October 5, 2001

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

SUBJECT: FERMI 2 - RELIEF REQUESTS (RR-A31 AND RR-A32) CONCERNING INSERVICE INSPECTION REQUIREMENTS FOR THE CLASS 1 REACTOR VESSEL NOZZLES (TAC NO. MB2166 AND MB2755)

Dear Mr. O'Connor:

By letter dated June 11, 2001, Detroit Edison Company submitted Relief Request (RR) RR-A31 associated with the inservice inspection (ISI) requirements specified in American Society of Mechanical Engineers (ASME) Code, Section XI, for the Class 1 reactor vessel nozzle inner radius region. By letter dated August 16, 2001, you revised the RR-A31 by dividing it into two relief requests, now RR-A31 and RR-A32. Pursuant to 10 CFR 50.55a(a)(3)(i), RR-A31 proposes a visual inspection as an alternative to the required volumetric examination for nozzles where plant configuration is such that visual examination of the inner radius may be performed on essentially 100 percent of the inner radius. Pursuant to 10 CFR 50.55a(a)(3)(ii), RR-A32 requested relief based on hardship for nozzles where visual examination of the inner radius is limited by physical obstructions.

Based on our review of your submittal, we have concluded that the proposed alternative in RR-A31 provides an acceptable level of quality and safety, and, therefore, it is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the remainder of the second 10-year ISI interval at Fermi, which began February 2000 and ends February 2010. For RR-A32, we have concluded that complying with the specified requirements would result in hardship without a compensating increase in the level of quality and safety, and the proposed alternative provides reasonable assurance of structural integrity of the subject components. Therefore, RR-A32 is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the remainder of the second 10-year ISI intereval at Fermi.

Sincerely,

/RA by Darl S. Hood for/

William D. Reckley, Acting 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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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RISK-INFORMED INSERVICE INSPECTION PROGRAM AND BWRVIP-75

RELIEF REQUESTS (RR-A31 and RR-A32)

DETROIT EDISON COMPANY

FERMI 2

DOCKET NO. 50-341

1.0 INTRODUCTION

By letter dated June 11, 2001, Detroit Edison Company submitted Relief Request (RR) RR-A31 associated with the inservice inspection (ISI) requirements specified in American Society of Mechanical Engineers (ASME) Code, Section XI, for the Class 1 reactor vessel nozzle inner radius region. By letter dated August 16, 2001, you revised the RR-A31 by dividing it into two relief requests, now RR-A31 and RR-A32. Pursuant to 10 CFR 50.55a(a)(3)(i), RR-A31 proposes a visual inspection as an alternative to the required volumetric examination for nozzles where plant configuration is such that visual examination of the inner radius may be performed on essentially 100 percent of the inner radius. Pursuant to 10 CFR 50.55a(a)(3)(ii), RR-A32 requested relief based on hardship for nozzles where visual examination of the inner radius is limited by physical obstructions. The subject relief requests are for the second 10-year ISI interval at Fermi Power Plant, Unit 2, which began February 2000, and ends February 2010.

2.0 APPLICABLE REQUIREMENTS

ISI of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME *Boiler and Pressure Vessel Code* (B&PV Code), and applicable addenda, as required by 10 CFR 50.55a(g), except where specific 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 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 (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 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, which was 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 Code of record for the Fermi Unit 2 second 10-year ISI interval is the 1989 edition of the ASME B&PV Code.

3.0 RELIEF REQUEST A31

3.1 Component Function/Description

The reactor pressure vessel nozzle inner radius section for the following systems:

- Reactor vessel head nozzles (3)
- Main steam nozzles (4)
- CRD [control rod drive] return nozzle - nonfunctional/capped (1)
- Reactor recirculation loop suction nozzles (2)

3.2 Code Requirements for Which Relief is Requested

ASME Code, Section XI, 1989 edition, Table IWB-2500-1, for Examination Category B-D, requires a volumetric examination of the inner radius section of all RPV [reactor pressure vessel] nozzles welded with full penetration welds as shown in Figures IWB-2500-7(a) through (d).

