October 14, 2005

Mr. Mark B. Bezilla
Vice President - Nuclear, Davis-Besse
FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
5501 North State Route 2
Oak Harbor, OH 43449-9760

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION, UNIT 1 - AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE - REQUEST FOR RELIEF FROM QUALIFICATION REQUIREMENTS FOR DISSIMILAR METAL PIPING WELDS (TAC NO. MC7257)

Dear Mr. Bezilla:

By letter to the Nuclear Regulatory Commission (NRC) dated June 6, 2005 (Serial Number 3141), FirstEnergy Nuclear Operating Company (FENOC) submitted Request RR-A28 regarding American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI inservice inspection (ISI) requirements for the third 10-year interval for the Davis-Besse Nuclear Power Station, Unit 1 (DBNPS). Supplement 10 to Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," of Section XI of the ASME Code contains the qualification requirements for dissimilar metal piping welds. Request RR-A28 proposed to allow the use of an alternative to these requirements based on ASME Code Case N-695.

The NRC staff concludes that the proposed alternatives to Supplement 10, as defined under Code Case N-695 and administered by the Electric Power Research Institute's Performance Demonstration Initiative, provides 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 third 10-year ISI interval for DBNPS which began on September 21, 2000.

When Code Case N-695 is endorsed in a future revision of Regulatory Guide 1.147, "In service Inspection Code Case Acceptability, ASME Section XI, Division 1," the licensee may use Code Case N-695 with any identified limitations or modifications without NRC authorization. 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 In-service Inspector.

The NRC staff's safety evaluation is enclosed.

Sincerely,

/RA/

Gene Y. Suh, Chief, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-346

Enclosure: Safety Evaluation

cc w/encl: See next page

The NRC staff's safety evaluation is enclosed.

Sincerely,
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Gene Y. Suh, Chief, Section 2
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

THIRD 10-YEAR INTERVAL IN-SERVICE INSPECTION

REQUEST FOR RELIEF NO. RR-A28

FIRSTENERGY NUCLEAR OPERATING COMPANY

DAVIS - BESSE NUCLEAR POWER STATION, UNIT 1

DOCKET NO. 50-346

1.0 INTRODUCTION

By application to the U.S. Nuclear Regulatory Commission (NRC, Commission) dated June 6, 2005 (Agencywide Documents Access Management System Accession No. ML051590468), FirstEnergy Nuclear Operating Company (the licensee) submitted Request RR-A28 regarding American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI in-service inspection (ISI) requirements for the third ten-year interval for the Davis-Besse Nuclear Power Station, Unit 1 (DBNPS). Supplement 10 to Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," of Section XI of the ASME Code contains the qualification requirements for dissimilar metal piping welds. Request RR-A28 proposed to allow the use of alternatives to these requirements based on ASME Code Case –695.

2.0 REGULATION EVALUATION

The ISI of the ASME Code Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) may be used, when authorized by the Director of the Office of Nuclear Reactor Regulation 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 In-service Inspection (ISI) of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. Section 50.55a(g)(4)(ii) requires that in-service examination of components and system pressure tests conducted during the 120-month intervals subsequent to the first 10-year interval 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 inspection interval, subject to the limitations and modifications listed therein. The third 10-year ISI interval for DBNPS began on September 21, 2000, and the ISI Code of record for the third 10-year interval is the 1995 Edition through the 1996 Addenda. 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.

2.0 LICENSEE'S EVALUATION

2.1 Components For Which Relief Is Requested

Dissimilar metal piping welds are subject to examination 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."

2.2 Code Requirements

The licensee proposed the following alternatives to the ASME Code, Section XI, Appendix VIII, Supplement 10 requirements:

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 percent of the cracks shall be in austenitic material. At least 50 percent of the cracks in austenitic material shall be contained wholly in the weld or buttering material. At least 10 percent 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 percent and 30 percent of the nominal pipe wall thickness. Paragraph 1.4(b) distribution table requires 20 percent of the flaws to have depths between 10 percent and 30 percent.

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 percent 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 Proposed Alternative and Licensee's Basis For Use

The licensee proposed the following alternative requirements to selected provisions of the ASME Code, Section XI, Appendix VIII, Supplement 10, requirements for the DBNPS third 10-year ISI interval. The proposed alternative, as implemented through the Electric Power Research Institute's Performance Demonstration Initiative (EPRI-PDI) program is attached to the licensee's submittal. The proposed alternative was incorporated in ASME Code Case N–695 which was approved by the ASME on May 21, 2003.

