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

July 25, 2024

Q. Shane Lies
Senior Vice President and Chief
Nuclear Officer
Indiana Michigan Power Company
Nuclear Generation Group
One Cook Place
Bridgman, MI 49106

SUBJECT: DONALD C. COOK NUCLEAR PLANT, UNIT NO. 1 – REVIEW OF REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM CAPSULE W TECHNICAL REPORT (EPID L-2023-LRO-0074)

Dear Q. Shane Lies:

By letter dated October 18, 2023, (Agencywide Documents Access and Management System Accession No. ML23292A065), Indiana Michigan Power Company (the licensee) submitted report WCAP-18837-NP, Revision 0, “Analysis of Capsule W from the American Electric Power Company D.C. Cook Unit 1 Reactor Vessel Radiation Surveillance Program.” The report was provided in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), part 50, appendix H, “Reactor Vessel Material Surveillance Program Requirements.” Testing was performed in accordance with American Society for Testing and Materials Standard E185-82, “Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels,” as specified in 10 CFR, part 50, appendix H, paragraph III.B.1.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the licensee’s submittal as documented in the enclosed staff evaluation. The NRC staff concludes that the licensee has provided the information required by the regulations and that no additional follow-up is required at this time. This completes the NRC staff’s efforts for EPID L-2023-LRO-0074.

If you have any questions, please contact me at 301-415-2855 or via e-mail at Scott.Wall@nrc.gov.

Sincerely,

/RA/

Scott P. Wall, Senior Project Manager
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-315

Enclosure:
Review of Reactor Vessel Material Surveillance
Program Capsule W Technical Report

cc: Listserv

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

OFFICE OF NUCLEAR REACTOR REGULATION

REVIEW OF REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM

CAPSULE W TECHNICAL REPORT

INDIANA MICHIGAN POWER COMPANY

DONALD C. COOK NUCLEAR PLANT, UNIT NO. 1

DOCKET NO. 50-315

1.0 INTRODUCTION

By letter dated October 18, 2023 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML23292A065), Indiana Michigan Power Company (the licensee) submitted to the U.S. Nuclear Regulatory Commission (NRC) an evaluation of the testing results of reactor vessel radiation surveillance program Capsule W for the Donald C. Cook Nuclear Plant (CNP), Unit 1, in accordance with the Title 10 of the *Code of Federal Regulations* (10 CFR), part 50, appendix H, "Reactor Vessel Material Surveillance Program Requirements." The evaluation report is titled WCAP-18837-NP, Revision 0, "Analysis of Capsule W from the American Electric Power Company D.C. Cook Unit 1 Reactor Vessel Radiation Surveillance Program," dated June 2023.

2.0 REGULATORY EVALUATION

The regulations in 10 CFR, part 50, appendix H, requires licensees to implement a material surveillance program to monitor changes in the fracture toughness properties of ferritic materials in the reactor vessel beltline region of light-water nuclear power reactors which result from exposure of these materials to neutron irradiation and the thermal environment.

Paragraph IV.A of appendix H to 10 CFR, part 50, specifies that a summary technical report for each capsule withdrawal and the associated test results must be submitted within 18 months of the date of capsule withdrawal, unless an extension is granted by the Director, Office of Nuclear Reactor Regulation.

Paragraph IV.B of appendix H to 10 CFR, part 50, requires that capsule evaluation reports include all data specified by American Society for Testing and Materials (ASTM) Standard Practice E185-82 and the results of all fracture toughness tests conducted on the surveillance capsule materials in both the unirradiated and irradiated condition.

Paragraph IV.C of appendix H to 10 CFR, part 50, requires that if a change in the technical specifications (TSs) is required, either in the pressure-temperature (P/T) limits or in the operating procedures required to meet the limits, the expected date for submittal of the revised TSs must be provided with the report.

