14	10	21	3
15	11	23	3
16	12	24	4
17	12	26	4
18	13	27	4
19	13	29	4
20	14	30	5

Item 12 - [Paragraph 3.1 alternative:]

During the qualification process, the ultrasonic examiners concluded that transducer contact could not be maintained in certain areas of the specimen during scanning for axial defects. In the procedure performance summary issued by PDI, a limitation is noted for the detection of axial flaws in Supplement 10 field weld configurations.

As an alternative methodology to address the procedure detection limitation, Dominion proposes to use surface geometry profiling software to help the examiner confirm locations where the raw data indicates lack of transducer contact due to problematic surface geometry. In this technique, a focused immersion transducer is positioned ahead of the transducer bundle on the examination array. This transducer location permits accurate profile data across the examination volume with minimal tilt and jitter from the array. The software translates this data into a scale representation of the examination surface where specific points in the raw data can be imported and correlated with the surface geometry.

With this data the examiner can adjust flaw bounding dimensions, determine metal ligament, if applicable, and better judge if limitations apparent in the raw data can be supported by local surface profile data. This last feature is the more important capability of the process as it pertains directly to the anticipated surface geometry of the Dominion primary loop dissimilar metal (DM) welds. Procedures made specific to Dominion will require the following:

1) Regular 22 mm x 22 mm transducers for detection of circumferential defects. This is the "standard technique" qualified for detection and length sizing. These transducers will also be used initially for axial defect scans.

2) 100% profiling of all nozzle to primary piping DM weld ID surfaces (Hot Leg and Cold Leg).

3) Evaluation of the raw data for transducer contact and profile data for supporting evidence.

The information thus generated will allow assessment of the limitations of coverage for detection from the axial scans.

To supplement the axial detection capability, Dominion proposes to use eddy current examination techniques to interrogate the surface of the examination volume for all 6 primary loop DM welds at Surry Unit 2. Eddy current data will be used to provide assurance of detection of surface breaking defects in both the axial and circumferential orientations and will serve to supplement the ultrasonic procedure in that regard. The eddy current probes are pencil sized and spring loaded, allowing them to more closely follow the surface geometry of counterbore, miss-match, and root protrusions.

Technical Basis - The weld locations in question have been inspected during construction, during preservice inspection, and in two subsequent inservice inspections with no unacceptable indications discovered. The construction examinations were [conducted using] radiographic and surface examinations while the preservice examinations were conducted ultrasonically. The last inservice examinations were performed from the inside of the piping with immersion ultrasonic techniques, which might have been more likely to detect axial flaws than the PDI qualified contact techniques which are more subject to problems associated with irregular surface condition.

These weld inspection locations encompass dissimilar metal welds made between cast austenitic stainless steel and ferritic nozzles made with austenitic stainless steel weld metal. The nozzles are clad with austenitic stainless steel. The material is known to be highly resistant to either IGSCC or transgranular stress corrosion cracking (TGSCC) in pressurized water reactor (PWR) reactor coolant environments so that the possibility of service induced environmental cracking is very low. Furthermore, during development of the Risk Informed Inservice Inspection (RI-ISI) Program at Surry Unit 2, the welds in question were found to have low safety significance and did not require inspection. The RI-ISI Expert Panel added the welds to the inspection matrix for defense-in-depth considerations only.

These previous flaw free examinations, the fact that all of the materials exposed to the reactor water environment at these locations are resistant to SCC, and the results of the RI-ISI work indicate that the proposed alternative inspections provide an adequate level of quality and assurance of safety.

Item 13 - [Paragraph 3.2(b) alternative:]

During the PDI qualification activity, the contractor that has been selected for the reactor vessel (RV) nozzle to piping weld examinations was able to achieve a depth sizing accuracy of 0.189 in. RMS [Root mean square] rather than the 0.125 in. RMS required by paragraph 3.2(b) of Supplement 10. Dominion proposes that for any flaws detected and depth sized in the subject welds, the difference between the Supplement 10 required 0.125 in. RMS and the demonstrated 0.189 in. RMS, namely 0.064 in., will be added to the flaw depth sizing.