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 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, but the remainder shall be alternative flaws. Specimens with IGSCC [intergranular stress corrosion cracking] shall be used when available. Alternative flaws shall meet the following requirements: (1) alternative flaws, if used, shall provide crack-like reflective characteristics and shall only be used when implantation of cracks would produce spurious reflectors that are uncharacteristic of service-induced flaws, and (2) alternative flaws shall have a tip width no more than 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 the weld or buttering material. At least one and no more than 10% of the flaws shall be in ferritic base material. At least one and no more than 10% of the flaws shall be in austenitic base material.

Technical Basis - Under the current ASME Code requirement, 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 test sets shall be selected from Table 1 [VIII-S10-1]. The number of unflawed grading units shall be at least 1½ times the number of flawed grading units.

Technical Basis - [Table S-10-1] Code Case –695 Table 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 Table 1 [Table VIII-S10-1].

Item 5 - Paragraph 1.2(c)(1)&1.3(c) alternative:
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%

In addition, the proposed alternative includes the following:
At least 75% of the flaws shall be in the range of 10 to 60% of wall thickness.

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 specimen 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 inside diameter [ID] and outside diameter [OD] scanning surfaces, requires that they be conducted separately, and requires that flaws be concealed from the candidate.

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 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.

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 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.

Item 11 - Paragraph 3.1 alternative:

Uses the acceptance Table VIII-S10-1 (shown in the licensee's submittal) which is a modification of Table VIII-S2-1.

Technical Basis - The proposed alternative adds new Table 1. It is a modified version of Table VIII-S2-1 to reflect the reduced number of unflawed grading units and allowable false calls. As provided by the EPRI Performance Demonstation Initiative (PDI) a part of ongoing Code activities, Pacific Northwest Natonal Laboratory has reviewed the statistical significance of these revisions and offered revised Table VIII-S10-1.

3.0 TECHNICAL EVALUATION

Since 2001, EPRI has been developing a PDI program to implement Supplement 10 to Appendix VIII of Section XI of the ASME Code. During the development process, certain aspects of Supplement 10 were identified as difficult or impossible to implement. To overcome the implementation difficulties, EPRI researched, tested, and demonstrated the effectiveness of an alternative to selected paragraphs of the Code. EPRI representatives presented the alternative before the appropriate ASME committees which formalized the alternative in ASME Code Case –695 which was approved on May 21, 2003. The NRC staff representatives on these committees participated in the consensus process and joined with the industry in approving Code Case –695. The differences between the ASME Code and the EPRI-PDI program are discussed below.

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 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 EPRI-PDI guidelines, the equivalent range would be reduced to 4.5-inch to 5.5-inch diameter pipe. With current 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 to between 15.5-inch and 16.5-inch diameter pipe. The difference between the ASME Code and the proposed EPRI-PDI program for diameters less than 5 inches is not significant because of the shorter metal path and beam spread associated with smaller diameter piping. The NRC staff considers the proposed alternative to be 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.

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, EPRI-PDI developed a process for fabricating flaws that produce ultrasonic testing (UT) acoustic responses similar to the responses associated with real cracks. EPRI presented its process for discussion at public meetings held June 12 through 14, 2001, and January 31 through February 2, 2002, at the EPRI NDE [Non-Destructive Evaluation] Center, in Charlotte, NC. The NRC staff attended these meetings and determined that the process parameters used for manufacturing fabricated flaws resulted in acceptable acoustic responses. EPRI-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.

Paragraph 1.1(d)(1) and Table VIII-S2-1:
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 the 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 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 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.

Paragraph 1.2(b), 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 proposed alternative, as shown in the licensee's submittal as Table VIII-S10-1, would follow the detection criteria of the table beginning with a minimum number of flaws in a test set starting at 10, and reducing the number of unflawed grading units to one and a half times the number of flawed grading units, while maintaining the same statistical design basis as the ASME Code. The proposed alternative paragraphs satisfy the pass/fail objective established for the 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.

Paragraph 1.2(c)(1), Paragraph 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. At least 75 percent of the flaws shall be in the range of 10 to 60 percent of the wall thickness with the remaining flaws located randomly throughout the pipe 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.

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.

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.

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 allows identification of the specific location to be an option. This 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 concludes that the licensee's proposed alternative to use Supplement 10, as defined under Code Case N-695 and administered by the EPRI-PDI program, 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 DBNPS for the remainder of the third 10-year ISI interval which began on September 21, 2000. When Code Case N-695 is endorsed in a future revision of Regulatory Guide 1.147, "In service Inspection Code Case Acceptability, ASME Section XI, Division 1," the licensee may use Code Case N-695 with any identified limitations or modifications without NRC authorization. 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 In-service Inspector.

Principal Contributor: T. Steingass

Date: October 14, 2005