

NUCLEAR REGULATORY COMMISSION  
FIRSTENERGY NUCLEAR OPERATING COMPANY  
DAVIS-BESSE NUCLEAR POWER STATION

DOCKET NO. 50-346

EXEMPTION

[NRC-2010-0378]

1.0 BACKGROUND

FirstEnergy Nuclear Operating Company (FENOC, the licensee) is the holder of Facility Operating License No. NFP-3, which authorizes operation of the Davis-Besse Nuclear Power Station, Unit 1 (DBNPS). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC, the Commission) now or hereafter in effect.

The facility consists of one pressurized-water reactor located in Ottawa County, Ohio.

2.0 REQUEST/ACTION

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix G requires that fracture toughness requirements for ferritic materials of pressure-retaining components of the reactor coolant pressure boundary of light-water nuclear power reactors provide adequate margins of safety during any condition of normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the pressure boundary may be subjected over its service lifetime; and Section 50.61 provides fracture toughness requirements for protection against pressurized thermal shock (PTS) events. By letter dated April 15, 2009, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091130228), as supplemented by letters dated December 18, 2009, (ADAMS Accession No.

ML093570103) and October 8, 2010 (ADAMS Accession No. ML102861221), FENOC proposed exemptions from the requirements of 10 CFR Part 50, Appendix G and 10 CFR 50.61, to revise certain DBNPS reactor pressure vessel (RPV) initial (unirradiated) properties using Framatome Advanced Nuclear Power Topical Report (TR) BAW-2308, Revisions 1A and 2A, "Initial  $RT_{NDT}$  of Linde 80 Weld Materials."

The licensee requested an exemption from Appendix G to 10 CFR Part 50 to replace the required use of the existing Charpy V-notch ( $C_v$ ) and drop weight-based methodology and allow the use of an alternate methodology to incorporate the use of fracture toughness test data for evaluating the integrity of the DBNPS RPV circumferential beltline welds based on the use of the 1997 and 2002 editions of American Society for Testing and Materials (ASTM) Standard Test Method E 1921, "Standard Test Method for Determination of Reference Temperature  $T_0$ , for Ferritic Steels in the Transition Range," and American Society for Mechanical Engineering (ASME), *Boiler and Pressure Vessel Code* (Code), Code Case N-629, "Use of Fracture Toughness Test Data to establish Reference Temperature for Pressure Retaining materials of Section III, Division 1, Class 1." The exemption is required since Appendix G to 10 CFR Part 50, through reference to Appendix G to Section XI of the ASME Code pursuant to 10 CFR 50.55(a), requires the use of a methodology based on  $C_v$  and drop weight data.

The licensee also requested an exemption from 10 CFR 50.61 to use an alternate methodology to allow the use of fracture toughness test data for evaluating the integrity of the DBNPS RPV circumferential beltline welds based on the use of the 1997 and 2002 editions of ASTM E 1921 and ASME Code Case N-629. The exemption is required since the methodology for evaluating RPV material fracture toughness in 10 CFR 50.61 requires the use of the  $C_v$  and drop weight data for establishing the PTS reference temperature ( $RT_{PTS}$ ).

### 3.0 DISCUSSION OF EXEMPTION

Pursuant to 10 CFR 50.12(a), the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 50 when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, are consistent with the common defense and security; and (2) when special circumstances are present. These circumstances include the special circumstances that allow the licensee an exemption from the use of the  $C_v$  and drop weight-based methodology required by 10 CFR Part 50, Appendix G and 10 CFR 50.61. These exemptions only modify the methodology to be used by the licensee for demonstrating compliance with the requirements of 10 CFR Part 50, Appendix G and 10 CFR 50.61, and does not exempt the licensee from meeting any other requirement of 10 CFR Part 50, Appendix G and 10 CFR 50.61.

#### Authorized by Law

These exemptions would allow the licensee to use an alternate methodology to make use of fracture toughness test data for evaluating the integrity of the DBNPS RPV beltline welds, and would not result in any changes to the operation of the plant. Section 50.60(b) of 10 CFR Part 50 allows the use of alternatives to 10 CFR Part 50, Appendix G, or portions thereof, when an exemption is granted by the Commission under 10 CFR 50.12. In addition, Section 50.60(b) of 10 CFR Part 50 permits different NRC-approved methods for use in determining the initial material properties. As stated above, 10 CFR 50.12(a) allows the NRC to grant exemptions from the requirements of 10 CFR Part 50, Appendix G and 10 CFR 50.61. The NRC staff has determined that granting of the licensee's proposed exemptions will not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, the exemptions are authorized by law.

