September 10, 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 REQUEST (RR-30) CONCERNING RISK-INFORMED INSERVICE INSPECTION PROGRAM AND BOILING WATER REACTOR VESSEL AND INTERNALS PROJECT REPORT 75 (BWRVIP-75) FOR THE SECOND INSERVICE INSPECTION INTERVAL (TAC NO. MB1813)

Dear Mr. O'Connor:

By letter dated April 30, 2001, Detroit Edison Company (licensee) submitted Relief Request (RR-30) for a risk-informed inservice inspection (RI-ISI) program as an alternative to the current inservice inspection (ISI) program at Fermi Nuclear Power Plant Unit 2 (Fermi) for American Society of Mechanical Engineers (ASME) Code Class 1 Categories B-J and B-F piping welds. The Fermi RI-ISI program was developed in accordance with the methodology contained in the Electric Power Research Institute (EPRI) Report EPRI-TR-112657, which has been approved by the Nuclear Regulatory Commission (NRC). The proposed alternative also discussed concurrent implementation of the guidance provided in BWRVIP-75 which has been approved by the NRC with comment. This relief request was made pursuant to 10 CFR 50.55a(a)(3)(i) for the second 10-year ISI interval.

Based on our review of your submittal, we have concluded that the proposed RI-ISI program is an acceptable alternative to the current ISI program based on ASME Code, Section XI requirements for Class 1, Categories B-J and B-F welds, pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternative provides an acceptable level of quality and safety. The enclosed safety evaluation authorizes implementation of the proposed RI-ISI program with the as-revised version of BWRVIP-75 for the Fermi second 10-year ISI interval which began February 2000, and ends February 2010.

Sincerely,

/RA/

Claudia M. Craig, 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 REQUEST (RR-30)

DETROIT EDISON COMPANY

FERMI 2

DOCKET NO. 50-341

1.0 INTRODUCTION

By letter dated April 30, 2001 (Ref. 1), Detroit Edison Company (licensee) proposed a risk-informed inservice inspection (RI-ISI) program for Fermi Nuclear Power Plant Unit 2 (Fermi) as an alternative to a portion of their current inservice inspection (ISI) program. The scope of the RI-ISI program is limited to the American Society of Mechanical Engineers (ASME) Code Class 1 Categories B-J and B-F piping welds only. The licensee's RI-ISI program was developed in accordance with the methodology contained in the Electric Power Research Institute (EPRI) Report EPRI TR-112657, Rev. B-A (Ref. 2), which was previously reviewed and approved by the staff by letter dated October 28, 1999.

The proposed alternative also discussed concurrent implementation of the guidance provided in Boiling Water Reactor Vessel and Internals Project Report 75 (BWRVIP-75) for intergranular stress corrosion cracking (IGSCC) susceptible welds as an alternative to Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-01 sample schedules and frequencies. The second ISI interval for Fermi commenced on February 17, 2000. The licensee proposed the RI-ISI program as an alternative pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR) for the second 10-year ISI interval.

2.0 BACKGROUND

2.1 Applicable Requirements

Pursuant to 10 CFR 50.55a(g), ISI of ASME Code Class 1, 2, and 3 components must be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code, "Rules for Inservice Inspection of Nuclear Power Plant Components" (hereinafter called Code) and applicable addenda, except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulations at 10 CFR 50.55a(a)(3) state 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 the proposed

ENCLOSURE

alternative 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 set forth in the Code, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that ISI of components conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of the 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. For Fermi, the applicable edition of the Code for the second 10-year ISI interval, which began in February, 2000, is the 1989 Edition, no Addenda.

2.2 Summary of Proposed Approach

The licensee has proposed to use an RI-ISI program for ASME Class 1 piping (Examination Categories B-F and B-J welds), as an alternative to the ASME Code, Section XI requirements. The ASME Code requires in part that for each successive 10-year ISI interval, 100 percent of Category B-F welds and 25 percent of Category B-J welds for the ASME Code Class 1 piping greater than 1-inch in nominal diameter be selected for volumetric and/or surface examination, based on existing stress analyses and cumulative usage factors. The submittal follows the staff- approved RI-ISI process and methodology delineated in EPRI TR-112657, Rev. B-A. By assessing piping failure potential and piping failure consequences, and performing probabilistic risk assessments (PRA) and safety significance ranking of piping segments, inspection locations are significantly reduced. However, the program retains the fundamental requirements of the Code, such as inspection methods, acceptance guidelines, pressure testing, corrective measures, documentation requirements, and quality control requirements. Thus, ISI program requirements of other non-related portions of the ASME Code Section XI are unaffected.