The NRC Regulatory Guide (RG) 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," May 1988 (ML003740284), provides guidance on general procedures acceptable to the NRC staff for calculating effects of neutron radiation embrittlement of low-alloy steels used for light-water-cooled reactor vessels.

3.0 NRC STAFF EVALUATION

3.1 Surveillance Capsule Program

Irradiation surveillance of the reactor vessel is necessary to assure that the vessel material will maintain its fracture toughness throughout the service life of the plant. The surveillance capsule contains both dosimeters, as well as archival material samples to be irradiated to levels comparable to those expected to be accrued by the reactor vessel at the end of its licensed period. Under the program, fracture toughness test data is obtained from the material specimens exposed in the surveillance capsules which are withdrawn periodically from the reactor vessel.

The CNP, Unit 1, reactor pressure vessel (RPV) material surveillance program was developed based on ASTM E185-70 "Standard Recommended Practice for Surveillance Tests for Nuclear Reactor Vessels." The program contains a total of eight capsules. Capsule W is the fifth capsule that has been removed. The licensee removed Capsule W from the reactor vessel at 32.9 effective full-power years (EFPY).

3.2 Neutron Fluence Evaluation

A fluence evaluation utilizing the neutron transport and dosimetry cross-section libraries was derived from the Evaluated Nuclear Data File (ENDF) database (specifically, ENDF/B-VI). The licensee reported that Capsule W was removed at 32.9 EFPY and received a fluence of 1.66 x 10^{19} n/cm^2 (newtons per square centimeter) (E >1.0 MeV).

The licensee projected the peak clad/base metal interface vessel fluence at 48 EFPY (end-of-license extension) of plant operation to be 2.57 x 10^{19} n/cm^2 (E > 1.0 MeV). Using the RG 1.99, Revision 2, attenuation formula and a vessel thickness of 8.5 inches, the licensee calculated vessel peak quarter-thickness (1/4T) and three-quarter thickness (3/4T) fluence of 1.54 x 10^{19} n/cm^2 and 0.56 x 10^{19} n/cm^2, respectively.

3.3 Material Test Results

The licensee performed mechanical tests of the Charpy V-notch and tensile specimens in Capsule W in accordance with 10 CFR, part 50, appendix H, and ASTM Specification E185-82.

3.3.1 Transition Temperature Shift

The reactor vessel intermediate shell plate B4406-3 Charpy specimens, oriented with the longitudinal axis of the specimen parallel to the major working direction (longitudinal orientation), resulted in an irradiated 30 ft-lb (foot-pound) transition temperature of 138.6 °F (degree Fahrenheit). This results in a 30 ft-lb transition temperature increase of 130.6 °F.

The reactor vessel intermediate shell plate B4406-3 Charpy specimens, oriented with the longitudinal axis of the specimen perpendicular to the major working direction (Transverse orientation), resulted in an irradiated 30 ft-lb transition temperature of 154.8 °F. This results in a 30 ft-lb transition temperature increase of 135.3 °F.

The weld material (Heat # 13253, Flux Linde 1092, Lot # 3791) Charpy specimens resulted in an irradiated 30 ft-lb transition temperature of 78.7 °F. This results in a 30 ft-lb transition temperature increase of 177.1 °F.

The reactor vessel heat-affected zone (HAZ) material Charpy specimens resulted in an irradiated 30 ft-lb transition temperature of 63.0 °F. This results in a 30 ft-lb transition temperature increase of 156.3 °F for the HAZ material specimens.

The reactor vessel correlation monitor material (CMM) Charpy specimens resulted in an irradiated 30 ft-lb transition temperature of 173.0 °F. This results in a 30 ft-lb transition temperature increase of 126.0 °F for the CMM material specimens

3.3.2 Upper Shelf Energy

The average upper-shelf energy of intermediate shell plate B4406-3 (longitudinal orientation) resulted in an average energy decrease of 21.2 ft-lb after irradiation. This decrease results in an irradiated average upper-shelf energy of 105.0 ft-lb for the longitudinally oriented specimens.

