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

April 9, 2010

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 1 – CORRECTIONS OF TYPOGRAPHICAL ERRORS RE: AMENDMENT NO. 281 AND SAFETY EVALUATION (TAC NO. ME2310)

Dear Mr. Allen:

On March 24, 2010, the U.S. Nuclear Regulatory Commission issued Amendment No. 281 to Facility Operating License No. NPF-3 for the Davis-Besse Nuclear Power Station, Unit 1 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML100640506). The amendment approved changes to the current licensing basis for Davis-Besse Nuclear Power Station, Unit 1 (DBNPS) associated with the leak-before-break (LBB) evaluation for the reactor coolant pump suction and discharge nozzle dissimilar metal welds.

FirstEnergy Nuclear Operating Company staff subsequently identified typographical errors in the Amendment and repspective safety evaluation. Specifically, the corrections are as follows:

Amendment No. 281 to NPF-3, page 1, Section 2, the last sentence should read "September 28, 2009..." and not "September 28, 2010...." Safety Evaluation, page 3, Section 3.2, first paragraph, "electronic e-mail dated" has been added in from of the statement "December 15, 2009 (ADAMS Accession No. ML100040016)..." to clarify that it is an e-mail and not a letter. Safety Evaluation, page 8, 5th paragraph, first sentence, the word "incorpor+ated" should read "incorporate." Safety Evaluation, page 11, first paragraph: second full sentence should read "have performed any..." and not "has perform any...." Safety Evaluation, page 11, 6th paragraph, last sentence should read "maximum number of crack sizes..." and not "maximum number of crack size...". Safety Evaluation, page 13, Section 3.3.6, Item (1), 2nd sentence should read "SRP Section 3.6.3" and not "SPR Section 3.6.3." Safety Evaluation, page 14, Section 5.0, instances of the word "amendments" have been changed to "amendment." Safety Evaluation, page 16, Section 7.0, 2nd paragraph, last sentence should read "issuance of the amendment..." and not "issuance of the amendments...."

The NRC staff determined that these typographical errors were inadervently introduced. The proposed corrections do not change any of the conclusions in the safety evaluation associated with the amendment and does not affect the associated notice to the public.

Corrected Amendment No. 281 to NPF-3 page 1 and safety evaluation pages 3, 8, 11, 13, 14 and 16 are enclosed. If you or your staff have any questions, please call me at 301-415-3867

Sincerely,

Michael Mahoney, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-346

Enclosures:
Amendment No. 281 to NPF-3

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ENCLOSURE

CORRECTED PAGE 1 OF AMENDMENT NO. 281

FACILITY OPERATING LICENSE NO. NPF-3

DAVIS-BESSE NUCLEAR POWER STATION, UNIT 1

-AND-

CORRECTED PAGES 3, 8, 11, 13, 14 AND 16 OF SAFETY EVALUATION

FIRSTENERGY NUCLEAR OPERATING COMPANY

DOCKET NO. 50-346

DAVIS-BESSE NUCLEAR POWER STATION,

UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 281
License No. NPF-3

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by FirstEnergy Nuclear Operating Company (FENOC, the licensee), dated September 28, 2009, as supplemented by letter dated January 20, 2010, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended to authorize revision of the current licensing basis for Davis-Besse Nuclear Power Station, Unit 1, as set forth in the application for amendment by the licensee; dated September 28, 2009, as supplemented by letter dated January 20, 2010.

weld overlay installation on the LBB-approved RCP piping changes, the piping geometry, and the design basis of the original LBB evaluation. SRP Section 3.6.3 specifies that the worst loads should be applied to the worst pipe location(s) to demonstrate that safety margins in SRP Section 3.6.3 are satisfied. Normally, a LBB evaluation analyzes several pipe locations with the worst load combinations to ensure that all possible worst-case scenarios have been addressed. However, when a weld overlay is installed on a DMW, it is not clear whether the worst-case location with the worst-case load combination in the original LBB evaluation would bound the overlaid DMW. Therefore, licensees will update their original LBB evaluation to show that the design basis is maintained after weld overlay installation (i.e., demonstrate the overlaid DMW satisfies the safety margins). Licensees will revise their Updated Final Safety Analysis Report after receipt of the safety evaluation to document the resolution of this issue.

