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

June 11, 2009

Mr. Barry S. Allen
Site Vice President
FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
Mail Stop A-DB-3080
5501 North State Route 2
Oak Harbor, OH 43449-9760

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION, UNIT NO. 1 - REQUEST FOR ADDITIONAL INFORMATION RELATED TO RELIEF REQUESTS FOR ALTERNATIVE DISSIMILAR METAL WELD REPAIR METHODS FOR REACTOR VESSEL NOZZLES, REACTOR COOLANT PUMP NOZZLES, AND REACTOR COOLANT PIPING (RR-A32 AND RR-A33) (TAC NOS. ME0477 AND ME0478)

Dear Mr. Allen:

By letter to the Nuclear Regulatory Commission (NRC) dated January 30, 2009 (Agencywide Documents Access and Management System Accession No. ML090350070), FirstEnergy Nuclear Operating Company submitted two relief requests for proposed alternatives to certain requirements associated with reactor vessel nozzle, reactor coolant pump nozzle, and reactor coolant piping weld repairs, for the Davis-Besse Nuclear Power Station, Unit No. 1.

The NRC staff is reviewing your submittal and has determined that additional information is required to complete the review. The specific information requested is addressed in the enclosure to this letter. During a discussion with your staff on June 3, 2009, it was agreed that you would provide a response within 30 days from the date of this letter.

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for staff review and contribute toward the NRC's goal of efficient and effective use of staff resources. If circumstances result in the need to revise the requested response date, please contact me at (301) 415-4037.

Sincerely,

Cameron S. Goodwin, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-346

Enclosure:
Request for Additional Information

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFORMATION

DAVIS-BESSE NUCLEAR POWER STATION, UNIT NO. 1

DOCKET NO. 50-346

In reviewing the FirstEnergy Nuclear Operating Company's submittal dated January 30, 2009, related to relief requests RR-A32 and RR-A33 to install the optimized weld overlay (OWOL) or the full structural weld overlay (FSWOL) on reactor coolant pump (RCP) nozzles, core flood nozzles, and cold-leg drain nozzles, for the Davis-Besse Nuclear Power Station, Unit No. 1 (DBNPS), the Nuclear Regulatory Commission (NRC) staff has determined that the following information is needed in order to complete its review:

REQUEST RR-A32

1.2 Section 4.0, page 3, states that the OWOL will be applied to a demineralized makup water (DMW) if the maximum depth of defects in the DMW is less than 50 percent through wall, and the FSWOL will be installed if the maximum depth of defects is greater than 50 percent through wall. This description is not clear as to the exact locations of the flaws in the DMW by which the OWOL is applicable to be installed.

a. The primary water stress-corrosion cracking (PWSCC) flaws are initiated from the inner surface of the DMW based on industry's operating experience. One of the bases for the overlay design is that the overlay will generate compressive stresses in the inner region of the pipe wall to mitigate the flaw initiation and growth. However, Section 4.0 does not clearly state the initiation site of the 50 percent through wall flaw. Specify the flaw location (i.e., where is the flaw initiated) for the application of the OWOL.

b. In addition, the staff has identified the following scenarios: (1) if a 50 percent through wall flaw is detected inside the DMW during the pre-installation inspection, (but is not connected to the inside surface of the pipe (i.e., an embedded flaw), discuss which weld overlay, OWOL or FSWOL, will be installed; (2) if the embedded flaw is greater than 50 percent through wall which means that a portion of the flaw is located in the outer 50 percent region and a portion of the flaw is located in the inner 50 percent region of the pipe wall thickness, discuss which overlay (OWOL or FSWOL) will be installed; (3) if the embedded flaw is less than 50 percent through wall and is located in the outer 50 percent region of the pipe wall thickness, discuss which weld overlay, OWOL or FSWOL, will be installed; and (4) if the embedded flaw is less than 50 percent through wall and is located in the inner 50 percent region of the pipe wall thickness, discuss which weld overlay, OWOL or FSWOL, will be installed.

c. If a flaw regardless of its depth is initiated from the outside surface of the pipe, discuss whether the OWOL is applicable.

ENCLOSURE

1.3 Attachment 1 to the relief request provides only background and technical basis rather than requirements for the weld overlay design. Nevertheless, Section A1.1 of Attachment 1 to the relief request discusses the pre-installation inspection requirements. Please provide the pre-installation examination requirement in Section 5 of the relief request and Section A2.1 of Attachment 2 to the relief request.

