



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
WASHINGTON, D.C. 20555-0001

August 19, 2019

Mr. Paul Fessler
Senior Vice President and
Chief Nuclear Officer
DTE Electric Company
Fermi 2 – 260 TAC
6400 North Dixie Highway
Newport, MI 48166

SUBJECT: FERMIS 2 - PROPOSED ALTERNATIVE TO THE REQUIRED EXAMINATION
COVERAGE FOR CERTAIN ASME CLASS 1 WELDS (EPID L-2019-LLR-0026)

Dear Mr. Fessler:

By letter dated February 28, 2019, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19059A327), as supplemented by letter dated June 11, 2019 (ADAMS Accession No. ML19162A314), DTE Energy Company (the licensee) proposed five alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code. One of those proposed alternatives, RR-A37, pertains to an alternative to Section XI, Table IWB-2500-1 Examination Category B-D, "Full Penetration Welded Nozzles in Vessels." of the ASME BPV Code for Fermi 2 Power Plant (Fermi 2). Of the five requests in the letter, RR-A40 was issued on June 13, 2019 (ADAMS Accession No. ML19143A219, RR-A41 was issued on June 26, 2019 (ADAMS Accession No. ML19169A315) and RR-A36 was withdrawn by the licensee on April 16, 2019 (ADAMS Accession No. ML19169A315). RR-A39 will be dispositioned through a separate correspondence.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.55a(z)(1), the licensee proposed an alternative to use inspection requirements documented in Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Inner Nozzle Radius and Nozzle-to-Shell Weld, Section XI, Division 1." For the visual examinations allowed by Code Case N-702, the licensee proposed to use ASME Code Case N-648-1, "Alternative Requirements for Inner Radius Examination of Class 1 Reactor Vessel Nozzles, Section XI, Division 1," with associated required conditions specified in Regulatory Guide 1.147, Revision 18, "Inservice Inspection Code Case Acceptability, Section XI, Division 1," on the basis that it provides an acceptable level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of proposed alternative RR-A37 at Fermi 2 for the remainder of the current operating license for ASME BPV Code, Section XI, Category B-D, Item Nos. B3.90 and B3.100.

All other requirements of the ASME BPV Code, Section XI, for which an alternative has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Project Manager, Sujata Goetz at 301-415-8004 or via e-mail at Sujata.Goetz@nrc.gov.

Sincerely,

/RA/

Lisa M. Regner, Acting Branch Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No.: 50-341

Enclosure
Safety Evaluation

cc: Listserv

SUBJECT: FERM1 2 - PROPOSED ALTERNATIVE TO THE REQUIRED EXAMINATION
COVERAGE FOR CERTAIN ASME CLASS 1 WELDS (EPID L-2019-LLR-0026)
DATED AUGUST 19, 2019

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE RR-A37 REGARDING

THE USE OF ASME CODE CASE N-702

DTE ELECTRIC COMPANY

FERMI 2 POWER PLANT

DOCKET NO. 50-341

1.0 INTRODUCTION

By letter dated February 28, 2019, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19059A327), as supplemented by letter dated June 11, 2019 (ADAMS Accession No. ML19162A314), DTE Energy Company (the licensee) proposed five alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code. One of those proposed alternatives, RR-A37, pertains to an alternative to Section XI, Table IWB-2500-1 Examination Category B-D, "Full Penetration Welded Nozzles in Vessels." of the ASME BPV Code for Fermi 2 Power Plant (Fermi 2). Of the five requests in the letter, RR-A40 was issued on June 13, 2019 (ADAMS Accession No. ML19143A219 and RR- A41 was issued on June 26, 2019 (ADAMS Accession No. ML19169A315) and RR-A36 was withdrawn by the licensee on April 16, 2019 (ADAMS Accession No. ML19169A315). RR-A39 will be dispositioned through a separate correspondence.