#### No Undue Risk to Public Health and Safety

The underlying purpose of Appendix G to 10 CFR Part 50 is to set forth fracture toughness requirements for ferritic materials of pressure-retaining components of the reactor

coolant pressure boundary of light-water nuclear power reactors to provide adequate margins of safety during any condition of normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the pressure boundary may be subjected over its service lifetime. The methodology underlying the requirements of Appendix G to 10 CFR Part 50 is based on the use of  $C_v$  and drop weight data. The licensee proposes to replace the use of the existing  $C_v$  and drop weight-based methodology by a fracture toughness-based methodology to demonstrate compliance with Appendix G to 10 CFR Part 50. The NRC staff has concluded that the exemptions are justified based on the licensee utilizing the fracture toughness methodology specified in BAW-2308, Revisions 1A and 2A, within the conditions and limitations delineated in the NRC staff's safety evaluations (SEs), dated August 4, 2005 (ADAMS Accession No. ML052070408) and March 24, 2008 (ADAMS Accession No. ML080770349). The use of the methodology specified in the NRC staff's SEs will ensure that pressure-temperature limits developed for the DBNPS RPV will continue to be based on an adequately conservative estimate of RPV material properties and ensure that the pressure-retaining components of the reactor coolant pressure boundary retain adequate margins of safety during any condition of normal operation, including anticipated operational occurrences. This exemption only modifies the methodology to be used by the licensee for demonstrating compliance with the requirements of Appendix G to 10 CFR Part 50, and does not exempt the licensee from meeting any other requirement of Appendix G to 10 CFR Part 50.

The underlying purpose of 10 CFR 50.61 is to establish requirements for evaluating the fracture toughness of RPV materials to ensure that a licensee's RPV will be protected from failure during a PTS event. The licensee seeks an exemption from 10 CFR 50.61 to use a methodology for the "determination of adjusted/indexing reference temperatures." The licensee proposes to use ASME Code Case N-629 and the methodology outlined in its submittal, which are based on the use of fracture toughness data, as an alternative to the  $C_v$  and drop weight-

based methodology required by 10 CFR 50.61 for establishing the initial, unirradiated properties when calculating  $RT_{PTS}$  values. The NRC staff has concluded that the exemption is justified based on the licensee utilizing the methodology specified in the NRC staff's SE regarding TR BAW-2308, Revisions 1-A and 2-A, dated August 4, 2005, and March 24, 2008, respectively. This TR established an alternative method for determining initial (unirradiated) material reference temperatures for RPV welds manufactured using Linde 80 weld flux (i.e., "Linde 80 welds") and established weld wire heat-specific and Linde 80 weld generic values of this reference temperature. These weld wire heat-specific and Linde 80 weld generic values may be used in lieu of the nil-ductility reference temperature ( $RT_{NDT}$ ) parameter, the determination of which is specified by paragraph NB-2331 of Section III of the ASME Code. Regulations associated with the determination of RPV material properties involving protection of the RPV from brittle failure or ductile rupture include Appendix G to 10 CFR Part 50 and 10 CFR 50.61, the PTS rule. These regulations require that the initial (unirradiated) material reference temperature,  $RT_{NDT}$ , be determined in accordance with the provisions of the ASME Code, and provide the process for determination of  $RT_{PTS}$ , the reference temperature  $RT_{NDT}$ , evaluated for the end of license fluence.

In TR BAW-2308, Revision 1, the Babcock and Wilcox Owners Group proposed to perform fracture toughness testing based on the application of the Master Curve evaluation procedure, which permits data obtained from sample sets tested at different temperatures to be combined, as the basis for redefining the initial (unirradiated) material properties of Linde 80 welds. NRC staff evaluated this methodology for determining Linde 80 weld initial (unirradiated) material properties and uncertainty in those properties, as well as the overall method for combining unirradiated material property measurements based on NRC-accepted values of initial (unirradiated) reference temperature ( $IRT_{T_0}$ ), with property shifts from models in Regulatory Guide (RG) 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials,"

