June 3, 2003

Mr. William T. O'Connor, Jr.
Vice President - Nuclear Generation
Detroit Edison Company
6400 North Dixie Highway
Newport, MI 48166

SUBJECT: FERMI 2 - EVALUATION OF RELIEF REQUESTS RR-A33 AND RR-A34 REGARDING SECOND 10-YEAR INSERVICE INSPECTION (TAC NOS. MB7566 AND MB7567)

Dear Mr. O'Connor:

By letter dated January 31, 2003, the Detroit Edison Company (the licensee) submitted Relief Requests (RR)-A33 and RR-A34 for Fermi 2. In RR-A33 and RR-A34, the licensee proposed alternatives to the requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, "Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components," 1995 edition, 1996 addenda, Appendix VIII, Supplements 10 (RR-A33) and 4 (RR-A34) for the remainder of the second 10-year ISI interval, which began on February 17, 2000.

The Nuclear Regulatory Commission (NRC) staff has reviewed RR-A33 and RR-A34. The NRC staff's safety evaluation is enclosed. Pursuant to Title 10 of the *Code of Federal Regulations,* Part 50, Section 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternatives described in Relief Requests RR-A33 and RR-A34 on the basis that the proposed alternatives inspections provide an acceptable level of quality and safety. The proposed alternatives are authorized for the remainder of the second 10-year ISI interval.

Sincerely,

/RA by Darl Hood for/

L. Raghavan, Chief, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-341

Enclosure: Safety Evaluation

cc w/encl: See next page

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cc:

Mr. Peter Marquardt
Legal Department
688 WCB
Detroit Edison Company
2000 2nd Avenue
Detroit, MI 48226-1279

Michigan Department of Environmental Quality
Waste and Hazardous Materials Division
Hazardous Waste and Radiological Protection Section
Nuclear Facilities Unit
Constitution Hall, Lower-Level North
525 West Allegan Street
P.O. Box 30241
Lansing, MI 48909-7741

U.S. Nuclear Regulatory Commission
Resident Inspector's Office
6450 W. Dixie Highway
Newport, MI 48166

Monroe County Emergency Management
Division
963 South Raisinville
Monroe, MI 48161

Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, IL 60532-4351

Norman K. Peterson
Director, Nuclear Licensing
Detroit Edison Company
Fermi 2 - 280 TAC
6400 North Dixie Highway
Newport, MI 48166

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SECOND 10-YEAR INSERVICE INSPECTION INTERVAL

FERMI 2

DETROIT EDISON COMPANY

DOCKET NO. 50-341

1.0 INTRODUCTION

By letter dated January 31, 2003, the Detroit Edison Company (the licensee) submitted Relief Requests (RR)-A33 and RR-A34 for Fermi 2. In RR-A33 and RR-A34, the licensee proposed alternatives to the requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, "Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components," 1995 edition, 1996 addenda, Appendix VIII, Supplement 10 (RR-A33) and Supplement 4 (RR-A34) for the remainder of the second 10-year ISI interval, which began on February 17, 2000.

ISI of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with ASME Code, Section XI, 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). The regulation at 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 pre-service examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ISI Code of record for the second 10-year interval for Fermi 2 is the 1989 edition, no 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.

ENCLOSURE

In RR-A33, the licensee proposes to use the dissimilar metal weld (DMW) inspection qualification criteria of the Electric Power Research Institute's (EPRI's) Performance Demonstration Initiative (PDI) Program in lieu of selected aspects of ASME Code, Section XI, Appendix VIII, Supplement 10. In RR-A34, the licensee proposes to use EPRI's PDI Program criteria in lieu of selected aspects of the ASME Code, Section XI, Appendix VIII, Supplement 4.

2.0 EVALUATION OF RR-A33

Components for Which Relief Is Requested

ASME Code, Section XI, 1989 edition, no addenda, Class 1, Category B-F, Pressure-Retaining Piping Welds, Item Numbers B5.10, B5.130, subject to ultrasonic examination using procedures, personnel, and equipment qualified to ASME Code, Section XI, 1995 edition, 1996 addenda, Appendix VIII, Supplement 10 criteria.

The following sections describe (1) the specific paragraphs of Supplement 10 of the ASME Code, Section XI, 1989 edition, no addenda, Appendix VIII, for which the licensee has proposed alternatives, (2) the licensee's proposed alternatives and technical bases, and (3) the NRC staff's evaluation. The proposed alternatives will be implemented through the PDI Program.

2.1 Paragraph 1.1(b) (as stated)

> 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.

Licensee's proposed alternative (as stated)

> 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 reduces the detrimental effects of the curvature. This change maintains consistency between Supplement 10 and the recent revision to Supplement 2.