The RCP suction nozzle is directly welded to a pipe elbow with a DMW without a safe-end. The RCP suction nozzle is made of cast austenitic stainless steel (CASS) with a nominal inside diameter of 28 inches. The elbow is made of carbon steel and its inside surface is clad with stainless steel. The licensee will apply a FSWOL to a portion of the suction nozzle, DMW, and a portion of the elbow.

The RCP discharge nozzle is welded to a stainless steel safe-end with a stainless steel weld. The downstream of the safe-end is welded to the carbon steel pipe elbow with a DMW. The licensee proposed to apply either a FSWOL or OWOL on a portion of the safe-end, DMW and a portion of the elbow. The discharge nozzle will not be covered with the weld overlay.

3.2 Weld Overlay Design

By letter dated January 30, 2009 (ADAMS Accession No. ML090350070), with supplements dated July 13, 2009 (ADAMS Accession No. ML091950627), November 23, 2009 (ADAMS Accession No. ML093360333), and electronic e-mail dated December 15, 2009 (ADAMS Accession No. ML100040016), the licensee submitted Relief Requests RR-A32 and RR-A33 for the OWOL and FSWOL designs, respectively, to be applied on the DMWs of the RCP suction and discharge nozzles.

By letter dated January 21, 2010, the NRC approved Relief Request RR-A33 for the FSWOL design (ADAMS Accession No. ML100080573). By letter dated January 29, 2010, the NRC approved Relief Request RR-A33 for the OWOL design (ADAMS Accession No. ML100271531).

The requirements for the design, stress analyses, crack growth calculations, and examinations of the FSWOL and OWOL are discussed in detail in the above relief requests and respective NRC's safety evaluations. The weld overlay design is discussed herein briefly to demonstrate that PWSCC, an active degradation mechanism affecting the Alloy 82/182 DMW of the subject RCP piping, will be mitigated by the weld overlay and it will no longer be an active degradation mechanism; thereby, the RCP piping will continue to satisfy the screening criteria of SRP 3.6.3.

3.2.1 Weld Overlay Thickness Sizing

The weld overlay thickness affects the critical crack size and leakage calculations in the LBB evaluation. The overlay thickness is derived based on several assumptions and requirements of the American Society of Mechanical Engineers (ASME) Code. The licensee evaluates a postulated or an actual crack in the DMW in accordance with flaw evaluation rules of the ASME Code, Section XI, "Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components."

The licensee derived the Z-factor for the Alloy 82/182 DMW from Reference 4.

The Z-factors for ferritic (carbon steel) base metals and associated weld metals, and for austenitic weld materials fabricated using SMAW or SAW process are derived from the ASME Code, Section XI, Appendix C. For conservatism, the licensee applied the Z-factor for the SAW to the cast austenitic stainless steel RCP casing. The weld overlay is fabricated with the gas tungsten arc welding process with Alloy 52M as the weld metal. This weldment (weld overlay) has high fracture toughness and the Z-factor is 1.0 per the ASME Code, Section XI, Appendix C. The NRC staff finds that the Z-factors used in the updated LBB evaluation are acceptable because they were derived from the ASME Code, Section XI, Appendix C or recognized studies such as Reference 4.

The NRC staff questioned whether internal pressure was actually applied to the crack surface in calculating the flaw stability. In letter dated January 20, 2010, the licensee responded that although the updated LBB evaluation included the terms that could be used for evaluating crack face pressure, crack face pressure was not used in calculating flaw stability or leakage. This is consistent with the net-section-collapse analysis equations that are provided in SRP 3.6.3 and in the ASME Code, Section XI, Appendix C. The NRC staff finds that internal pressure on the crack surface of the DMW and weld overlay does not affect the result significantly. Therefore, the NRC staff does not object that the internal pressure was not applied to the crack face.