1.4 Figure 5-2 on page 6 shows that the proposed weld overlay does not cover the stainless steel weld between the safe end and the RCP pump nozzle. (a) Confirm that the weld overlay will not cover the stainless steel weld, and (b) If the stainless steel weld will not be covered with the weld overlay, discuss whether the OWOL has sufficient length to support ultrasonic testing (UT) of the DMW.

RR-A32 Attachment 1

1.5 Section A1.1, Page 2, 4th paragraph, states that the OWOL thickness is based on the actual internal pressure, pipe loads, and the allowable flaw size criteria of American Society of Mechanical Engineers (ASME) Code Section XI, paragraph IWB-3641. Specify the exact criteria or cite the specific subparagraph in IWB-3641 from specific edition or addenda of the ASME Code, Section XI.

1.6 Section A1.2 discusses the improvement on residual stresses of the DMW following the OWOL installation. The licensee has committed to submit, prior to entry into Mode 4, a residual stress profile in the nozzle to show that crack initiation due to PWSCC is highly unlikely. However, in order to approve the relief request, the NRC staff needs to have the assurance that the residual stresses in the subject DMWs at DBNPS are acceptable to mitigate PWSCC. The licensee has referenced MRP-169 which contains the results of residual stresses for the OWOL. Clarify whether the residual stress analysis performed for the generic OWOL in MRP-169 is applicable to the DMWs in the subject nozzles in the DBNPS relief request. In the response, provide a comparison of the DMWs and nozzle configurations between the MRP-169 model and at DBNPS to show whether the MRP-169 residual stress analysis bounds the subject DMWs in the relief request.

1.7 Section A1.3, Page 4, last paragraph, states that a flaw in the DMW extending into the outer 25 percent of the pipe wall would violate the design basis of the OWOL. (1) After the OWOL is installed, if a flaw is detected in the outer 25 percent region of the DMW wall thickness during the inservice inspection, discuss how the flaw will be dispositioned prior to plant restart because any flaw remaining in the outer 25 percent region of the DMW wall thickness would violate the design basis, and (2) Before the OWOL is installed, if a flaw is detected in the outer 25 percent region of the DMW wall during the pre-installation inspection, discuss how the flaw will be dispositioned prior to overlay installation and discuss whether OWOL or FSWOL will be applied in this situation.

RR-A32 Attachment 2

1.8 Section A2.2, page 2, requires a certain flaw size be assumed in the design analysis and crack growth calculations. However, Section A2.2, Page 3, states that if

inspection in accordance with a full qualification to the modified requirements of ASME Code Section XI, Appendix VIII, Supplement 11 cannot be performed for both the axial and circumferential 50 percent through-wall flaws, four alternatives will be applied. The discussion regarding flaw sizing with respect to UT capability in Section A2.2 is confusing due to the "If statement" regarding the UT qualification. The staff needs to evaluate the design requirements that are being used for the OWOL.

a. Please state the exact flaw assumptions used in the DBNPS OWOL design and flaw growth calculations based on the current understanding of qualified UT capability that will be used at DBNPS.

b. State the size of the flaw that the current UT is qualified to detect after OWOL installation at DBNPS and provide the technical basis to support the UT qualification.

c. It appears that Section A2.2 does not provide criteria for the location of the flaw (surface connected or embedded) under which an OWOL is applicable to be installed. The licensee needs to discuss the factors/conditions by which the OWOL is applicable for installation, such as the location of the flaw (e.g., in the region of the pipe wall thickness and initiation site), the depth of the flaw, and the combination of the two factors. The licensee needs to incorporate, in Section A2.2 or some other section in Attachment 2 to the relief request, the factors/conditions/criteria by which the OWOL is applicable to be installed.

1.9 Section A2.2, page 3. The third bullet (alternative) states that "...An additional design requirement is added to show that ASME Code Section XI design criteria are met for a 100% through-wall axial flaw..." Specify the "additional" design requirement.