NRC Staff Evaluation

The 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 outside diameter (OD) pipe would be equivalent to the range of a 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 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 inches and 16.5 inches. The difference between the Code and the proposed alternative for diameters less than 5-inches is not significant because of the shorter metal path and beam spread associated with smaller diameter piping. The proposed alternative is considered more conservative than current Code requirements, and is, therefore, acceptable.

2.2 Paragraph 1.1(d) (as stated)

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

Licensee's Proposed Alternative (as stated)

> At least 60% of the flaws shall be cracks, the remainder shall be alternative flaws. Specimens with IGSCC shall be used when available. Alternative flaws, if used, shall provide crack-like reflective characteristics and shall be limited to the case where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. Alternative flaw mechanisms shall have a tip width of less than or equal to 0.002 in. (.05 mm). Note, to avoid confusion the proposed alternative modifies instances of the term "cracks" or "cracking" to the term "flaws" because of the use of alternative flaw mechanisms.
>
> Technical Basis - Implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. In addition, it is important to preserve the dendritic structure present in field welds that would otherwise be destroyed by the implantation process. To resolve these issues, the proposed alternative allows the use of up to 40% fabricated flaws as an alternative flaw mechanism under controlled conditions. The fabricated flaws are isostatically compressed which produces ultrasonic reflective characteristics similar to tight cracks.

NRC Staff Evaluation

The 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 NDE 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. PDI is selectively installing these fabricated flaws in specimen locations that are unsuitable for real cracks.

2.3 Paragraph 1.1(d)(1) (as stated)

> 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.

Licensee's Proposed Alternative (as stated)

> 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 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 most 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 Code.

NRC Staff Evaluation

The Code requires that at least 50 percent of the flaws be contained in austenitic material. At least 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 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.

2.4 Paragraph 1.2(b) (as stated)

> 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.

Licensee's Proposed Alternative (as stated)

> 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 - New Table VIII-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.

NRC Staff Evaluation

The 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 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 Table VIII-S2-1 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 NRC staff finds that the proposed alternative satisfies the pass/fail objective established for Appendix VIII performance demonstration acceptance criteria.

2.5 Paragraph 1.2(c)(1) and 1.3(c) (as stated)

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%"

Licensee's Proposed Alternative (as stated)

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.

NRC Staff Evaluation

For detection and length sizing, the Code requires that at least one third of the flaws be located between 10 percent and 30 percent through the wall thickness and one third located greater than 30 percent through the wall thickness. The remaining 40 percent 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 pipe thickness. With the exception of the 10-30 percent increment, the proposed alternative is a subset of the current 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.

2.6 Paragraph 2.0 (as stated)

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

Licensee's Proposed Alternative (as stated)

> 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 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. This is consistent with the recent revision to Supplement 2.

NRC Staff Evaluation

The Code requires the specimen inside surface be concealed from the candidate. This requirement is applicable for test specimens used for qualification examinations 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 finds this to be appropriate and, therefore, acceptable.

2.7 Paragraphs 2.2(b) and 2.2(c) (as stated)

> 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.

Licensee's Proposed Alternative (as stated)

... 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.

NRC Staff Evaluation

The Code requires that the location of flaws added to the test set for length sizing shall be identified to the candidate. The proposed alternative would create an option for identifying the location of additional flaws. This option would provide 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 alternative is more conservative than the Code requirements and is, therefore, acceptable.

2.8 Paragraphs 2.3(a) and 2.3(b) (as stated)

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.

Licensee's Proposed 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. This is consistent with the recent revision to Supplement 2. It also incorporates terminology from length sizing for additional clarity.

NRC Staff Evaluation for 2.3(a)

The Code requirement is that 80 percent of the flaws be sized in a specific location that is identified to the candidate. The proposed alternative would permit 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 alternative is more conservative than the Code requirements and is, therefore, acceptable.

NRC Staff Evaluation for 2.3(b)

The Code requires that the location of flaws added to the test set for depth sizing shall be identified to the candidate. The proposed alternative would create an option for identifying the location of additional flaws. This option would provide 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 proposed alternative is more conservative than the Code requirements and is, therefore, acceptable.

2.9 Paragraph 3.1 (as stated)

> 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.

Licensee's Proposed Alternative (as stated)

> Stipulates that the acceptance Table VIIIS-10-1 be used in lieu of Table VIII-S2-1.
>
> Technical Basis - The proposed alternative replaces Table VIII-S2-1 with a new Table VIII-S10. Table VIII-S10-1 is a modification of Table VIII-S2-1 to reflect the reduced number of unflawed grading units and allowable false calls. As part of ongoing Code activities, Pacific Northwest National Laboratory (PNNL) has reviewed the statistical significance to this new Table VIII-S10-1.