The NRC staff asked the licensee to discuss whether the saturated fracture toughness (worst case conditions) of the CASS material of the RCP nozzles was used in the updated LBB evaluation. In letter dated January 20, 2010, the licensee responded that the saturated fracture toughness of the CASS material of the RCP nozzles was used in the updated LBB evaluation in accordance with ASME Section XI Code Case N-481, "Alternative Examination Requirements for Cast Austenitic Pump Casings Section XI, Division 1." The saturated fracture toughness is determined from actual material certified material test reports (CMTRs). The licensee selected the lower bound fracture toughness of the worst DBNPS pump casing considering thermal embrittlement. Using the material properties from the CMTRs, the licensee calculated the saturation impact energy (CVsat) used in determining the J-R curve (J-Integral resistance curves for stable crack growth) and subsequently, the fracture toughness of the CASS material.

The NRC staff approved Code Case N-481 to be used in RG 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 14. ASME annulled Code Case N-481 in March 2004, and the provisions of the code case are incorporated in the ASME Code. Subsequently the code case is not approved for use in RG 1.147, Revision 15. Therefore, Code Case N-481 is no longer permitted to be used. However, the licensee used the lower bound fracture toughness of the worst DBNPS pump casing material heats considering thermal embrittlement. Therefore, the NRC staff finds that the licensee has appropriately considered thermal embrittlement of the CASS RCP nozzles in the flaw stability analysis.

The licensee calculated various critical crack sizes for the FSWOL design from 45 to 58 inches in circumference. For the OWOL design, the licensee calculated various critical crack sizes from 39 inches to 52 inches.

The NRC staff noted that the critical crack sizes (lengths) for the FSWOL are comparable to the critical crack size for the OWOL design for the RCP discharge nozzle. In letter dated January 20, 2010, the licensee explained that at the RCP discharge nozzle, there is little difference in thickness between the weld overlay thicknesses evaluated with the minimum and

calculating leakage in through-wall cracked piping, and has been used in numerous LBB evaluations that the NRC has approved. The licensee stated further that PICEP was verified by comparison to a large number of tests for leakage through cracks. However, the licensee recognizes that neither industry nor the NRC have performed any tests to verify leak rates through weld overlaid pipe or through PWSCC cracked piping. The licensee noted that there may be uncertainties in the leakage calculations associated with LBB, thus, a factor of 10 is applied between the calculated leakage rate and the leakage detection capability in nuclear plants applying LBB.

The licensee stated that it used a crack morphology that was verified by early EPRI/Battelle work to justify the PICEP computer program. The values used provided a good mean prediction of leakage for a large number of tests. NUREG/CR-6004, "Probabilistic Pipe Fracture Evaluations for Leak-Rate Detection Applications," NRC, April 1995, provides data on microscopic measurements to quantify flow path morphology and is the basis of a modified model that is reasonable for predicting leakage for the overlaid DMW.

The original LBB evaluation assumed fatigue cracking with a crack morphology roughness of 0.000197 with no turns. However, in the updated LBB evaluation, the licensee assumed that the morphology associated with PWSCC crack propagation parallel to the long direction of the dendritic grains would be applicable. The PWSCC crack usually results in various 45 and 90 degree turns as it propagates through the pipe wall thickness. The licensee obtained the following data from the NRC-sponsored research on PWSCC (Reference 6), as input to the leakage calculation.

Local roughness, inches = .000663778
Global roughness, inches = .0044842
Number of 90 degree turns per inch = 150.87
Global flow path length to thickness ratio = 1.009
Global plus local flow path length to thickness ratio = 1.243

The average numbers of turns (reported as 90 degree turns only) for a typical PWSCC crack is 150.87. However, the licensee modified the number of turns to derive the effective (equivalent) number of turns based on the crack opening displacement and roughness to simulate the total path fluid flow resistance in the original DMW and overlay. The licensee also developed equivalent roughness and equivalent flow path length for flow through a complex crack.

