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

October 8, 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 September 29, 2009, it was agreed that you would provide a response within 45 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,

Stephen P. Sands, 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

By letter dated January 30, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML090350070), FirstEnergy Nuclear Operating Company (the licensee) submitted for staff review and approval Requests RR-A32 and RR-A33 to install optimized weld overlays (OWOL) or full structural weld overlays (FSWOL) on Alloy 82/182 dissimilar metal welds (DMWs) at reactor coolant pump nozzles, core flood nozzles, and cold-leg drain nozzles at the Davis Besse Nuclear Power Station.

By letter dated July 13, 2009, the licensee responded to the staff's request for additional information (RAI) and revised the relief requests accordingly (ADAMS Accession No. ML091950627). To complete its review, the staff requests the following clarification on some of the licensee's RAI response. The staff is also providing additional comments on the submittal as follows.

Questions and Comments Related to Relief Request RR-A32 (the OWOL design)

1. Your Response to Question 1.2.b(1), (2) and (3) states that if the pre-installation examination detects an embedded (i.e., subsurface) flaw and the flaw is accepted by the American Society of Mechanical Engineers (ASME) Code, Section XI, IWA-3300 and/or IWB-3640, an OWOL will be applied. If the flaw is judged to be unacceptable, a FSWOL will be applied.

It appears that RR-A32 may be used to repair embedded flaws even though RR-A32 provides requirements only for inside-surface-connected flaws. The Nuclear Regulatory Commission (NRC) staff notes that IWB-3640 allows a maximum flaw (surface connected or subsurface) of 75 percent flaw to remain in the DMW. This implies that the OWOL may be applied to a DMW that may contain an embedded flaw of 75 percent through-wall. The NRC staff does not agree that an embedded flaw of 75 percent through-wall in the DMW can be repaired by the OWOL. The NRC staff's position is that any embedded flaw whose depth is greater than 50 percent through-wall should be repaired by the FSWOL. Any embedded flaw whose depth is equal to or less than 50 percent through-wall may be repaired by the OWOL. If any part of an embedded flaw is located in the outer 25 percent of the DMW wall thickness, the OWOL cannot be used to repair the DMW. The outer 25 percent wall thickness should be free of flaws because it provides structural support to the OWOL. Discuss if this is the same position that would be used for the repair of embedded flaws per RR-A32.

2. Your Response to 1.8c. The revised Section A2.2(2) states that "...For repair [of] axial flaws in the underlying base material or weld, the flaws shall be assumed to be 75 percent through the original wall thickness of the item for the entire axial length of the flaw or combined flaws, as applicable..." However, due to limitation on the ultrasonic test (UT) of axial flaws in the DMW, Section A2.2 also states that "A design requirement is added to show that ASME Code Section XI design criteria are met for a 100 percent through-wall axial flaw...". In response to Question 1.8a, you confirmed that the OWOL design assumes that an inside surface connected axial flaw in the DMW is 100 percent through-wall. Explain why Section A2.2(2) still discusses a 75 percent through-wall axial flaw in the DMW even though in other parts of A2.2, a 100 percent through-wall flaw was assumed.

3. Your Response to 1.11a and 1.11b. In response to Question 1.11a, you stated that the subject piping may be in either water-backed or dry condition when the OWOL is installed. In response to Question 1.11b, you stated that the residual stress analysis assumed the piping was dry. (a) Describe briefly the overlay welding procedures with regard to when the pipe will be dry and when the pipe will be filled with water. (b) If the OWOL is installed when the piping has water inside, discuss whether the residual stresses analyzed for the dry piping condition would bound the residual stresses for the water-backed pipe condition. (c) In addition to the changes in residual stresses in the pipe, the staff concerns the potential for martensite formation which would cause embrittlement during temper bead welding. Discuss how the Procedure Qualification Report considers the cooling rate of the water vs. no water in the pipe for the field installation to minimize the potential of base metal embrittlement.