Technical Basis - Use of the difference between the Code required depth sizing accuracy and the achieved sizing accuracy as an addition to the size of any flaws discovered by the examination will [ensure] that the flaw acceptability and evaluation is based on an appropriately conservative size. The use of the 0.064 in. is appropriate because it was determined as a result of demonstrated performance under the auspices of the PDI process.

3.4 NRC Staff Evaluation

In its superseding submittal dated August 10, 2004, the licensee proposed to use the program developed by PDI that is similar to the ASME Code, Section XI requirements. The differences between the ASME Code and the PDI program are discussed below.

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 implementation of the PDI guidelines would significantly reduce the equivalent range of 15.5-inch to 16.5-inch diameter pipe. The difference between the ASME Code and the PDI for diameters less than 5 inches is not significant because of shorter metal path and beam spread associated with smaller diameter piping. As such, the licensee’s proposed alternative to use the PDI guidelines is considered more conservative overall than current ASME Code requirements. The NRC staff finds that the licensee’s proposed alternative will provide an acceptable level of quality and safety.

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 ultrasonic testing acoustic responses similar to the responses associated with real cracks. PDI is selectively installing these fabricated flaws in specimen locations that are unsuitable for 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 Center in Charlotte, North Carolina. The NRC staff attended these meetings and determined that the process parameters used for manufacturing fabricated flaws resulted in acceptable acoustic responses. The NRC staff finds that the licensee’s proposed alternative will provide an acceptable level of quality and safety.

Item 3 - 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 testing 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 PDI program consists of placing 80 percent of the flaws in the weld metal or buttering material. This provides a challenging testing scenario that is reflective of field experience and minimizes testmanship associated with telltale reflectors common to placing flaws in austenitic base material. The NRC staff considers the licensee's proposed alternative to implement the PDI program to be more conservative than current ASME Code requirements. The NRC staff finds that the licensee's proposed alternative will provide an acceptable level of quality and safety .

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 five 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 licensee's proposed implementation of the PDI program would follow the detection criteria of Table VIII-S10-1 beginning with a minimum of ten flaws in a test set 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 licensee's proposed alternative satisfies the pass/fail objective established for ASME Code, Section XI, Appendix VIII performance demonstration acceptance criteria. As such, the NRC staff finds that the licensee's proposed alternative will provide an acceptable level of quality and safety.

Item 5 - Paragraphs 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 licensee's proposed alternative, which implements the PDI program, 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- to 30-percent increment, the licensee's proposed alternative is a subset of the current ASME Code requirements. The 10- to 30-percent increment would be in the subset if it contained at least 30 percent of the flaws. This 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 licensee's proposed alternative will provide an acceptable level of quality and safety.

Item 6 - Paragraph 2.0

The ASME Code requires the specimen inside surface to be concealed from the candidate. This requirement is applicable for test specimens used for qualification that are 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 licensee's 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 licensee's proposed alternative will provide an acceptable level of quality and safety.

Items 7 and 8 - Paragraphs 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 licensee's proposed alternative, which implements the PDI program, 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. As such, the NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the licensee's proposed alternative will provide an acceptable level of quality and safety.

Items 9 and 10 - Paragraphs 2.3(a) and 2.3(b)

Regarding 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 licensee's proposed alternative, which implements the PDI program, 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 licensee's proposed alternative will provide an acceptable level of quality and safety.

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 licensee's 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. As such, the NRC staff considers the proposed alternative to be more conservative than current ASME Code requirements. The NRC staff finds that the licensee's proposed alternative will provide an acceptable level of quality and safety.

Item 12 - Supplement 10 of Appendix VIII to the ASME Code, Section XI requires that examination procedures, equipment, and personnel meet specific criteria as specified in Table VIII-S10-1 for both detection and false calls. However, a limitation was noted for detection axial flaws where transducer contact could not be maintained in certain areas of the specimen.