3.0 EVALUATION

Pursuant to 10 CFR 50.55a(a)(3), the staff has reviewed and evaluated the licensee's proposed RI-ISI program, including those portions related to the applicable methodology and processes contained in Reference 2, based on guidance and acceptance criteria provided in Regulatory Guides (RGs) 1.174 (Ref. 3) and 1.178 (Ref. 4) and in Standard Review Plan (SRP) Chapter 3.9.8 (Ref. 5).

3.1 Proposed Changes to the ISI Program

The scope of the licensee's RI-ISI program is limited to include Category B-J piping welds and Category B-F dissimilar metal nozzle welds only. The RI-ISI program was proposed as an alternative to the existing ISI program which is based on examination requirements of the ASME Code, Section XI. A general description of the proposed changes to the ISI program was provided in Sections 2 and 5 of Reference 1.

3.2 Engineering Analysis

In accordance with the guidance provided in RGs 1.174 and 1.178, an engineering analysis of the proposed changes using a combination of traditional engineering analysis and supporting insights from PRA was performed. The licensee discussed how the engineering analyses conducted for the Fermi RI-ISI program ensure that the proposed changes are consistent with the principles of defense-in-depth, and that adequate safety margins will be maintained. The licensee evaluated a piping location's susceptibility to a particular degradation mechanism that may be a precursor to leak or rupture, and then performed an independent assessment of the consequence of a failure at that location. In general, the approach is consistent with the process approved in EPRI TR-112657.

The Fermi RI-ISI program is limited to ASME Class 1 piping welds examination Category B-F and B-J welds only. The licensee stated in Reference 1 that other non-related portions of the ASME Section XI Code requirements, such as inspection methods, acceptance guidelines, pressure testing, corrective measures, documentation requirements, and quality control requirements, will be unaffected by the RI-ISI program. This is consistent with the guidelines provided in EPRI TR-112657, and, therefore, is acceptable.

In Reference 1, the licensee also stated that current augmented ISI programs will be implemented using the guidance contained in BWRVIP-75. BWRVIP-75 provides alternative criteria to GL 88-01 for the examination of welds subject to IGSCC. The licensee stated that BWRVIP-75 will be implemented concurrently with the RI-ISI program.

Both GL 88-01 and BWRVIP-75 specify examination extent and frequency requirements for austenitic stainless steel welds that are classified as Categories "A" through "G," depending on their susceptibility to IGSCC. In accordance with EPRI TR-112657, piping welds identified as Category "A" are considered resistant to IGSCC and are assigned a low failure potential provided no other damage mechanisms are present. The augmented inspection program for the other piping welds subject to IGSCC is unaffected by the RI-ISI program and will be conducted in accordance with the recommendations in BWRVIP-75.

By letter dated September 15, 2000 (Ref. 6), the staff reviewed the BWRVIP-75 report and concluded that the guidance provided in the subject report for revisions of GL 88-01 inspection schedules was generally acceptable except for the open items identified in the safety evaluation. Once the staff's recommendations are incorporated into the proposed guidance, the staff concluded that the revised BWRVIP-75 report can be used to replace the inspection guidance in GL 88-01.

The staff also found that, with the exception of the open items discussed in the subject safety evaluation, the BWRVIP-75 guidance is acceptable for licensee referencing as the technical basis for relief from, or as an alternative to, the ASME Code and 10 CFR 50.55a, in order to use the sample schedules and frequencies specified in the BWRVIP-75 report that are less than those required by the ASME Code. The staff's approval of the as-revised BWRVIP-75 report also allows licensees to utilize the as-revised BWRVIP-75 guidance in lieu of the licensees' commitments to GL 88-01 and NUREG-0313, Rev. 2, or as the technical basis for a plant-specific request for a license amendment to change technical specifications requiring GL 88-01 or NUREG-0313, Rev. 2 inspections. Based on the above discussion, the use of the

as-revised version of BWRVIP-75 for the augmented weld sample schedule and frequency is acceptable.

Fermi is currently in the first period of its second ISI interval, which means 100 percent of the required RI-ISI program inspections will be completed in the second interval using the RI-ISI methods as stated in Reference 1. The staff prefers completion of all examinations under a single program in an ISI interval, therefore, this approach is acceptable in terms of ASME Code percentage completion.