3.3 Licensee's Proposed Alternative (as stated)

Detroit Edison proposes to perform a visual examination per the requirements of the approved Fermi ISI NDE [nondestructive examination] Program and ASME Section XI. Required coverage will include essentially 100% of the surface M-N as shown in Figures IWB-2500-7(a) through (d) in lieu of the volumetric examination required by Table IWB-2500-1, Examination Category B-D, Item B3.100, for inservice examination of reactor vessel nozzles listed above.

The resolution sensitivity for remote in-vessel exams will be established using a 1-mil [millirem] wire standard similar to that used for other RPV [reactor pressure vessel] internal examinations intended to detect cracking. Any direct exams, such as exams of the RPV head vent and spare nozzles, will be performed in accordance with ASME Section XI VT [volumetric testing]-1 requirements.

Crack-like surface flaws exceeding the acceptance criteria of Table IWB-3512-1 are unacceptable for continued service unless the reactor vessel meets the requirements of IWB-3142.2, IWB-3142.3, or IWB-3142.4.

[In response to the staff's questions during a teleconference on September 26, 2001, the licensee provided the following clarifications:

- Of the systems/components listed in Section 3.1 above, only the reactor vessel head nozzles will receive direct visual examinations, while the other systems and components will receive enhanced visual examinations.

- The reactor vessel head nozzles consist of two nozzles that are capped (nonfunctional), and one nozzle that is isolated from the reactor vessel head via two isolation valves that are normally closed during operation.

- For Table IWB-3512-1, the depth of a crack indication is assumed to be one half of the measured length of the crack indication.]

3.4 Licensee's Bases for Alternative (as stated)

All nozzle forgings were nondestructively examined during fabrication and have previously been examined using inservice ultrasonic techniques specific to the nozzle configuration. No indications of fabrication defects or service related cracking was detected by these examinations.

Nozzle inner radius examinations are the only non-welded areas requiring examination on the RPV. This requirement was deterministically made early in the development of ASME Section XI, and applied to 100 percent of nozzles welded with full penetration welds. Fatigue cracking is the only applicable degradation mechanism for the nozzle inner radius region. For all nozzles other than feedwater, there is no significant thermal cycling during operation. Therefore, from a risk perspective there is no need to perform volumetric examination on any nozzles other than feedwater and operational CRD returns. No service related cracking has ever been discovered in any of the BWR [boiling-water reactor] fleet plant nozzles other than on feedwater or operational CRD returns. The six feedwater nozzle inner radius sections will continue to be examined with UT [ultrasonic testing] techniques developed and qualified with GE-NE-523-A71-0594-A, Revision 1 (the NRC has approved this report under TAC No. MA6787). The feedwater nozzles alone represent 20 percent of all nozzles currently requiring volumetric inner radius examination, which is more than industry accepted risk sampling requirements for similar items. Detroit Edison believes that application of a visual examination alternative for the listed nozzle inner radius regions ensures an acceptable level of quality and safety.

3.5 Evaluation

In the mid 1970s, fatigue-initiated cracking was discovered in the nozzle inner radius section of feedwater nozzles at 18 BWRs. VTs (i.e., UT) did not reveal the presence of these cracks, which prompted the NRC to prepare NUREG-0619 which modified inspection requirements for these components.

In NUREG-0619, the NRC staff concluded that UT of the vessel nozzle inner radius section involves complex geometries, long examination metal paths, and inherent UT beam spread, scatter, and attenuation. During the intervening years, improvements in UT technologies were introduced (e.g., computer modeling, tip diffraction, and phased array scanning), which improved the quality of the examination for this component. However, the area remains difficult to examine completely.

The NRC staff finds that even with vessel examinations using improved NDE technology from the outside surface, the complex geometry of the RPV nozzle inner radius sections prevents complete UT coverage. The licensee proposed to perform an enhanced VT-1 (EVT) visual examination with essentially 100-percent coverage in lieu of the UT. The enhanced aspect of

the examination is to use 8x magnification video equipment to examine the inner radii. The resolution sensitivity for this remote, in-vessel exam will be established using a 1-mil diameter wire.