As an alternative, the licensee will use a surface geometry profiling technique to identify locations that lack transducer contact. An eddy current technique will be used to supplement ultrasonic procedure at these locations. The eddy current probe will provide data from areas with irregular surface conditions. The licensee's proposed alternative, which combines ultrasonic testing and eddy current techniques, will provide reasonable assurance that axial flaws will be detected. The NRC staff finds that the licensee's proposed alternative will provide an acceptable level of quality and safety.

Item 13 - Supplement 10 of Appendix VIII to the ASME Code, 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-RMS. 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-RMS depth sizing criterion. At this time, achieving the 0.125-inch-RMS appears to be impractical. The vendor contracted by the licensee has only been able of achieving an accuracy of 0.189-inch-RMS. The licensee has proposed to use 0.189-inch-RMS to size any detected flaws during the forthcoming outage. The licensee would add the difference (0.064 inch) between the Code-required RMS (0.125 inch) and the demonstrated accuracy (0.189-inch-RMS) to the measurements acquired from flaw sizing. The request is for the remainder of the cycle in the third 10-year ISI interval.

From performance demonstration of typical hot leg and cold leg weld examinations with a wall thickness of 2.5 inches, the NRC staff gathered information that suggested that the RMS values were independent of flaw depth. In the thickness range of test specimens, 0.125-inch-RMS of the flaw depth measurement would be approximately 5-percent tolerance on RMS percent of the typical wall thickness and, likewise, 0.189-inch-RMS would translate to approximately 7.5 percent of the RMS percent of the typical wall thickness. The increase in error of 2.5 percent of the measured flaw depth is less than the planar flaw acceptance criteria in Table IWB-3514-2. The NRC staff believes that the flaw depth adjustment proposed by the licensee will ensure a conservative bounding flaw depth value.

Based on the above, the NRC staff has determined that achieving the 0.125-inch-RMS for depth sizing of flaws in dissimilar metal weld test specimens during qualification of ultrasonic examination procedure, equipment, and personnel for the subject welds is impractical at this time, and that the licensee's proposed alternative to make flaw depth adjustment will provide reasonable assurance of structural integrity.

3.5 Conclusion

The NRC staff has determined that the licensee's proposed alternative to Supplement 10, as administered by the EPRI-PDI Program for Items 1 through 12, provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternative for Items 1 through 12 in Relief Request SR-036 for the remainder of the third 10-year ISI interval at Surry, Unit 2.

Regarding Item 13, the NRC staff has determined that compliance with the Code requirement is impractical, and that the licensee's proposed alternative to Supplement 10, as administered by the EPRI-PDI Program for Item 13, will provide reasonable assurance of structural integrity. Therefore, pursuant to 10 CFR 50.55a(g)(6)(i), the NRC staff grants relief for Item 13 in Relief Request SR-036 for the remainder of the third 10-year ISI interval at Surry, Unit 2. The granting of relief pursuant to 10 CFR 50.55a(g)(6)(i) 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 relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

4.0 SAFETY EVALUATION - Relief Request SR-037

4.1 Components for which Relief Is Requested

ASME Section XI, Class I, Examination Category R-A, Pressure-Retaining Dissimilar Metal Welds in Vessel Nozzles, Item B5.10, NPS 4 or Larger Nozzle-to-Safe End Butt Welds at Surry, Unit 2 subject to examination using procedures, personnel, and equipment qualified to ASME Section XI, Appendix VIII, Supplement 2, 3, or 10 criteria. The specific welds involved are listed below:

Weld No.	ID	Wall Thickness	Base Metal	Weld Metal
29"-RC-301-2501R-1-01DM (loop A hot leg)	29"	2.70"	SA508 Class 2 / ASTM A-376 TP 316	austenitic stainless steel
29"-RC-304-2501R-1-01DM (loop B hot leg)	29"	2.70"	SA508 Class 2 / ASTM A-376 TP 316	austenitic stainless steel
29"-RC-307-2501R-1-01DM (loop C hot leg)	29"	2.70"	SA508 Class 2 / ASTM A-376 TP 316	austenitic stainless steel

4.2 Code Requirements and Requested Relief

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, as applicable for wrought austenitic piping welds, and Supplement 3, as applicable for ferritic piping welds.