The licensee described its alternative thermal stratification, cycling, and striping (TASCS) susceptibility screening criteria, which consists of additional considerations to the previously approved criteria stated in EPRI TR-112657. The additional considerations include conditions of potential mixing of fluid in the turbulent penetration region at branch piping connections, diminished stratified temperature differences at locations which lack a sustained source of cold or hot fluid, and situations with a low potential for cyclic thermal fluctuation at a leaking valve. This alternative thermal stratification screening criteria is listed under EPRI Report 1000701, *"Interim Thermal Fatigue Management Guideline (MRP-24)*", January 2001, (Ref. 7), has been reviewed and accepted by the staff and is, therefore, acceptable.

Piping systems within the scope of the RI-ISI program were divided into piping segments. Pipe segments are defined as continuous runs of piping potentially susceptible to the same type(s) of degradation and whose failure will result in similar consequences. The licensee's submittal also stated that failure potential estimates were generated utilizing industry failure history, plant-specific failure history, and other relevant information using the guidance provided in EPRI TR-112657 with the exception of the recently approved TASCS mechanism discussed above. The staff concludes that the licensee has met the SRP 3.9.8 guidelines to confirm that a systematic process was used to identify pipe segments' susceptibility to common degradation mechanisms, and to categorize these degradation mechanisms into the appropriate degradation categories with respect to their potential to result in a postulated leak or rupture.

Additionally, the licensee stated that the consequences of pressure boundary failure were evaluated and ranked based on their impact on core damage frequency (CDF) and large early release frequency (LERF), and that the impact due to both direct and indirect effects was considered using guidance provided in EPRI TR-112657. The licensee reported no deviations from the consequence evaluation methodology in EPRI TR-112657. Based on the above discussion, the staff finds the consequence evaluation performed for this application to be acceptable.

3.3 Probabilistic Risk Assessment

The licensee used its original level 1 and level 2 individual plant evaluation (IPE) to evaluate the consequences of pipe ruptures for the RI-ISI assessment. The Fermi IPE was submitted in September 1992, revised in September 1993, and supplemented by request for additional information response in June 1994. In its submittal, the licensee reported a CDF of 5.7E-6/year and LERF of 8.0E-7/year. The staff evaluation report dated November 16, 1994, concluded that the IPE satisfied the intent of GL 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities." No weakness or problems in the models, data, or methods were identified during the staff review of the IPE.

The licensee's most recent level 1 risk model (PSA97C) was developed in 1997 and reviewed using the Boiling Water Reactors Owners Group probabilistic safety analysis peer certification process. The licensee reported that the CDF increased slightly (to 7.1E-6/year) reflecting a slight increase in unavailability due to increased on-line maintenance.

The licensee reported that the Fermi 2 Level 1 and Level 2 IPE results were used to evaluate the consequences of pipe ruptures for the RI-ISI assessment during power operation. The consequence evaluation was reviewed versus the PSA97C update and no changes in the consequence rank assignment or in the delta risk evaluation were identified in that review, as presented in the memo to file referenced as NFGE-01-008. The licensee further stated that no changes to the risk-informed Class 1 piping consequence conclusions are anticipated from planned model revisions.

The staff finds that the use of the IPE supported by the review against the latest model update and changes planned to the model at the time of the submittal provides reasonable assurance that the results used to support this RI-ISI relief request adequately reflects the current as-operated plant.

The staff recognizes that the quantitative results of the IPE are used as order of magnitude estimates for several risk and reliability parameters used to support the assignment of segments into three broad consequence categories. The staff did not review the IPE analysis to assess the accuracy of the quantitative estimates. The staff believes that inaccuracies in the models or in assumptions large enough to invalidate the broad categorizations developed to support RI-ISI should have been identified during the staff's review of the IPE and by the licensee's model update control program. Therefore, while minor errors or inappropriate assumptions in the IPE could affect the consequence categorization of a few segments and thus, the location of several inspections, these errors will not invalidate the general results or conclusions of the safety evaluation (SE). The staff finds the quality of the licensee's IPE sufficient to support the application of the approved EPRI methodology and the proposed RI-ISI program.

The degradation category and the consequence category were combined according to the approved methodology described in the EPRI TR-112657 to categorize the risk significance of each segment. The risk significance of each segment is used to determine the number of weld inspections required in each segment.

The licensee conducted a bounding analysis to estimate the change in risk expected from replacing the current ISI program with the RI-ISI program. The calculations estimated the change in risk due to removing locations and adding locations to the inspection program. For high consequence category segments, the licensee used the conditional core damage probability (CCDP) and conditional large early release probability (CLERP) based on the highest estimated CCDP and CLERP. For medium consequence category segments, bounding estimates of CCDP and CLERP were used. The licensee estimated the change in risk using bounding pipe failure rates from the EPRI methodology.