1.10 Section A2.2, page 3. The fourth bullet (alternative) states that "...An analysis of fatigue and PWSCC growth must demonstrate that any growth shall not impair the ASME Code Section XI acceptance criteria for the OWOL at the end of the inspection interval..." (a) Clarify whether the growth calculation is for the flaw growth in the DMW, in the OWOL, or in both components, and (b) It is not clear as to the exact acceptance criteria in the phrase "...impair the ASME Code Section XI acceptance criteria..." The specific ASME subarticle with the edition and addenda of the ASME Code, Section XI that contains the acceptance criteria should either be cited or provided.

1.11 Section A2.2, Page 4, first paragraph, *Residual Stress Analysis,* states that thermal boundary conditions (wet or dry) will be considered in the residual stress analyses.

a. Discuss whether water will be present inside the pipe when the OWOL is installed at DBNPS.

b. Discuss whether residual stresses are analyzed based on the actual condition (wet or dry) when the OWOL will be installed.

c. The licensee states that the residual stress analysis assumes a conservative pre-overlay residual stress condition from the weld repair during construction. Provide the depth of the postulated flaw for the inside surface weld repair during construction that is assumed in the residual stress analysis.

d. Discuss whether the repair depth of the postulated flaw bounds the worst weld repair in the field.

1.12 Section A2.3, page 5, third paragraph, *Examination Requirements,* states that "...If 100 percent coverage of the required volume for axial flaws cannot be achieved, but essentially 100 percent coverage for circumferential flaws (100 percent of the susceptible volume) can be achieved, the examination for axial flaws shall be performed to achieve the maximum coverage practicable, with limitations noted in the examination report. The examination coverage requirements shall be considered to be met..."

a. Clarify why 100 percent examination coverage of the required volume for axial flaws cannot be achieved.

b. The staff notes that the detection of 50 percent through-wall axial flaws in the DMW after OWOL installation, has not yet been qualified as stated in Section A2.2 and the current UT technology does not provide reliable results for the examination of the CASS material from which the RCP nozzles are fabricated. In light of these issues, discuss the estimated coverage that will be achieved (i.e., maximum coverage practicable) for the examination of axial flaws in the required examination volume shown in Figure A2-2; and, discuss the estimated coverage that will be achieved for the examination of axial flaws in the DMW (i.e., the susceptible material) for the preservice and inservice examinations

c. Provide estimated examination coverage for all nozzles and associated DMWs.

1.13 Section A2.3, Page 6.

a. The inspection schedule table on page 6 is confusing. Clarify why the table provides an inspection schedule for the "full structural" overlay even though Request RR-A32 is strictly related to the OWOL.

b. Provide detailed requirements for preservice and inservice inspection regarding acceptance criteria for detected flaws in the OWOL and base metal, because the proposed requirements on page 6 of Section A2.3 are inadequate. The requirements should be similar to the inspection requirements for the FSWOL in Section A1.4(b), *Preservice Inspection,* and A1.4(c), *Inservice Inspection,* of Attachment 1 to Relief Request RR-A33.

1.14 Section A2.3, Page 6.

a. For FSWOL or OWOL of a cracked DMW (Category F), the proposed examination schedule is every 5 years. However, the inspection schedule in Section A1.4(c)(2) of Attachment 1 to Relief Request RR-A33 (for the FSWOL) requires UT during the first or second refueling outage following overlay application. Discuss the discrepancy.

b. For OWOL of a cracked DMW (category F), the proposed examination schedule is every 5 years. This inspection schedule is not consistent with the inspection requirements of Section A1.4(c)(2) of Attachment 1 to Relief Request RR-A33 which requires UT during the first or second refueling outage following the overlay application. Provide technical basis to support the 5-year inspection schedule.

1.15 The footnote on Figure A2-2 states that "...to a depth of the outer 50 percent (optimized weld overlay) of underlying material (A-B-C-D)..." This statement is not consistent with the statements on page 3 of Section A2.2 in which it is assumed that the volumetric examination for the axial flaw may not be qualified for a depth of outer 50 percent of underlying material. Please revise the footnote to be consistent with the actual UT capability at DBNPS at the time of the submittal or response to this request for additional information, or clarify the discrepancy.