4. Your Response to Q1.13b—Preservice and Inservice Examination Requirements

(a) Preservice examination Item (1) requires that UT locates and measures any planar flaws that have propagated into the outer 25 percent of the base metal. Preservice Examination Item (2) requires that the planar flaws in the outer 25 percent of the base metal satisfy the design analysis requirements of Section [A]2.2. The planar flaws in the outer 25 percent region apply only to axial flaws. In the circumferential direction, UT is qualified to locate and size the planar flaws in the outer 50 percent of the base metal. There should be two acceptance criteria for preservice examination: one for the axial planar flaws and one for the circumferential planar flaws. Explain and justify the 25 percent through-wall flaw requirement for the circumferential planar flaws in Preservice Examination Items (1) and (2).

(b) Preservice Examination Item (2) states that "...Planar flaws in the outer 25 percent of the base metal thickness shall meet the design analysis requirements of 2.2...." The reference should be Section A2.2.

(c) Inservice Examination Item (2) should be revised to read "For welds whose pre-overlay examination, <u>post-overlay acceptance examination, and preservice examination</u> did not reveal any planar flaws, the examination volume in Fig. A2-2 shall be ultrasonically examined within 10 years following application of the optimized weld overlay..." The underline and strikeout are suggested revisions to the proposed requirement. In order to not inspect the overlaid DMW during the first or second refueling outage, the DMW should not contain any planar flaws (embedded or inside-surface connected) based on pre-overlay, post-overlay and preservice examinations.

The NRC staff suggests the above revision (underline and strikeout) because of the following reasons. (1) Besides inside-surface connected flaws, no subsurface flaws should exist in the overlaid DMW in order for the DMW to be considered for a 10-year inspection frequency. A subsurface flaw may grow as a result of overlay installation and needs to be monitored. The OWOL takes credit for the outer 25 percent of the wall thickness to support the pipe loads. Therefore, the inspection of the OWOL should be more stringent than that for the FSWOL. Therefore, only a DMW without any surface or subsurface flaws is allowed to be not inspected during the first or second refueling outage after the OWOL installation. (2) After weld overlay installation, a flaw that was not detected during the pre-installation examination may occur in the overlaid DMW and may be detected by the acceptance or preservice examination. In this case, the flaw may be allowed to remain in service in the OWOL or original DMW per the requirements of acceptance and preservice examinations. Therefore, the post-overlay acceptance and preservice examinations should be included in Inservice Examination Item (2) above to ensure that the overlaid DMW contains no planar flaws in order for the weld to be eligible for a 10-year inspection frequency.

(d) Inservice Examination Item (3) should be revised to read "...For welds whose pre-overlay examination, post-overlay acceptance examination, or preservice examination reveal planer flaws, the examination volume in Fig. A2-2 shall be ultrasonically examined once during the first or second refueling outage following application of the optimized weld overlay..." The reason for the staff suggested wording and removal of "inside surface connected" is the same as above Question 4(c).

(e) Inservice Examination Items (2) and (3) allow the OWOL to be placed in a sample inspection where 25 percent of the population (a total of 4 DMWs) will be examined once each inspection interval. The NRC staff thinks that all DMWs with OWOL need to be examined once per inspection interval and should not be placed in a sample inspection population. If a flaw develops in the outer 25 percent wall thickness region of the original DMW, the OWOL's ability to maintain the pressure boundary may be reduced because the OWOL by itself cannot support the pipe loading without taking credit for 25 percent wall thickness of the base metal. Therefore, all DMWs with OWOLs need to be inspected periodically.

(f) Inservice Examination Item (1) requires that "...The weld overlay inspection interval shall not be greater than the life of the overlay as determined in A1.3(a) above..." Section A1.3 is in Attachment 1 of the relief request submital, but Section A1.3(a) does not exist. Also, Section A1.3 discusses inspectability considerations--not inspection intervals. Please clarify the reference of A1.3(a).

(g) Inservice Examination Item (5) requires that "...If a planar circumferential flaw is detected in the outer 50 percent of the base material thickness or if a planar axial flaw is detected in the outer 25 percent of the base material thickness, it shall meet the design analysis requirements of A2.2...." Please explain the above requirement in detail, specifically the design analysis requirements of A2.2. For example, explain how a planar flaw that occurs in the outer 50 percent of the base metal meets the design analysis requirements of A2.2. Clarify whether the subject planar flaw is a subsurface flaw or an inside-surface connected flaw.