The average upper-shelf energy of intermediate shell plate B4406-3 (transverse orientation) resulted in an average energy decrease of 3.2 ft-lb after irradiation. This decrease results in an irradiated average upper-shelf energy of 93 ft-lb for the transversely oriented specimens.

The average upper-shelf energy of the surveillance program weld material (Heat # 13253, Flux Linde 1092, Lot # 3791) Charpy specimens resulted in an average energy decrease of 36.2 ft-lb after irradiation. This decrease results in an irradiated average upper-shelf energy of 74.0 ft-lb.

The average upper-shelf energy of the HAZ material Charpy specimens resulted in an average energy decrease of 28.9 ft-lb after irradiation. This decrease results in an irradiated average upper-shelf energy of 91.3 ft-lb for the HAZ material.

The average upper-shelf energy of the CMM Charpy specimens resulted in an average energy decrease of 19.9 ft-lb after irradiation. This decrease results in an irradiated average upper-shelf energy of 100.5 ft-lb for the CMM material.

3.3.3 Credibility Evaluation

The NRC staff notes that the credibility assessment performed in appendix D of WCAP-18795-NP, Revision 0, found the surveillance weld data to be “credible” and the forging data to be “non-credible” in accordance with the RG 1.99, Revision 2. The licensee determined that, based on the credibility evaluation presented in Appendix D of the capsule report, the intermediate shell plate B4407-3 is deemed “credible”, based on the methodology in RG 1.99, Revision 2. The surveillance weld material data (Heat # 13253, Flux Lind 1092, Lot # 3791) was not evaluated since it is not representative of any welds in the reactor vessel. The NRC staff reviewed the credibility evaluation of plate B4407-3 and had no objections. However, surveillance data determined to be “non-credible” may still need to be factored into licensing calculations, such as P/T limits.

4.0 CONCLUSION

The NRC staff finds that there are no needed changes to the CNP, Unit 1, Technical Specification (TS) 3.4.3, “Reactor Coolant System Pressure and Temperature Limits,” or TS 3.4.12, “Low Temperature Overpressure Protection System.”

The NRC staff finds that the licensee’s report of reactor vessel surveillance capsule W from Unit 1 satisfies the requirements of 10 CFR, part 50, appendix H, and that the licensee performed tests and calculations based on 10 CFR 50, appendix H and RG 1.99, Revision 2, appropriately. The staff also concludes that the licensee’s submittal meets the reporting requirements in section IV of 10 CFR, part 50, appendix H.

Principal Contributors: EPalmer, NRR
JAmbrosini, NRR
SBhatt, NRR

Date: July 25, 2024

SUBJECT: DONALD C. COOK NUCLEAR PLANT, UNIT NO. 1 – REVIEW OF REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM CAPSULE W TECHNICAL REPORT (EPID L-2023-LRO-0074) DATED JULY 25, 2024

DISTRIBUTION:
PUBLIC
RidsACRS_MailCTR Resource
RidsNrrDorlLpl3 Resource
RidsNrrDssSnsb Resource
RidsNrrDnrlNvib Resource
RidsNrrLASRohrer Resource
RidsNrrLASLent Resource
RidsNrrPMDCCook Resource
RidsRgn3MailCenter Resource
EPalmer, NRR
JAmbrosini, NRR
SBhatt, NRR

ADAMS Accession No.: ML24183A016

OFFICE	NRR/DORL/LPL3/PM	NRR/DORL/LPL3/LA	NRR/DSS/SNSB/BC
NAME	SWall	SRohrer (SLent for)	PSahd
DATE	06/28/2024	07/02/2024	04/03/2024
OFFICE	NRR/DNRL/NVIB/BC	NRR/DORL/LPL3/BC	NRR/DORL/LPL3/PM
NAME	ABuford	JWhited	SWall
DATE	06/24/2024	07/24/2024	07/25/2024

OFFICIAL RECORD COPY