As such, the licensee has requested to use the following proposed alternatives: implement an alternative to the requirements of ASME Section XI, Appendix VIII, Supplement 10; and implement a proposed alternative PDI program for Supplement 10 and implement this revised program for Supplements 2 and 3.

4.3 Licensee's Basis for Relief

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 Surry Unit 2, the applicable weld joint is the reactor vessel nozzle to pipe dissimilar metal weld, which is a combination of ferritic and cast austenitic components assembled with austenitic stainless steel weld metal.

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 ten 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 three 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 the same. 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. This configuration 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 initiate in fine-grained base materials.

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

Based on the above, the use of a limited number of Supplement 2 or 3 flaws is sufficient to assess 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.

4.4 Licensee's Proposed Alternative

SPECIMEN REQUIREMENTS

Qualification test specimens shall meet the requirements listed herein, unless a set of specimens is designed to accommodate specific limitations stated in the scope of the examination procedure (e.g., pipe size, access limitations). The same specimens may be used to demonstrate both detection and sizing qualification.

GENERAL

The specimen set shall conform to the following requirements:

(a) Specimens shall have sufficient volume to minimize spurious reflections that may interfere with the interpretation process.

(b) The specimen set shall include the minimum and maximum pipe diameters and thicknesses for which the examination procedure is applicable. Applicable tolerances are provided in Supplements 2, 3, and 10.

(c) The specimen set shall include examples of the following fabrication conditions:

  (1) geometric and material conditions that normally require discrimination from flaws (e.g., counterbore or weld root conditions, cladding, weld buttering, remnants of previous welds, adjacent welds in close proximity, and weld repair areas);

  (2) typical limited scanning surface conditions (e.g., internal tapers, exposed weld mats, and cladding conditions).

SUPPLEMENT 2 FLAWS

(a) At least 70% of the flaws shall be cracks, and the remainder shall be alternative flaws.

(b) Specimens with IGSCC shall be used when available.

(c) Alternative flaws, if used, shall provide crack-like reflective characteristics and shall comply with the following:

  (1) Alternative flaws shall be used only when implantation of cracks produces spurious reflectors that are uncharacteristic of service-induced flaws.

  (2) Alternative flaws shall have a tip width of no more than 0.002 in. (0.05 mm).

SUPPLEMENT 3 FLAWS

Supplement 3 flaws shall be mechanical or thermal fatigue cracks.

DISTRIBUTION

The specimen set shall contain a representative distribution of flaws. Flawed and unflawed grading units shall be randomly mixed.

PERFORMANCE DEMONSTRATION

Personnel and procedure performance demonstration tests shall be conducted according to the following requirements:

(a) The same essential variable values, or, when appropriate, the same criteria for selecting values as demonstrated in Supplement 10 shall be used.

(b) The flaw location and specimen identification shall be obscured to maintain a "blind test."

(c) All examinations shall be completed prior to grading the results and presenting the results to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited.

DETECTION TEST

(a) The specimen set for Supplement 2 qualification shall include at least five flawed grading units and ten unflawed grading units in austenitic piping. A maximum of one flaw shall be oriented axially.

(b) The specimen set for Supplement 3 qualification shall include at least three flawed grading units and six unflawed grading units in ferritic piping. A maximum of one flaw shall be oriented axially.

(c) Specimens shall be divided into grading units.

   (1) Each grading unit shall include at least 3 in. (76 mm) of weld length.

   (2) The end of each flaw shall be separated from an unflawed grading unit by at least 1 in. (25 mm) of unflawed material. A flaw may be less than 3 in. (76 mm) in length.

   (3) The segment of weld length used in one grading unit shall not be used in another grading unit.

   (4) Grading units need not be uniformly spaced around the pipe specimen.