The licensee performed its bounding analysis with and without taking credit for an increased probability of detection (POD). The licensee estimated the aggregate change in CDF to be about 7E-9/year and estimated the aggregate change in LERF to be about 7E-9/year excluding credit for any increased POD due to the use of improved inspection techniques.

Including the expected increased POD results in an aggregate estimated change in CDF of 1.4E-9/year and aggregate estimated change in LERF of 1.4E-9/yr. The CDF and LERF estimates are the same because the highest maximum CCDP and CLERP are the same value (5E-3) and the change in risk is dominated by the high consequence segments.

The staff finds the licensee's process to evaluate and bound the potential change in risk reasonable because it accounts for the change in the number and location of elements inspected, recognizes the difference in degradation mechanism related to failure likelihood, and considers the effects of enhanced inspection. System level and aggregate estimates of the changes in CDF and LERF are less than the corresponding guideline values in EPRI TR-112657. The staff finds that redistributing the welds to be inspected with consideration of the risk-significance of the segments provides assurance that segments whose failure have a significant impact on plant risk receive an acceptable and often improved level of inspection. Therefore, the staff concludes that the implementation of the RI-ISI program as described in the licensee's application will have a small impact on risk consistent with the guidelines of RG 1.174, and thus, will not cause the NRC safety goals to be exceeded.

3.4 Integrated Decision Making

As described in the licensee's submittal, an integrated approach is utilized in defining the proposed RI-ISI program by considering in concert the traditional engineering analysis, risk evaluation, and the implementation and performance monitoring of piping under the program. This is consistent with the guidelines of RG 1.178.

The selection of pipe segments to be inspected is described in Section 3.5 of the submittal using the results of the risk category rankings and other operational considerations. Table 3.5 of the submittal provides the number of locations and inspections by risk category for the various Fermi systems. Table 3.6-1 provides the final summary table comparing the number of inspections required under the existing ASME Section XI ISI program with the alternative RI-ISI program, and presents the risk impact results by each system. The licensee used the methodology described in EPRI TR-112657 to guide the selection of examination elements within high and medium risk ranked piping segments. The methodology described in EPRI TR-112657 calls for maintaining existing augmented programs, other than thermal fatigue and IGSCC Category A piping welds which the RI-ISI program supersedes. The EPRI report describes targeted examination volumes (typically associated with welds) and methods of examination based on the type(s) of degradation expected. The staff has reviewed these guidelines and has determined that, if implemented as described, the RI-ISI examinations should result in improved detection of service-related degradations over that currently provided by the ASME Code, Section XI.

The staff finds that the location selection process is acceptable since it is consistent with the process approved for EPRI TR-112657, takes into account defense-in-depth, and includes coverage of systems subjected to degradation mechanisms in addition to those covered by augmented inspection programs.

The objective of ISI required by ASME Section XI is to identify conditions (i.e., flaw indications) that are precursors to leaks and ruptures in the pressure boundary that may impact plant safety. Based on the integrated approach for the improved detection of service-related degradation and location selection, the staff has concluded the proposed RI-ISI program does

meet this objective. Further, since the risk-informed program is based on inspection for cause, the element selection targets specific degradation mechanisms.

Chapter 4 of EPRI TR-112657 provides guidelines for the areas and/or volumes to be inspected as well as the examination method, acceptance standard, and evaluation standard for each degradation mechanism. Based on the review of the cited portion of the EPRI report, the staff concludes that the examination methods for the proposed RI-ISI program are appropriate since they are selected based on specific degradation mechanisms, pipe sizes, and materials of concern.

3.5 Implementation and Monitoring

Implementation and performance monitoring strategies require careful consideration by the licensee and are addressed in Element 3 of RG 1.178 and SRP 3.9.8. The objective of Element 3 is to assess performance of the affected piping systems under the proposed RI-ISI program by implementing monitoring strategies that confirm the assumptions and analyses used in the development of the RI-ISI program. Pursuant to 10 CFR 50.55a(a)(3)(i), a proposed alternative, in this case the implementation of the RI-ISI program, including inspection scope, examination methods, and methods of evaluation of examination results, must provide an acceptable level of quality and safety.

The licensee stated in Section 4 of the submittal that upon approval of the RI-ISI program, they will prepare procedures that comply with the EPRI TR-112657 guidelines to implement and monitor the RI-ISI program. The licensee confirmed that the applicable portions of the ASME Code, such as inspection methods, acceptance guidelines, pressure testing, corrective measures, documentation requirements, and quality control requirements would be retained.