The primary degradation mode in RPV nozzles is fatigue, which produces hairline surface indications along the circumference of the nozzle at the inner radius section. Given the 1-mil resolution capability of the EVT, it is highly unlikely that the licensee would not detect such flaws using high magnification cameras that can examine 100 percent of the nozzle inner radius section surface area. The staff has determined that the high resolution image from the camera may be used in lieu of UT of the inner nozzle radius that is difficult to perform, and provides adequate assurance of structural integrity. The licensee has also committed to adhere to the allowable flaw length criteria in Table IWB-3512-1 of the ASME Code, Section XI, 1989 edition, for the disposition of any linear flaws. Therefore, there is reasonable assurance that the proposed alternative will result in an acceptable level of quality and safety.

3.6 Conclusion

Based on the information provided in the licensee's submittal, the NRC staff has determined that the proposed alternative in RR-A31, as described in Section 3.3 above, provides an acceptable level of quality and safety, and, therefore, it is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the remainder of the second 10-year ISI interval at Fermi, which began February 2000 and ends February 2010. This authorization is limited to those components described in Section 3.1 above.

4.0 RELIEF REQUEST A32

4.1 Component Function/Description

The RPV nozzle inner radius section for the following systems:

- Core spray nozzles A and B (2)
- Reactor recirculation loop inlet nozzles A, B, C, D, E, F, G, H, J, and K (10)
- Jet pump instrumentation nozzles A and B (2)

4.2 Code Requirements for Which Relief is Requested

ASME Code, Section XI, 1989 edition, Table IWB-2500-1 for Examination Category B-D, requires a volumetric examination of the inner radius section of all RPV nozzles welded with full penetration welds as shown in Figures IWB-2500-7(a) through (d).

4.3 Licensee's Proposed Alternative (as stated)

Detroit Edison proposes to perform a visual examination of the accessible surface M-N as shown in Figures IWB-2500-7(a) through (d) in lieu of the volumetric examination required by Table IWB-2500-1, Examination Category B-D, Item B3.100, for inservice examination of reactor vessel nozzles identified in this relief request.

The resolution sensitivity for remote in-vessel exams will be established using a 1-mil wire standard similar to that used for other RPV internal examinations intended to detect cracking.

Crack-like surface flaws exceeding the acceptance criteria of Table IWB-3512-1 are unacceptable for continued service unless the reactor vessel meets the requirements of IWB-3142.2, IWB-3142.3, or IWB-3142.4.

4.4 Licensee's Bases for Relief (as stated)

Performance of the volumetric examination results in significant personnel radiation exposure and does not result in a significant increase in the level of plant quality or safety. Detroit Edison is proposing to implement a visual examination of the accessible portions of the nozzle inner radius region for the specified nozzles.

Performance of the volumetric examination requires the examiner to enter and remain inside the biological shield penetration area around the nozzle for the duration of the ultrasonic examination, which takes approximately 1 hour. Dose rates for the specified RPV nozzles are in the range of 180 mr/hr [(millirem/hour) to 200 mr/hr], with shielding in place. Performance of these examinations results in an estimated personnel exposure of about 3 Rem per inspection interval. Performance of a visual examination using remote cameras essentially eliminates any personnel exposure.

Visual examination of the inner radius region for the subject nozzles is limited because reactor internal piping configuration prevents placement of the camera in all positions necessary to examine surface M-N over the full circumference. The specific nozzle limitations and estimated coverage are as follows.

Nozzle Type/(No.)	Limitation	Estimated Coverage
Core Spray (2)	Thermal Sleeve and Sparger	40%
Recirculation Inlet (10)	Thermal Sleeve/Jet-pump riser	50%
Jet-pump instrumentation (2)	Instrumentation lines	60%

The limited visual examination does not significantly reduce the level of plant quality and safety for the following reasons:

- There are no mechanisms of damage other than fatigue for the nozzle inner radius, and for other than feedwater nozzles, there is no cause for significant thermal cycling. Therefore, the primary flaw of concern would be a flaw that was not detected during the manufacturing process. All of the nozzles at Fermi were examined during and after manufacturing by surface and volumetric techniques. Additionally, preservice and inservice ultrasonic examinations have detected no flaws. It is very unlikely that flaws will be initiated by the fatigue mechanism.

· More than 50% of the total nozzle population receives a complete nozzle inner radius examination [either UT or EVT in accordance with RR-A31].