(d) All grading units shall be correctly identified as being either flawed or unflawed.

LENGTH-SIZING TEST

(a) The coordinated implementation shall include the following requirements for personnel length-sizing qualification.

(b) The specimen set for Supplement 2 qualification shall include at least four flaws in austenitic material.

(c) The specimen set for Supplement 3 qualification shall include at least three flaws in ferritic material.

(d) Each reported circumferential flaw in the detection test shall be length sized. When only length-sizing is being tested, the regions of each specimen containing a flaw to be sized may be identified to the candidate. The candidate shall determine the length of the flaw in each region.

(e) Supplement 2 or Supplement 3 examination procedures, equipment, and personnel are qualified for length-sizing when the flaw lengths estimated by ultrasonics, as compared with the true lengths, do not exceed 0.75 in. (19 mm) RMS, when they are combined with a successful Supplement 10 qualification.

DEPTH-SIZING TEST

The coordinated implementation shall include the following requirements for personnel depth-sizing qualification:

(a) The specimen set for Supplement 2 qualification shall include at least four circumferentially oriented flaws in austenitic material.

(b) The specimen set for Supplement 3 qualification shall include at least three flaws in ferritic material.

(c) For a separate depth-sizing test, the regions of each specimen containing a flaw to be sized may be identified to the candidate. The candidate shall determine the depth of the flaw in each region.

(d) Supplement 2 or Supplement 3 examination procedures, equipment, and personnel are qualified for depth-sizing when the flaw depths estimated by ultrasonics, as compared with the true depths, do not exceed 0.125 in. (3 mm) RMS, when they are combined with a successful Supplement 10 qualification.

PROCEDURE QUALIFICATION

Procedure qualification shall include the following additional requirements:

(a) The specimen set shall include the equivalent of at least three personnel performance demonstration test sets. Successful personnel performance demonstration may be combined to satisfy these requirements.

(b) Detectability of all flaws in the procedure qualification test set that are within the scope of the procedure shall be demonstrated. Length and depth sizing shall meet the requirements of 3.1, 3.2, and 3.3.

(c) At least one successful personnel performance demonstration shall be performed.

(d) To qualify new values of essential variables, at least one personnel performance demonstration is required. The acceptance criteria of 4(b) shall be met.

4.5 NRC Staff Evaluation

The licensee requests relief from the qualification requirements of ASME Section XI, Appendix VIII, Supplements 2 and 3 criteria when used in coordination with the PDI alternative for implementing Appendix VIII, Supplement 10. 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. If the licensee were to implement the qualifications for each supplement, this 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. Thus, the process of having the licensee use 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 has recognized that flaws in austenitic material are more difficult to detect and size than flaws in ferritic material. The ASME Code has concluded that performing a Supplement 3 qualification following a Supplement 2 qualification would result in diminishing returns on measuring personnel skills and procedure effectiveness. Therefore, instead of using separate Supplement 2 and Supplement 3 qualification procedures, the ASME Code developed Supplement 12. Supplement 12 provides for a Supplement 3 add-on to a Supplement 2 qualification. This 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 ASME Code, Section XI, 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, 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 remaining 90 percent of the flaws are in the more challenging austenitic material. When expanding the PDI Supplement 10 qualification of ten flaws 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 would require a minimum of 18 flaws in the performance demonstration test. However, the performance demonstration results added to the appropriate PDI Supplement 10 results must satisfy the acceptance criteria of the PDI Supplement 10. As a part of its review of ongoing ASME Code activities, PNNL demonstrated, in a statistical evaluation, that the proposed alternative acceptance criteria satisfied the pass/fail objective established for Appendix VIII for an acceptable performance demonstration.

The NRC staff has determined that use of a limited number of flaws to qualify personnel to 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 ferritic and austenitic piping welds. As such, the licensee's proposed alternative provides an acceptable level of quality and safety.

4.6 Conclusion

The NRC staff has determined that the licensee's 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 Request for Relief SR-37 for the remainder of the third 10-year ISI interval at Surry, Unit 2.

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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