The licensee further stated that the RI-ISI program is a living program and its implementation will require feedback of new relevant information to ensure the appropriate identification of safety-significant piping locations. The submittal also states that, as a minimum, risk ranking of piping segments will be reviewed and adjusted on an ASME period basis and that significant changes based on NRC bulletins or generic letters, or industry and plant-specific feedback may require more frequent adjustments.

The proposed periodic reporting requirements meet existing ASME Code requirements and applicable regulations, and therefore, are considered acceptable. The staff finds that the proposed process for RI-ISI program updates meets the guidelines of RG 1.174 which provide that risk-informed applications should include performance monitoring and feedback provisions; therefore, the licensee's proposed process for program updates is acceptable.

4.0 CONCLUSION

The regulation at 10 CFR 50.55a(a)(3)(i) permits alternatives to specified regulatory requirements when authorized by the Director of the Office of Nuclear Reactor Regulation on the basis that an alternative provides an acceptable level of quality and safety. In this case, the licensee's proposed alternative is to use the risk-informed process described in the NRC-approved EPRI TR-112657. As discussed in Section 3.0 of this SE, the staff concludes that the licensee's proposed RI-ISI program, as described in its submittal, will provide an

acceptable level of quality and safety with regard to the number of inspections, locations of inspections, and methods of inspections.

The staff finds that the results of the different elements of the engineering analysis are considered in an integrated decision making process. The impact of the proposed change in the ISI program is founded on the adequacy of the engineering analysis and acceptable change in plant risk in accordance with RG 1.174 and 1.178 guidelines.

The licensee's methodology also considers implementation and performance monitoring strategies. Inspection strategies ensure that failure mechanisms of concern have been addressed and there is adequate assurance of detecting damage before structural integrity is affected. The risk significance of piping segments is taken into account in defining the inspection scope for the RI-ISI program. System pressure tests and visual examination of piping structural elements will continue to be performed on all locations within the reactor coolant pressure boundary as currently required by the ASME Code Section XI program.

The Fermi methodology provides for conducting an engineering analysis of the proposed changes using a combination of engineering analysis with supporting insights from a PRA. Defense-in-depth quality is not degraded in that the methodology provides reasonable confidence that any reduction in existing inspections will not lead to degraded piping performance when compared to existing performance levels. Inspections are focused on locations with active degradation mechanisms as well as selected locations that monitor the performance of system piping.

Modification of the sample schedules and frequencies prescribed by GL 88-01 to conform with BWRVIP-75 guidance takes into account the failure experience gained in the fleet through a deterministic approach. The staff has evaluated and conditionally approved sample schedules and frequencies per BWRVIP-75 for IGSCC susceptible welds and accepts it as an alternative to the ASME Code and 10 CFR 50.55a.

As discussed above, the staff's review of the licensee's proposed RI-ISI program for ASME Code Class 1, Categories B-F and B-J welds only, concludes that the program is an acceptable alternative to the current ISI program, which is based on ASME Code, Section XI requirements for Class 1 welds. Therefore, the staff authorizes the proposed alternative pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that the alternative provides an acceptable level of quality and safety. This safety evaluation authorizes implementation of the proposed RI-ISI program for the second 10-year ISI interval, which began in February 2000, and ends in February 2010.

5.0 REFERENCES

1. Letter dated April 30, 2001, Paul Fessler, Detroit Edison Company, to U.S. Nuclear Regulatory Commission, containing *Risk-Informed Inservice Inspection (RI-ISI) Program Plan Relief Request (RR-A30)* for Fermi Nuclear Power Plant, Unit 2.

2. EPRI TR-112657 Report, Revision B-A, *Revised Risk-Informed Inservice Inspection Evaluation Procedure*, January 2000.

3. NRC Regulatory Guide 1.174, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis*, July 1998.

4. NRC Regulatory Guide 1.178, *An Approach for Plant-Specific Risk-Informed Decision Making: Inservice Inspection of Piping*, September 1998.

5. NRC NUREG-0800, Chapter 3.9.8, *Standard Review Plan for Trail Use for the Review of Risk-Informed Inservice Inspection of Piping*, September 1998.

6. Letter dated September 15, 2000, Jack R. Strosnider, USNRC, to Carl Terry, BWRVIP Chairman, *Safety Evaluation of the "BWRVIP Vessel and Internals Project, BWR Vessel and Internals Project, Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules (BWRVIP-75),"* EPRI Report TR-113932, October 1999.

7. EPRI Report 1000701, *"Interim Thermal Fatigue Management Guideline (MRP-24)*", January 2001.

Principal Contributors: T. Steingass
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Date: September 10, 2001