1.16 The RCP nozzle is made of CASS material and UT of CASS material has not yet been qualified to the requirements of the ASME Code, Section XI. For the FSWOL design, the staff has provided licensees with two options to compensate for the inadequacy of the current UT capability. Licensees may assume either a 100 percent postulated flaw in the DMW (Option 1) or a 75 percent flaw but increase the DMW inspection frequency (Option 2).

a. Discuss the UT of the OWOL in light of the inadequacy of UT of CASS components.

b. Discuss the procedures that will be used to perform UT of the DMW from the CASS pump nozzle side.

1.17 Discuss whether the same welding sequences, heat input, interpass cooling temperatures, number of weld heads, and weld head travel directions for the original dissimilar butt weld fabrication and overlay installations will be included in the finite element model to analyze the residual stresses.

<u>RR-A32 Attachment 3</u>

1.18.1 Section A3-1(b) states that the maximum area of a weld overlay using the ambient temperature temper bead welding over the ferritic base material shall be 600 square inches. The maximum area that the staff has approved for the FSWOL design is the 500 square inch area. The staff is concerned about the potential distortion and cracking with the large welded area on the ferritic nozzle. The industry has provided stress analyses to demonstrate the acceptability of the 500 square-inch area, but has not provided a stress analysis for the 600 square-inch area. The licensee states that

the current industry analysis for the 500 square-inch area would support the proposed 600 square-inch area.

a. Provide a technical justification of whether and how the results of the stress analysis for the 500 square-inch area can be extrapolated for the 600 square-inch area. If a plant-specific analysis is performed to support the proposed 600 square-inch area on the ferritic nozzle, a finite element analysis should be performed to demonstrate that the residual stresses in the nozzle are acceptable and that the nozzle will not be distorted significantly. The analysis should consider necessary loadings, including bending moments and thermal expansions. The ASME Code Section III stress allowables will not be exceeded with a weld area of 600 square inches. This analysis should be submitted for staff review.

b. The 600 square-inch area will be applicable to the weld material deposited on the carbon steel elbow. The model in the industry's analysis for the 500 square-inch area is a straight pipe. An elbow may present different stress distribution and there is a potential for stress risers with the overlay material on the elbow. Provide the basis of how the current 500 square-inch area analysis is applicable to the subject elbow.

c. The subject carbon steel elbow at DBNPS has a stainless steel cladding. Clarify whether the current 500 square-inch area analysis contains stainless steel cladding on the inside of the pipe and if not, justify the applicability of the current analysis. The 600 square-inch area question also applies to Relief Request RR-A33.

<u>RR-A32 Attachment 5: Performance Demonstration Initiative (PDI)</u>

1.19 Paragraph 1.1(d)(1) of Supplement 11 requires that all cracks must extend at least 75 percent through-wall from the inside surface of the pipe and may extend to 100 percent through the base metal. The proposed alternative requires flaws to extend at least 50 percent through-wall from the inside surface. However, RR-A32 Attachment 1, page 1, 6th paragraph, states that nondestructive examination qualification for axial flaws shall be done to the current requirements from Appendix VIII, Supplement 11 for a 75 percent through-wall flaw. Clarify the discrepancy regarding the UT qualification for the axial flaw size between requirements in Attachment 1 and Attachment 5.

1.20 Paragraph 2.2 of Supplement 11 requires that for flaws in the base grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25 percent of the base wall thickness. The proposed alternative requires "...50 percent of the base metal wall thickness..." Clarify whether the proposed wording should be revised to read "outer 50 percent" of the base metal wall thickness.

1.21 The proposed alternative to Paragraph 3.2 of Supplement 11 requires that "....50 percent though[sic]-base-metal position..." Clarify whether the alternative should be revised to read "...The length of base metal cracking is measured at the 50 percent through-base-metal position from the inside surface of the pipe/dissimilar metal weld..."

1.22 The alternative is silent on the requirements for the representative mockups, base materials, weld material, weld butter, and overlay material that will be used for the performance demonstration test specimens. Provide the requirements for the representative mockups, base material, and overlay material for the performance demonstration test specimens. Specifically:

a. Discuss the mockup configuration (e.g., pipe diameter) and general requirements;

b. Discuss the fabrication of the mockup;

c. Discuss whether cast austenitic stainless steel materials are used in mockup;

d. Discuss whether the RCP nozzles are addressed by the mockups used in the qualification.

e. Discuss the differences, if any, between the mockups and the RCP nozzles in the field. If there are differences, discuss why the differences are acceptable to qualify the ultrasonic examination per Performance Demonstration Initiative (PDI).

