

August 6, 2003

Mr. Jeffrey T. Gasser, Vice President  
Southern Company  
Southern Nuclear Operating Company, Inc.  
40 Inverness Center Parkway  
Post Office Box 1295  
Birmingham, AL 35201

SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2; JOSEPH M. FARLEY  
NUCLEAR PLANT, UNITS 1 AND 2 AND VOGTLE ELECTRIC GENERATING  
PLANT, UNITS 1 AND 2 RE: RELIEF REQUEST NUMBER GR-03-01 FOR  
QUALIFICATION REQUIREMENTS FOR DISSIMILAR METAL PIPING WELDS  
(TAC NOS. MB9023, MB9024, MB9025, MB9026, MB9027 AND MB9028)

Dear Mr. Gasser:

By letter dated May 14, 2003, Southern Nuclear Operating Company (SNC, the licensee) submitted proposed alternatives to, and requested relief from, the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a, concerning the third 10-year inservice inspection interval (ISI) for Edwin I. Hatch Nuclear Plant, Units 1 and 2, and for Joseph M. Farley Nuclear Plant, Units 1 and 2, and for the second 10-year ISI interval for Vogtle Electric Generating Plant, Units 1 and 2.

Supplement 10 to Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," of Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) contains the qualification requirements for procedures, equipment, and personnel involved with examining dissimilar metal welds using ultrasonic techniques. In lieu of these ASME Code requirements, SNC requested to use the dissimilar metal weld criteria of the Electric Power Research Institute-Performance Demonstration Initiative Program.

Based on the information provided by the licensee, the Nuclear Regulatory Commission (NRC) staff concludes that the proposed alternative will provide an acceptable level of quality and safety. Therefore, the use of the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the remainder of the current 10-year ISI interval at each unit. The NRC staff's Safety Evaluation is enclosed.

J. Gasser

- 2 -

August 6, 2003

If you need clarification of this approval, please contact the project manager, Mr. Steven D. Bloom, at (301) 415-1313.

Sincerely,

***/RA/***

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

Docket Nos. 50-321, 50-348, 50-364, 50-366, 50-424 and 50-425

Enclosure: As stated

cc w/encl: See next page

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## SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

### PRESSURE RETAINING PIPING WELDS EXAMINATION

#### SOUTHERN NUCLEAR OPERATING COMPANY, INC

#### EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2

#### JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2

#### VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2

#### DOCKET NOS. 50-321, 50-348, 50-364, 50-366, 50-424 AND 50-425

### 1.0 INTRODUCTION

By letter dated May 14, 2003, Southern Nuclear Company (SNC, the licensee) submitted proposed alternatives to, and requested relief from, the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a, concerning the third 10-year inservice inspection interval (ISI) for Edwin I. Hatch Nuclear Plant, Units 1 and 2, and for Joseph M. Farley Nuclear Plant, Units 1 and 2, and for the second 10-year ISI interval for Vogtle Electric Generating Plant, Units 1 and 2.

Supplement 10 to Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," of Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) contains the qualification requirements for procedures, equipment, and personnel involved with examining dissimilar metal welds using ultrasonic techniques. In lieu of these ASME Code requirements, SNC requested to use the dissimilar metal weld criteria of the Electric Power Research Institute (EPRI)-Performance Demonstration Initiative (PDI) Program.

### 2.0 REGULATORY EVALUATION

Section 50.55a(g) requires that ISI of the ASME Code Class 1, 2, and 3 components be performed in accordance with Section XI of the ASME Code and applicable addenda, except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). According to 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 an applicant demonstrates that the proposed alternatives would provide an acceptable level of quality and safety or if the specified requirement 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 (ISI) 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 ISI 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 ASME Code of record for Edwin I. Hatch Nuclear Plant , Units 1 and 2, third 10-year ISI interval, which began December 31, 1995, for Joseph M. Farley Nuclear Plant , Units 1 and 2, third 10-year ISI interval, which began December 1, 1997, and for Vogtle Electric Generating Plant, Units 1 and 2, second 10-year ISI interval, which began May 31, 1997, is the 1989 Edition.

### 3.0 DISCUSSION

#### 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 1996 Addenda of the ASME Code Section XI, Appendix VIII, Supplement 10, "Qualification Requirements for Dissimilar Metal Piping Welds."

#### 3.2 ASME Code Requirements (as stated by the licensee)

The following paragraphs or statements are from ASME Section XI, Appendix VII, 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.

### 3.3 Licensee's Proposed Alternatives and Basis for Licensing Action Request

The licensee proposed the following alternatives to the selected paragraphs in the 1995 Edition with 1996 Addenda ASME Code, Section XI, Appendix VIII, Supplement 10, requirements for Edwin I. Hatch Nuclear Plant, Units 1 and 2, Joseph M. Farley Nuclear Plant, Units 1 and 2, and Vogtle Electric Generating Plant, Units 1 and 2 during the remainder of the current interval. The proposed alternative, as stated by the licensee, will be implemented through the 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.

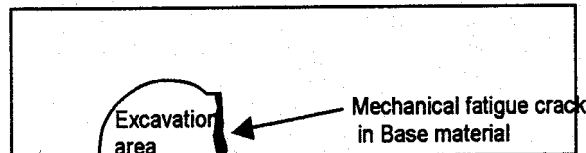
Technical Basis - The change in the minimum pipe diameter tolerance from 0.9 times the diameter to the nominal diameter minus 0.5 inch provides tolerances more in line with industry practice. Though the alternative is less stringent for small pipe diameters they typically have a thinner wall thickness 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 - 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 IGSCC [intergranular stress corrosion cracking] 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 - As illustrated below, 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 - 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. 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 - 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 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 - 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.

<u>Flaw Depth (% Wall Thickness)</u>	<u>Minimum Number of Flaws</u>
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 [ASME] 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 2.2(b) and 2.2(c) state:

... 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 - The proposed alternative to Paragraph 2.3(a) and 2.3(b) state:

... 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 - The proposed alternative modifies the acceptance criteria of Table VIII-2-1 as follows:

TABLE VIII-S2-1  
PERFORMANCE DEMONSTRATION DETECTION TEST  
ACCEPTANCE CRITERIA

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

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

### 3.4 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.

#### 3.4.1 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 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.

#### 3.4.2 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 EPRI Nondestructive Examination 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.

#### 3.4.3 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.

#### 3.4.4 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 one and a half 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.

#### 3.4.5 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 the wall thickness and one third located greater than 30 percent through the 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 increments, the proposed alternative is a subset of the current ASME Code requirements. The 10-30-percent increments 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.

#### 3.4.6 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.

#### 3.4.7 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.

#### 3.4.8 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.

#### 4.0 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 May 14, 2003, for the third 10-year ISI interval for Edwin I. Hatch Nuclear Plant, Units 1 and 2, and Farley Nuclear Plant, Units 1 and 2, and for the second 10-year ISI interval for Vogtle Electric Generating Plant, Units 1 and 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.

Principal Contributor: Z. Fu

Date: August 6, 2003

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Joseph M. Farley Nuclear Plant

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