5. Your Response to 1.18.1.a—Temper bead weld area on ferritic material

(a) In response to Question 1.18.1.a, you stated that two or more residual stress analyses of different surface areas over the ferritic material will be prepared. (1) Provide the dimensions of the weld surface areas on the ferritic base metal that will be modeled in the residual stress analysis. (2) Discuss whether the analyzed weld surface areas bound the weld surface area on the ferritic material for the actual installed OWOL. (3) Please provide drawings of the weld overlay design including overlay dimensions on the reactor coolant pump discharge and suction nozzle and pipe configuration (the safe end and elbow). The drawing should identify where the weld overlay begins and ends on the pump discharge and suction pipe with proper dimensions.

(b) In the original submittal dated January 30, 2009, you proposed a weld surface area on ferritic metal of 600 square inches. In the revised submittal dated July 13, 2009, the weld surface area is increased to 700 square inches. You referenced Electric Power Research Institute (EPRI) Report 1011898, November 2005, as the technical basis. EPRI did not perform a stress analysis based on 700 square inch area. However, EPRI concluded that users may justify repairs beyond 500 square inches by additional analysis and evaluation. The NRC staff is concerned with the potential for distortion; additional stresses imposed on the pipe, elbow and nozzle; changes to the microstructure of the base metal (formation of martensite); and other detrimental impact on the base metal. To demonstrate the acceptability of the proposed 700 square inches of weld area on the subject pipe configuration using ambient temperature temper bead welding, the licensee may propose the following options:

(1) Provide information that show favorable operating experience for similar weld overlays that have been installed in the field. The licensee may use applicable operating experience from outside of nuclear power plants, e.g., fossil power plants, natural gas pipe lines, chemical plants, and refinery plants; (2) Provide information from mockups that show favorable stress conditions and acceptable overlay product; or (3) Perform a finite element analysis that is similar to the analysis performed by EPRI in its qualification of the 100 and 300 square-inch weld areas to show favorable stress distribution and no distortion.

(c) In response to 1.18.a, you stated that "...This [stress analysis for the 700 square inch area] summary document will reference the calculations from which the residual stress and radial displacement information is extracted and will be forwarded to the NRC as discussed within Commitment 1 attached to FENOC's correspondence dated January 30, 2009..." As stated in the January 30, 2009, submittal, the reports in Commitment 1 will be submitted to the NRC prior to entry to Mode 4 of operation. The Mode 4 schedule is not adequate because the staff needs the stress analysis information as a basis for its safety evaluation of RR-A32 and RR-A33. Therefore, we request that the analysis that demonstrates the validity of a 700 square inch area be submitted as part of your response to this RAI. The analysis report should include sufficiently detailed information (e.g., assumptions, models, methodology, results, and conclusions).

6. Your Response to 1.21. The proposed revision to paragraph 3.2(a) in Attachment 5 of the relief request is different from the licensee's response to Question 1.21. Also, there is a typographical error in the alternative ("though-base-metal position" should be "through-base-metal position"). The same typographical error appears in RR-A33, Attachment 2.

7. Section A2.2, Residual Stress Analysis, Item (1) states that "...The resulting residual stresses on the inside surface over the entire length of primary water stress-corrosion cracking (PWSCC) susceptible material under the optimized weld overlay shall be less than or equal to 10,000 pounds per square inch tensile..."

ASME Code, Section XI, Code Case N-770 (Reference 1) has established that as part of an effective stress improvement mitigation technique, a compressive stress state is required on the wetted surface of all susceptible material used in dissimilar metal (DM) weld applications. This is consistent with the staff position and was developed, in part, due to the uncertainties in precise finite element stress modeling of the wetted surface of DM welds. Further, the staff position was not established to define a stress level at which crack initiation could not occur, but rather to provide a conservative stress value that along with calculated stress levels throughout the volume of the weld will provide a basis for reasonable assurance of structural integrity for a stress improved DM weld. Please provide additional basis, including supporting data, analyses and operational experience, to support allowing a wetted surface stress threshold of 10 ksi.