Specifically, pursuant to Title 10 of the Code of Federal Regulations (10 CFR), paragraph 50.55a(z)(1), the licensee proposed an alternative to use inspection requirements documented in Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Inner Nozzle Radius and Nozzle-to-Shell Weld, Section XI, Division 1." For the visual examinations allowed by Code Case N-702, the licensee proposed to use ASME Code Case N-648-1, "Alternative Requirements for Inner Radius Examination of Class 1 Reactor Vessel Nozzles, Section XI, Division 1," with associated required conditions specified in Regulatory Guide 1.147, Revision 18, "Inservice Inspection Code Case Acceptability, Section XI, Division 1," (ADAMS Accession No. ML16321A336) on the basis that it provides an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Adherence to Section XI of the ASME BPV Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components will meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in Section XI of the ASME BPV Code.

Enclosure

The regulation in 10 CFR 50.55a(z) states that alternatives to the requirements of paragraphs (b) through (h) of 10 CFR 50.55a, or portions thereof, may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the U.S. Nuclear Regulatory Commission (NRC) staff finds that the licensee may propose an alternative and the NRC has the regulatory authority to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Background

For all reactor pressure vessel (RPV) nozzle-to-vessel shell welds and nozzle inner radii, ASME BPV Code, Section XI, requires 100 percent inspection during each 10-year ISI interval. However, Code Case N-702 provides an alternative which reduces the inspection of RPV nozzle-to-vessel shell welds and nozzle inner radii areas from 100 percent to 25 percent of the nozzles for each nozzle type during each 10-year interval. For application of Code Case N-702, the licensee is required to address the conditions specified in RG 1.147, Revision 18, for ASME Code Case N-702:

The applicability of Code Case N-702 must be shown by demonstrating that the criteria in Section 5.0 of NRC Safety Evaluation [SE] regarding BWRVIP-108 [Boiling Water Reactor Vessel and Internals Project] dated December 19, 2007 (ADAMS Accession No. ML073600374) or Section 5.0 of NRC Safety Evaluation regarding BWRVIP-241 dated April 19, 2013 (ADAMS Accession No. ML13071A240) are met. The evaluation demonstrating the applicability of the Code Case shall be reviewed and approved by the NRC prior to the application of the Code Case.

BWRVIP-108, "Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Inner Radii" (ADAMS Accession Nos. ML023360232 and ML023360234; non-publicly available) and BWRVIP-241, "Probabilistic Fracture Mechanics [PFM] Evaluation for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii" (ADAMS Accession Nos. ML11119A042 (non-publicly available) and ML11119A043 (publicly available)) contain PFM analysis results supporting Code Case N-702. Both reports are for 40 years of operation. BWRVIP-241 contains additional PFM results supporting revision of the evaluation criteria under "Conditions and Limitations" in the SE for BWRVIP-108; SE for BWRVIP-241 accepted the revised criteria.

The NRC issued an SE dated April 26, 2017 (ADAMS Accession No. ML17114A096), on a supplemental document for license renewal, BWRVIP-241, Appendix A, "BWR Nozzle Radii and Nozzle-to-Vessel Welds Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21)." This SE extends the applicability of the BWRVIP-108 and BWRVIP-241 methodologies, and, therefore, Code Case N-702, from 40 years to the period of extended operation.

Code Case N-702 allows that VT-1 visual examination may be performed in lieu of volumetric examination for examination Item No. B3.100 nozzle inner radius sections. Code Case N-648-1, as conditionally accepted by RG 1.147, Revision 18, requires that nozzle inner radius examinations must use the allowable flaw length criteria of ASME BPV Code, Table IWB-3512-1, with limiting assumptions on the flaw aspect ratio.

3.2 ASME Code Component Affected

The affected components at Fermi 2 belong to examination Category B-D, "Full Penetration Welded Nozzles in Vessels" under examination Item Nos. B3.90, "Nozzle-to-Vessel Welds," and B3.100, "Nozzle Inside Radius Section."

Table 1			
RPV Nozzle-to-Vessel Welds and Inner Radii Subject to this Request			
Identification Number	Description	Total Number	Minimum Number to be examined
N1	Recirculation Outlet	2	1
N2	Recirculation Inlet	10	3
N3	Main Steam Outlet	4	1
N5	Core Spray	2	1
N6	Spare Nozzles	2	1
N7	Closure Head Vent	1	1
N8	Jet Pump Instrumentation	2	1

3.3 Applicable Code Edition and Addenda

This request applies to the fourth, fifth, and sixth 10-year ISI intervals, in which the licensee has adopted the 2013 Edition of ASME BPV Code, Section XI, as the code of record.