The licensee stated that a series of 20 crack sizes were evaluated, so that the relationship between crack size and crack opening displacement will be determined at closely spaced sample points for more accurate interpolation over a range that bounds the crack size of interest. PICEP has a limit of 20 crack sizes between zero and a maximum crack size, so the maximum number is used. The NRC staff finds it is acceptable that the licensee used the maximum number of crack sizes in PICEP.

Under normal operation conditions of the RCP piping, the leakage may occur in a two-phase condition (i.e., a mixture of steam and water) at the exit. The NRC staff asked the licensee to clarify whether the two-phase flow condition has been considered in the leak rate calculation. In letter dated January 20, 2010, the licensee responded that the leakage calculation in PICEP considers flashing to two-phase condition in the crack, such that a two-phase mixture will exist at the exit. In PICEP, the mass flow rate (for example lb/sec) is converted to a volumetric flow rate (gpm) and is output at 200 degrees Fahrenheit (F). The licensee stated that the fluid that leaked

The NRC staff finds that the leakage methodology in the updated LBB evaluation is more up-to-date in its prediction than the leakage methodology used in the original LBB evaluation because of the research that has been performed since the 1980's. PICEP does not provide for leakage through a composite flow path such as flow through the Alloy 82/182 base material and Alloy 52 weld overlay. To address this consideration, the licensee derived a set of input parameters to simulate the composite flow path through the PWSCC portion of the assumed through wall crack in the base metal and fatigue portion of the crack in the weld overlay.

In the 1980's, the NRC staff specified a margin of 10 for leak rates recognizing the uncertainties in the leakage prediction. At present, the NRC staff finds that PICEP is acceptable for the analysis of the overlaid DMW when appropriate crack modeling and conservative input parameters for the crack morphology are used. The NRC staff finds further that the licensee's PICEP input parameters provide a reasonable simulation of flow through the composite flow path assumed for the leakage calculation and are, therefore, acceptable.

3.3.5 Comparison of LBB Evaluations

The licensee compared the leakage flaw sizes calculated by the methodology in the updated LBB evaluation with the leakage flaw sizes calculated in the original LBB evaluation to determine any significant deviations between the two methodologies. The licensee used the method in the updated LBB evaluation to calculate the leakage flaws for the same straight pipe and elbow locations that were the subject of investigation in the original LBB evaluation. The results show that the leakage flaw sizes calculated by the updated LBB methodology are consistently smaller than the leakage flaw size calculated in the original LBB evaluation by approximately 15 percent. The licensee explained that the differences may be attributed to the Ramberg-Osgood parameters used in the updated LBB evaluation, which were not used in the original LBB evaluation. The licensee concludes that the results suggest that the methodology used in the updated LBB evaluation is comparable to the methodology used in the original LBB evaluation. The NRC staff finds that the differences in leakage flaw sizes between the two methodologies are not unexpected considering the differences in input parameters (use of Ramberg-Osgood parameters) and methodology (EPFM vs. limit load).

In terms of critical flaw size methodology, the original LBB evaluation determined critical flaw sizes based on the EPFM method. The updated LBB evaluation used a modified limit load methodology (two different materials) with the application of Z-factors in accordance with the ASME Code, Section XI, Appendix C. The NRC staff finds that the methodology in the updated LBB evaluation has used appropriate input parameters such as material properties and configurations and applied them to an appropriate model. Although uncertainties exist in the leak rate analysis of a composite overlaid DMW configuration, the margin available on leakage compensates for these uncertainties.

3.3.6 Summary

The NRC staff finds the updated DBNPS LBB evaluation acceptable because:

(1) The licensee demonstrated by weld residual stress analysis that the weld overlay will mitigate PWSCC in the DMW. This satisfied the screening criteria of SRP Section 3.6.3.

(2) The critical crack size is more than twice the leakage crack size of the overlaid DMW; therefore, the safety margin of 2 specified by SRP 3.6.3 is satisfied.