Reference 1: ASME Code, Section XI, Code Case N-770, Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities Section XI, Division 1, Appendix I.

8. Section A1.5 of RR-A32 Attachment 1 discusses the leak-before-break evaluation with respect to the OWOL. The OWOL have less thickness than the full structural weld overlays (FSWOL). The OWOL is unable, by itself, to satisfy structural integrity design requirements. Instead, the OWOL design requires a portion of the underlying Alloy 82/182 DM weld material to remain intact and carry a portion of the loads. This original weld material is susceptible to cracking. In order to understand potential limitations of OWOLs, the NRC staff has considered the possibility that either the OWOL design or installation process does not perform as expected, or a large pre-existing crack was missed by nondestructive examination (NDE), and a crack grows in the original weld after the OWOL is applied. During initial phases of crack growth, bending and residual stress variations and metallurgical inhomogeneity would lead to uneven growth. However, once a portion of a surface crack grew deep enough to encounter the crack resistant overlay material, it would stop growing in the depth direction at that azimuthal location. Other segments of the crack could continue to grow deeper until they also reach the overlay interface. This could continue until the remaining uncracked ligament of original weld material is insufficient to adequately reinforce the OWOL material, at which point the mitigated weld may fail without prior leakage during a design basis event.

In a FSWOL, the corrosion and PWSCC resistance of the overlay material can be credited to prevent crack growth into the overlay in the event that a large pre-existing crack was missed by NDE, or in the event that design deficiencies or misapplication of the FSWOL resulted in unanticipated tensile residual stress fields. If large cracks occur in the original DM weld material under a FSWOL, the FSWOL can withstand full design loading without failing; the PWSCC resistant material preserves the FSWOL load carrying ability and minimizes the likelihood of pipe rupture. In contrast, if the same deficiency in design or application affects the OWOL, the OWOL material, precisely because it is resistant to PWSCC, can cause small circumferential cracks in the original dissimilar metal weld to grow deep around the entire circumference, in which case the OWOL may become unable to withstand its design loading. In light of this possibility, please explain why application of an OWOL to a DMW is an appropriate mitigation method, and why its application will not invalidate previously approved leak-before- break analyses.

Questions and Comments Related to Relief Request RR-A33 (the FSWOL Design)

9. Your Response to 2.10. Section A1.4(c)(4) of RR-A33 states that "...If 100 percent of the susceptible material is not examined in the pre and post mitigation volume examinations, the inspection frequency of (3) above for cracked items shall be applied with the following exceptions..." Section A1.4(c)(4)(b) states that "...the weld may be placed in the 25 percent inspection sample population as noted in (3) above..." Section (3) referred to in the above statements does not provide inspection frequency nor sample inspection requirements. Please verify whether Section (3) in the aforementioned statements is correct.

10. Section 1.4(c)(1) of RR-A33 should be revised to read: "...For welds whose pre-overlay examination, post-overlay acceptance examination, or preservice examination did not reveal any planer flaws, the welds shall be placed into a population of full structural weld overlays to be examined on a sample basis..."

11. Section 1.4(c)(1) (2) of RR-A33 should be revised to read: "...For welds whose pre-overlay examination, post-overlay acceptance examination, or preservice examination reveal planar flaws, or for which a pre-overlay examination was not performed, the weld overlay shall be ultrasonically examined during the first or second refueling outage following application...."

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

October 8, 2009

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 September 29, 2009, it was agreed that you would provide a response within 45 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,

/RA/

Stephen P. Sands, 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

DISTRIBUTION:
PUBLIC LPL3-2 R/F
RidsNrrPMDavis-BesseResource
RidsAcrsAcnw_MailCTR Resource
RidsRgn3MailCenter Resource
RidsNrrDorlLpl3-2 Resource
RidsNrrLATHarris Resource
RidsOgcRp Resource
RidsNrrDorlDpr Resource

ADAMS Accession No. ML092720591 NRR-088

OFFICE	LPL3-2/PM	LPL3-2/LA	LPL3-2/BC
NAME	SSands	THarris	SCampbell
DATE	10/2/09	10/01/09	10/8/09

OFFICIAL RECORD COPY