REQUEST RR-33A

2.2 Figure 5-3 shows the proposed FSWOL covering the core flood nozzle, the DMW, and safe end. The figure does not show the weld that joins the safe end with the pipe which is also not shown. Clarify whether the proposed FSWOL will cover the weld that joins the safe end and the pipe as well as cover a part of the core flood pipe. This question also applies to Figure 5-4 regarding the cold-leg drainline configuration.

RR-A33 Attachment 1

2.3 Section A1.2.2(c)(1) states that for P-No.1 base materials, the Construction Code post weld heat treat exemptions permitted for circumferential butt welds may be applied to exempt the weld overlay from post weld heat treat with the following clarifications. Section A1.2.2(c)(1)(a) states that the nominal weld thickness is defined as the maximum overlay thickness applied over the ferritic base material. Section A1.2.2(c)(1)(b) states that the base material thickness is defined as the maximum thickness of the ferritic material where the overlay is applied. The staff has not accepted the exemption for the post weld heat treatment at the present as described in these sections. Provide either justification for these sections or remove them from RR-A33 Attachment 1.

2.4 Section A1.2.2(d)(3) states that "...The filler material used shall meet the minimum requirements for delta ferrite...." Discuss the minimum requirements for delta ferrite. Also there is no identification of the weld material. The staff suggests that the wording on Section A2.1(d)(3) from Attachment 2 of Relief Request RR-A32 be used in Section A1.2.2(d)(3).

2.5 Section A1.3(a)(5) states that the depths associated with the [postulated flaw] lengths are specified in A1.3(a)(3) and A1.3(a)(4). However, Section A1.3(a)(3) does not exist and

Section A1.3(a)(4) does not provide the flaw depth. Also Sections A1.3(a)(1) and A1.3(a)(2) do not exist in Section A1.3. Clarify.

2.6 Section A1.3(a)(8) states that "...any inside-surface-connected planar flaw found by the overlay preservice inspection of A1.4(b) that exceeds the depth of (3), (4) or (5) above..." Sections A1.3(a)(3), (4), and (5) either do not exist or do not pertain to the flaw depth. Clarify.

2.7 On page 8, clarify whether "Inservice Inspection" should be identified as "(c) Inservice Inspection."

2.8 Section A1.4(b)(2) states that "...Planar flaws in the outer 25 percent of the base metal thickness shall meet the design analysis requirements of 2(b)..." Section 2(b) does not exist in Attachment 1 of RR-A33. Clarify the discrepancy.

2.9 Section A1.4(c)(2) references A1.3(a)(3) which does not exist. Clarify.

2.10 Section A1.4(c)(8) includes two options to handle the problems in UT of cast austenitic stainless steel components (i.e., RCP nozzles). Option 1 is to assume a 100 percent initial flaw in the DMW. Option 2 is to assume a 75 percent initial flaw in the DMW with an increase inspection schedule. The staff allows either option to be implemented by licensees. However, as it is written in Section A1.4(c)(8), it is not clear which option was chosen for the weld overlay at Davis-Besse. Revise Section A1.4(c)(8) to identify the option that will be used at Davis-Besse.

RR-A33 Attachment 2

2.11 R-A33 Attachment 2 provides a comparison of the requirements in Supplement 11 of the ASME Code, Section XI to the proposed PDI program. The PDI program discussed in RR-A33 Attachment 2 appears to be for the OWOL design because some requirements discuss 50 percent through wall flaws instead of 75 percent through wall flaws. However, Relief Request RR-A33 is specifically for the FSWOL design. Explain why the PDI program for the OWOL design is presented in the FSWOL relief request.

General Comments

2.12 During recent weld overlay campaigns, some licensees have experienced hot cracking in the first Alloy 52M layer covering the stainless steel buffer layer on the stainless steel safe end and pipe segment. Discuss whether a stainless steel buffer layer will be applied on the safe end or pipe. Discuss measures that will be implemented to prevent hot cracking from occurring during overlay installation at DBNPS.

Mr. Barry S. Allen
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June 11, 2009

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Sincerely,
/RA/
Cameron S. Goodwin, Project Manager
Plant Licensing Branch III-2
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Docket No. 50-346
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