(3) The leak rate from the leakage crack size is more than 10 times of the RCS leakage detection system capability of 1 gpm; therefore, the safety margin of 10 on leakage specified by SRP 3.6.3 is satisfied.

(4) The licensee performed a plant-specific and component-specific LBB evaluation and used appropriate input parameters and methodology.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Ohio State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes requirements with respect to installation or use of a facility's components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 FINAL NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION (NSHCD)

The commission may issue the license amendment before the expiration of the 60-day period provided that its final determination is that the amendment involves no significant hazards consideration. This amendment is being issued prior to the expiration of the 60-day period. Therefore, a final finding of no significant hazards consideration follows.

The Commission has made a proposed determination that the amendment request involves no significant hazards consideration. Under the Commission's regulations in 10 CFR 50.92, this means that operation of the facility in accordance with the proposed amendment would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety. As required by 10 CFR 50.91(a), the licensee has provided its analysis of the issue of no significant hazards consideration which is presented below.

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The applicable accident is a Large Break Loss of Coolant Accident (LBLOCA). Since the application of [optimized weld overlays] OWOLs or [full structural weld overlays]

critical flawsize and the leakage flaw size. Although the longer flow path and considerations of crack morphology for the Alloy 82/182 weld location reduces leakage somewhat for a given through-wall flaw, the larger critical flaw size following application of the weld overlay allows for increased leakage margin. The evaluation described above demonstrates that these welds will perform as originally intended and that the adverse effects of PWSCC will be mitigated. Therefore, the proposed LBB update does not involve a significant reduction in a margin of safety. Based on the above, FENOC concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

As documented above, the proposed change does not involve a significant reduction in a margin of safety.

The NRC staff has reviewed the licensee's analysis and based on this review, determined that the three standards of 10 CFR 50.92 are satisfied. Therefore, the NRC staff has determined that the amendment involves no significant hazards consideration.

7.0 CONCLUSION

On the basis of its review of the updated DBNPS LBB evaluation, the NRC staff finds that the licensee has demonstrated that (1) the FSWOL and OWOL will provide favorable compressive stresses in the inner region on the DMW to mitigate potential PWSCC; (2) a margin of more than 10 exists between the calculated leak rate from the leakage flaw size and the detection capability of the RCS leakage detection system; (3) a margin of more than 2 exists between the critical flaw size and the leakage flaw size; (4) input parameters (e.g., loadings and crack morphology) are applied consistent with SRP Section 3.6.3; and (5) the methodology is adequate. Therefore, the RCP discharge and suction nozzles with associated DMWs exhibit LBB behavior consistent with the guidance in SRP Section 3.6.3, Revision 1. Pursuant to GDC-4 of Appendix A to 10 CFR Part 50, the NRC staff concludes that the licensee is permitted to continue to exclude consideration of the dynamic effects associated with the postulated rupture of the RCP discharge and suction nozzles from the current licensing basis at DBNPS.

The Commission has concluded, based on the considerations discussed above, that; (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner; (2) such activities will be conducted in compliance with the Commission's regulations; and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

8.0 REFERENCES

1. "Materials Reliability Program: Technical Basis for Preemptive Weld Overlays for Alloy 82/182 Butt Welds in PWRs (MRP-169)," Rev. 1, EPRI, Palo Alto, CA, and Structural Integrity Associates, Inc., San Jose, CA: 2008. 1012843.

2. "Materials Reliability Program: Crack Growth Rates for Evaluating Primary Water Stress-Corrosion Cracking (PWSCC) of Alloy 82, 182, and 132 Welds (MRP-115)," EPRI, Palo Alto, CA, 2004, 1006696.

Corrected Amendment No. 281 to NPF-3 page 1 and safety evaluation pages 3, 8, 11, 13, 14 and 16 are enclosed. If you or your staff have any questions, please call me at 301-415-3867

Sincerely,
/RA/

Michael Mahoney, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-346

Enclosures:
Amendment No. 281 to NPF-3

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ADAMS Accession No. ML100970549 NRR-106

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