which are based on  $C_v$  testing and a defined margin term to account for uncertainties in the NRC staff SE. Table 3 in the staff's August 4, 2005, SE of BAW-2308, Revision 1, contains the NRC staff-accepted  $IRT_{T_0}$  and corresponding initial uncertainty term,  $\sigma_i$ , for specific Linde 80 weld wire heat numbers. In accordance with the conditions and limitations outlined in the NRC staff's August 4, 2005 SE of TR BAW-2308, Revision 1, for utilizing the values in Table 3, the licensee's proposed methodology (1) utilized the appropriate NRC staff-accepted  $IRT_{T_0}$  and  $\sigma_i$  values for Linde 80 weld wire heat numbers; (2) applied the appropriate chemistry factors for temperatures greater than 167 °F (the weld wire heat-specific chemical composition, via the methodology of RG 1.99, Revision 2, indicated that higher chemistry factors are applicable); (3) applied a value of 28 °F for  $\sigma_\Delta$  in the margin term; and (4) submitted values for  $\Delta RT_{NDT}$  and the margin term for each Linde 80 weld in the RPV through the end of the current operating license. Additionally, the NRC's SE for TR BAW-2308, Revision 2, concludes that the revised  $IRT_{T_0}$  and  $\sigma_i$  values for Linde 80 weld materials are acceptable for referencing in plant-specific licensing applications as delineated in TR BAW-2308, Revision 2, and to the extent specified under Section 4.0, Limitations and Conditions, of the SE, which states: "Future plant-specific applications for RPVs containing weld heat 72105, and weld heat 299L44, of Linde 80 welds must use the revised  $IRT_{T_0}$  and  $\sigma_i$ , values in TR BAW-2308, Revision 2." The staff notes that neither of these weld heats is used at DBNPS. Therefore, all conditions and limitations outlined in the NRC staff SEs for TR BAW-2308, Revisions 1-A and 2-A, have been met for DBNPS.

The use of the methodology in TR BAW-2308, Revision 1, will ensure the PTS evaluation developed for the DBNPS RPV will continue to be based on an adequately conservative estimate of RPV material properties and ensure the RPV will be protected from failure during a PTS event. Also, when additional fracture toughness data relevant to the evaluation of the DBNPS RPV welds is acquired as part of the surveillance program, this data must be incorporated into the evaluation of the DBNPS RPV fracture toughness requirements.

Based on the above, no new accident precursors are created by allowing an exemption to use an alternate methodology to comply with the requirements of 10 CFR 50.61 in determining adjusted/indexing reference temperatures, thus, the probability of postulated accidents is not increased. Also, based on the above, the consequences of postulated accidents are not increased. Therefore, there is no undue risk to public health and safety. On February 3, 2010, a new rule, 10 CFR 50.61a, "Alternate Fracture Toughness Requirements for Protection Against PTS Events," became effective. The NRC staff reviewed this new rule against the licensee's exemption request and determined that there is no effect on the exemption request. The new rule does not modify the requirements from which the licensee has sought an exemption, and the alternative provided by the new rule does not address the scope of issues associated with both 10 CFR 50.61 and 10 CFR Part 50, Appendix G that the requested exemption does.

#### Consistent with Common Defense and Security

The proposed exemption would allow the licensee to use an alternate methodology to allow the use of fracture toughness test data for evaluating the integrity of the DBNPS RPV beltline welds. This change has no relation to security issues. Therefore, the common defense and security is not impacted by these exemptions.

#### Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR Part 50, Appendix G and 10 CFR 50.61 is to protect the integrity of the reactor coolant pressure boundary by ensuring that each reactor vessel material has adequate fracture toughness. Therefore, since the underlying purpose of 10 CFR Part 50, Appendix G and 10 CFR 50.61 is achieved by an alternative

methodology for evaluating RPV material fracture toughness, the special circumstances required by 10 CFR 50(a)(2)(ii) for the granting of an exemption from portions of the requirements of 10 CFR Part 50, Appendix G and 10 CFR 50.61 exist.

#### 4.0 CONCLUSION

The staff has reviewed the licensee's submittals and concludes that the licensee has provided adequate justification for its request for an exemption from certain requirements of Appendix G to 10 CFR Part 50 and 10 CFR 50.61, to allow an alternative methodology that is based on using fracture toughness test data to determine initial, unirradiated properties for evaluating the integrity of the DBNPS RPV beltline welds.

Accordingly, the Commission has determined that pursuant to 10 CFR 50.12, "Specific exemptions," an exemption from certain requirements of Appendix G to 10 CFR Part 50 and 10 CFR 50.61 is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest.

Pursuant to 10 CFR 51.32, "Finding of no significant impact," the Commission has previously determined that the granting of this exemption will not have a significant effect on the quality of the human environment (75 FR 76498).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 14 day of December 2010.

FOR THE NUCLEAR REGULATORY COMMISSION

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Office of Nuclear Reactor Regulation