3.4 Applicable Code Requirements

ASME BPV Code, Section XI, Table IWB-2500-1, examination Category B-D, requires a volumetric examination of all nozzles with full penetration welds to the vessel shell (or head) and integrally cast nozzles each 10-year interval.

3.5 Licensee's Proposed Alternative

The licensee proposed to implement ASME Code Case N-702 and reduce the ASME BPV Code-required volumetric examinations for all RPV nozzle-to-shell welds and inner radii to a minimum of 25 percent of the nozzle inner radii and nozzle-to-shell welds, including at least one nozzle from each system and nominal pipe size during each inspection interval. The required examination volume for the reduced set of nozzles remains at 100 percent of that depicted in Figures IWB-2500-7 (a) through (d), as applicable in Section XI of the ASME BPV Code.

In addition, the licensee stated it may perform a VT-1 visual examination, as outlined in ASME Code Case N-648-1, "Alternative Requirements for Inner Radius Examination of Class 1 Reactor Vessel Nozzles, Section XI, Division 1," in lieu of a volumetric examination for Category B-D, Item No. 3.100.

3.6 Licensee's Bases for Alternative

The alternative is based on the PFM results documented in the BWRVIP-241 report. The licensee proposed that it met the evaluation criteria in the SE for BWRVIP-241 as follows:

Criterion 1: Max RPV Heatup/Cooldown Rate

The maximum RPV heatup/cooldown rate is limited to < 115 degree Fahrenheit (°F)/hour (hr)

Fermi 2 technical specification (TS) surveillance requirement (SR) 3.4.10.1, reactor coolant system heatup and cooldown rates are limited to a maximum of 100 °F when averaged over any 1-hour period and thus meets the requirement of Criterion 1.

Criterion 2: Recirculation Inlet (N2) Nozzles

$$(pr/t)/C_{i-RPV} < 1.15, \text{ where}$$

p = RPV normal operating pressure (psi),
r = RPV inner radius (inch),
t = RPV wall thickness (inch), and
 $C_{i-RPV} = 19332$.

The Fermi 2 result based on the input parameters for this nozzle per the licensee submittal is $(pr/t)/C_{i-RPV} = 1.10$ ($[(1045)(127.1)/7.6875]/19332$), thus meeting the requirements of Criterion 2.

Criterion 3: Recirculation Inlet (N2) Nozzles

$$[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{i-NOZZLE} < 1.47, \text{ where}$$

r_o = nozzle outer radius (inch),
 r_i = nozzle inner radius (inch), and
 $C_{i-NOZZLE} = 1637$.

The Fermi 2 result based on the input parameters for this nozzle per the licensee submittal is $[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{i-NOZZLE} = 0.98$ ($[1045(11^2 + 6.19^2)/(11^2 - 6.19^2)]/1637$), thus meeting the requirements of Criterion 3.

Criterion 4: Recirculation Outlet (N1) Nozzles

$$(pr/t)/C_{o-RPV} \leq 1.15, \text{ where}$$

r = RPV inner radius (inch),
t = RPV wall thickness (inch), and
 $C_{o-RPV} = 16171$.

The Fermi 2 result based on the input parameters for this nozzle per the licensee submittal is $(pr/t)/C_{o-RPV} = 1.31$ ($[(1045)(127.1)/7.6875]/16171$), thus meeting the requirements of Criterion 4.

Criterion 5: Recirculation Outlet (N1) Nozzles

$$[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{o-NOZZLE} \leq 1.59, \text{ where}$$

r_o = nozzle outer radius (inch),
 r_i = nozzle inner radius (inch), and
 $C_{o-NOZZLE} = 1977$.

The Fermi 2 result based on the input parameters for this nozzle per the licensee submittal is $[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{o-NOZZLE} = 0.85$ $([1045(22.56^2 + 13.125^2)/(22.56^2 - 13.125^2)]/1977)$, thus meeting the requirements of Criterion 5.