NRC Staff Evaluation

The Code requirements discussed in Section 2.4 of this safety evaluation are based on statistical parameters for screening personnel. The proposed alternative increases the minimum number of flawed grading units and reduces the number of unflawed grading units while maintaining the same statistical parameters as the Code. The NRC staff finds this acceptable because the same pass/fail screening criteria used to develop the test size tables in Appendix VIII were used to create the PDI alternative in Supplement 10, Table VIII-S10-1.

2.10 Conclusion

The NRC staff has determined that the proposed alternatives to Supplement 10, as administered by the 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 alternatives described in RR-A33 for Fermi 2 for the remainder of the second 10-year

ISI interval. All other ASME Code, Section Xi, requirements for which relief was not specifically requested or granted in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

3.0 EVALUATION OF RR-A34

3.1 Components for Which Relief Is Requested

The ASME Code, Section XI, 1989 edition, no addenda, Class 1, Examination Category B-A, Item Number B1.10, longitudinal and circumferential shell weld and B1.20 head weld examinations subject to Appendix VIII, Supplement 4 requirements.

3.2 Code Requirements

ASME Code, Section XI, 1995 edition, 1996 addenda, Appendix VIII, Supplement 4, subparagraph 3.2(c), requires that performance demonstration results reported by the candidate when plotted on a two-dimensional plot (Figure VIII-S4-1) with the depth estimated by ultrasonics plotted along the ordinate and the true depth plotted along the abscissa satisfy the following statistical parameters:

- slope of the linear regression line is not less that 0.7
- the mean deviation of the flaw depth is less than 0.25 inch
- correlation coefficient is not less than 0.70

3.3 Proposed Alternative and Licensee Basis for Use (as stated)

> In lieu of the requirements of ASME Section XI, 1995 Edition, 1996 Appendix VII, Supplement 4, subparagraph 3.2(c), the acceptance criterion of 0.15-inch (root mean square) RMS provided in 10CFR50.55a(b)(2)(xv)(C)(1) for modifying subparagraph 3.2(a), is proposed for use.
>
> 3.2(c)(1) pertains to the slope of a linear regression line. The linear regression line is the difference between measured versus true value plotted along a through-wall thickness. For Supplement 4 performance demonstrations, a linear regression line of the data is not applicable because the performance demonstrations are performed on test specimens with flaws located in the inner 15 percent through-wall. The differences between measured versus true value produce a tight grouping of results that resemble a shotgun pattern. The slope of the regression line from such data is extremely sensitive to small variations, thus making the parameter of Subparagraph 3.2(c)(1) a poor and inappropriate acceptance criterion. 3.2(c)(2) pertains to the mean deviation of flaw depth. The value used in the Code is too lax with respect to evaluating flaw depths within the inner 15 percent of wall thickness. Therefore, the more appropriate criterion of 0.15 inch RMS of 10CFR 50.55a(b)(2)(xv)(C)(1), which modifies Subparagraph 3.2(a), as the acceptance criterion is proposed for use.

3.4 NRC Staff Evaluation

Supplement 4, Subparagraph 3.2(c) imposes three statistical parameters for depth sizing. The first parameter, 3.2(c)(1), pertains to the slope of a linear regression line. The linear regression line is a "best fit" line obtained by the least-square method using data points of UT-measured

flaw depth versus actual flaw depth. For Supplement 4 performance demonstrations, a best fit line acquired by the linear regression method would be calculated from data points that come from the inner 15-percent of the wall thickness. Plotting the data, UT-measured flaw depth versus true flaw depth produces closely grouped data points that resemble a shotgun pattern. The slope of a line calculated by linear regression from data points that are so close together would not produce meaningful results because the line would be extremely sensitive to small variations in depth measurements. The second parameter, 3.2(c)(2), pertains to the mean deviation of flaw depth. The Code currently requires a mean deviation flaw depth of less than 0.25-inch versus the licensee-proposed 0.15 RMS value. The licensee's proposal to use the more restrictive criterion of 0.15 RMS of 10 CFR 50.55a(b)(2)(xv)(C)(1), which modifies subparagraph 3.2(a), as the acceptance criterion is more conservative than Code and follows the PDI protocol. The third parameter, 3.2(c)(3), pertains to a correlation coefficient. The value of the correlation coefficient in subparagraph 3.2(c)(3) is inappropriate for this application since it is based on the linear regression from subparagraph 3.2(c)(1).

3.5 Conclusion

The NRC staff has determined that the proposed alternative to Supplement 4, as administered by the 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 in RR-A34 for Fermi 2 for the remainder of the second 10-year ISI interval. 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: R. Davis

Date: June 3, 2003