- Visual examination of the accessible nozzle inner radius surface (zone M-N) provides reasonable assurance that deep flaws are not present. Additionally, when flaws are initiated by the fatigue mechanism, they are typically encountered over a significant portion of the nozzle circumference, as was the case for cracking of feedwater nozzles addressed in NUREG-0619.

In summary, fatigue cracking is the only applicable degradation mechanism for the nozzle inner radius region. For all nozzles other than feedwater, there is no significant thermal cycling during operation. Therefore, from a risk perspective there is no need to perform volumetric examination on any nozzles other than feedwater and operational CRD returns. This is supported by the fact that no service related cracking has ever been discovered in any of the BWR fleet plant nozzles other than on feedwater or operational CRD returns. The six feedwater nozzle inner radius sections will continue to be examined with ultrasonic techniques developed and qualified with GE-NE-523-A71-0594-A, Revision 1 (the NRC has approved this report under TAC No. MA6787). The feedwater nozzles alone represent 20 percent of all nozzles currently requiring volumetric inner radius examination, which is more than industry accepted risk sampling requirements for similar items. Additionally, Relief Request RR-A31 provides for a full visual examination of 10 additional nozzles, resulting in a complete examination of more than 50 percent of the total nozzle population. Detroit Edison believes that the partial visual examination alternative for the nozzle inner radius regions above results in a significant reduction in personnel dose and still ensures an acceptable level of quality and safety.

4.5 Evaluation

As stated in Section 3.5 above, the staff finds that even with vessel examinations using improved NDE technology from the outside surface, the complex geometry of the RPV nozzle inner radius regions prevents complete UT coverage. At the same time, performance of UT on these components requires the examiner to enter and remain inside the biological shield penetration area around the nozzle for the duration of the UT, which takes approximately 1 hour. The licensee stated that dose rates for the specified RPV nozzles are in the range of 180 mr/hr with shielding in place, which results in an estimated personnel exposure of about 3 rem per inspection interval. Performance of a visual examination using remote cameras essentially eliminates any personnel exposure.

For the components listed in Section 4.1 above, the licensee proposed to perform an EVT visual examination on the accessible portion of the nozzle inner radius regions in lieu of UT. The licensee stated that the estimated coverage will be in the range of 40-60 percent. The enhanced aspect of the examination is to use 8x magnification video equipment to examine the inner radii. The resolution sensitivity for this remote in-vessel exam will be established using a 1-mil diameter wire.

The primary degradation mode in RPV nozzles is fatigue, which produces hairline surface indications along the circumference of the nozzle at the inner radius section. Given the resolution capacities of the EVT, it is highly unlikely that the licensee would not detect such flaws using high magnification cameras that can examine the accessible portions of the nozzle inner radius section surface area. As stated in Section 3.5 above, the staff has determined that

the high resolution image from the camera may be used in lieu of UT of the inner nozzle radius that is difficult to perform, and provides adequate assurance of structural integrity. The licensee has also committed to adhere to allowable flaw length criteria in Table IWB-3512-1 of the ASME Code, Section XI, 1989 edition, for the disposition of any linear flaws.

While the proposed visual examination on these components will be limited to about 40-60 percent estimated coverage, the NRC staff believes it still provides reasonable assurance that flaws of significant size will be detected. When flaws are initiated by the fatigue mechanism, they typically are encountered over a significant portion of the nozzle circumference, as was the case for cracking of feedwater nozzles addressed in NUREG-0619. The NRC staff also recognizes that industry experience has shown no cracking has been found in the subject nozzle inner radius regions, and that the subject nozzles are not subjected to significant thermal cycling. In addition, the staff notes that more than 50 percent of the total RPV nozzle population receives a complete nozzle inner radius examination (either UT or EVT in accordance with RR-A31). Therefore, the NRC staff has determined that there is reasonable assurance that the proposed alternative will result in an acceptable level of quality and safety.

4.6 Conclusion

Based on the information provided in the licensee's submittal, the NRC staff has concluded that complying with the specified requirements would result in hardship without a compensating increase in the level of quality and safety, and the proposed alternative provides reasonable assurance of structural integrity of the subject components. Therefore, RR-A32 is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the remainder of the second 10-year ISI at Fermi, which began February 2000 and ends February 2010.

Principal Contributors: D. Naujock
T. Kim

Date: October 5, 2001