The licensee addressed the requirements of BWRVIP-241, Appendix A, by describing how Sections A.3 (Management of Aging Effects) and A.4 (Time Limited Aging Analysis) are met to satisfy the requirements of 10 CFR 54.21. With respect to irradiation effects, the licensee stated that the only reactor vessel nozzles included in the reactor vessel beltline during the period of extended operation are the N16 nozzles, which are not subject to this proposed alternative. With respect to fatigue management, the licensee stated that the cumulative effects of fatigue damage for the RPV components will be adequately managed by the Fatigue Monitoring Program for the period of extended operation. The licensee further stated that fatigue is not the dominant contributor to the probability of failure.

3.7 Duration of Proposed Alternative

This request is for the remainder of the current operating license ending March 20, 2045 and includes the fourth, fifth, and sixth ISI intervals.

3.8 Staff Evaluation

The licensee proposed an alternative to implement ASME Code Case N-702 for all Fermi 2 RPV nozzle-to-vessel shell penetration welds and nozzle inner radii using the criteria in BWRVIP-241.

In general, the applicability of the BWRVIP-241 report to an ASME Code Case N-702 alternative is demonstrated by showing that Criteria 2 through 5 within Section 5.0 of the NRC SE for BWRVIP-241 are met for the bounding nozzles (recirculation inlet and outlet nozzles), and that Criterion 1 is met for all components included in the proposed alternative.

The NRC staff confirms that Criterion 1 (applicable to all nozzles within the scope of ASME Code Case N-702) is satisfied because Fermi 2 TS SR 3.4.10.1 limits the maximum heat-up/cool-down rate to less than or equal to 100 °F/hr, well below the 115 °F/hr criterion limit.

For Criteria 2 through 5, the licensee provided plant-specific data and its evaluation of the driving force factors, or ratios, using the criteria established in Section 5.0 of the BWRVIP-241 SE. The licensee stated that Criteria 2, 3, 4, and 5, are satisfied. The NRC staff performed the calculations and confirmed that they show that Criteria 2 through 5 are satisfied. Therefore, the BWRVIP-241 report applies to Fermi 2, and the basis for using Code Case N-702 is demonstrated for the Fermi 2 RPV nozzle-to-vessel welds and inner radii listed in Table 1 above.

The licensee's request addressed the requirements of BWRVIP-241, Appendix A, by describing how the management of aging effects and a time limited aging analysis are implemented for the

period of extended operation. The licensee specifically addressed neutron fluence effects and thermal cycle fatigue. The licensee states that the RPV nozzles included in this relief request are not exposed to neutron fluence greater than 1×10^{17} neutrons (n)/centimeter² (cm). NRC staff confirms that irradiation effects should not be a concern for the nozzles in this request based on a fluence less than the 1×10^{17} n/cm², since this is the fluence threshold established in 10 CFR 50, Appendix H, and Regulatory Issue Summary (RIS) 2014-11 (ADAMS Accession No. ML14149A165) below which irradiation is not considered to have a detrimental effect on materials. With respect to thermal cycle fatigue, the licensee stated that stress corrosion cracking initiation and growth is a much more dominant contributor to probability of failure when compared to fatigue crack growth from thermal cycles. The licensee concluded that thermal cycle fatigue will have no significant effect on the probability of failure as determined by BWRVIP-241. The NRC staff finds that, based on stress corrosion cracking initiation and growth being the dominant contributor to probability of failure, thermal cycle fatigue will not have a significant effect on the probability of failure as determined by BWRVIP-241.

For examination Item No. B3.100 nozzle inner radius sections, the NRC staff finds the licensee proposal to perform VT-1 visual examination in lieu of volumetric examination to be acceptable since the licensee will comply with ASME Code Case N-648-1, with associated required conditions specified.

4.0 CONCLUSION

As set forth above, the NRC staff determined that the licensee has demonstrated that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of proposed alternative RR-A37 at Fermi 2 for the remainder of the current operating license for ASME BPV Code, Section XI, Category B-D welds, Item Nos. B3.90 and B3.100.

All other requirements of the ASME BPV Code, Section XI, for which an alternative has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor(s): J. Jenkins, NRR/DMLR/MVIB

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