FENOC
FirstEnergy Nuclear Operating Company

Davis-Besse Nuclear Power Station
5501 N. State Route 2
Oak Harbor, Ohio 43449

July 5, 2012
L-12-225

10 CFR 54

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT:
Davis-Besse Nuclear Power Station, Unit No. 1
Docket No. 50-346, License Number NPF-3
Supplemental Reply to Request for Additional Information for the Review of the Davis-Besse Nuclear Power Station, Unit No. 1, License Renewal Application (TAC No. ME4640) and License Renewal Application Amendment No. 27

By letter dated August 27, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102450565), FirstEnergy Nuclear Operating Company (FENOC) submitted an application pursuant to Title 10 of the *Code of Federal Regulations*, Part 54 for renewal of Operating License NPF-3 for the Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse). During a telephone conference with the NRC held on June 21, 2012, the NRC requested clarification regarding NRC request for additional information (RAI) 4.7.5.1-1.

The Attachment provides the FENOC supplemental reply to NRC RAI 4.7.5.1-1. A discussion of the NRC request is shown in bold text followed by the FENOC response. The Enclosure provides Amendment No. 27 to the Davis-Besse LRA.

There are no regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Clifford I. Custer, Fleet License Renewal Project Manager, at 724-682-7139.

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 5, 2012.

Sincerely,

KWByrd

Kendall W. Byrd
Director, Site Engineering

A145
NRR

Attachment:

Supplemental Reply to Request for Additional Information for the Review of the Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse), License Renewal Application, Section 4.7.5.1

Enclosure:

Amendment No. 27 to the Davis-Besse License Renewal Application

cc: NRC DLR Project Manager (2 copies)
NRC Region III Administrator

cc: w/o Attachment or Enclosure
NRC DLR Director
NRR DORL Project Manager
NRC Resident Inspector
Utility Radiological Safety Board

<u>Section 4.7.5.1</u>

Question RAI 4.7.5.1-1 Supplement

The Nuclear Regulatory Commission (NRC) initiated a telephone conference call with FirstEnergy Nuclear Operating Company (FENOC) on June 21, 2012, to discuss time-limited aging analyses (TLAAs) associated with the Reactor Coolant System (RCS) Loop 1 cold leg drain line weld overlay as documented in Davis-Besse License Renewal Application (LRA) Section 4.7.5.1, "Reactor Coolant System Loop 1 Cold Leg Drain Line Weld Overlay Repair."

The NRC noted that in response to RAI 4.7.5.1-1, FENOC cited a summary calculation package that was prepared to document the design and analysis of the Davis-Besse reactor coolant pump 1-1 inlet cold leg drain line nozzle-to-elbow weld overlay. This summary calculation package was submitted by FENOC letter dated May 22, 2006 (ML061440282). In this package were summaries of an American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Section III evaluation (Calculation Number DB-06Q-304, Rev. 1) and a fatigue crack growth analysis (Calculation Number DB-06Q-307, Rev. 0). LRA Section 4.7.5.1 only identified the ASME Code Section III evaluation as a TLAA. The NRC's position is that the fatigue crack growth analysis is also a TLAA requiring disposition for license renewal.

FENOC agreed to provide a supplemental response to RAI 4.7.5.1-1 to disposition the TLAA associated with the fatigue crack growth analysis.

RESPONSE RAI 4.7.5.1-1 SUPPLEMENT

With respect to the potential for flaw growth, the reactor coolant pump 1-1 inlet cold leg drain line nozzle-to-elbow weld overlay is designed as a standard overlay (full structural) assuming a 360-degree flaw through the original pipe wall. As such, no credit is taken for any of the original pipe wall. The overlay material is Alloy 52, which is resistant to stress-corrosion cracking, and as such, flaw growth into the overlay by this mechanism is not expected. The presence of compressive residual stresses on the inside of the component after the overlay application also mitigates stress-corrosion cracking and minimizes fatigue crack growth into the overlay.

A fatigue crack growth analysis [Structural Integrity Associates Calculation DB-06Q-307, Rev. 0, "Predicting Crack Growth for the DB Unit 1 RCP 1-1 Cold Leg Drain Nozzle With Design Weld Overlay," May 18, 2006] was performed to demonstrate that flaws equal to, or greater than, the maximum flaw sizes that could have escaped detection during the performance of the ultrasonic examinations would not grow unacceptably in the nozzle, so as to undermine the basis for the weld overlay. The dissimilar metal weld (DMW) contained an axial indication in the nozzle weld butter material (Alloy 182) for which no qualified depth sizing was performed. However, supplemental examinations confirmed that the indication was not present in the outer two-thirds of the wall thickness. Therefore, a flaw depth of one-third of the wall thickness was assumed for the axial and circumferential crack growth evaluation. Stress intensity factors (K) versus flaw depth were computed for three paths through the original DMW and butter, for both axial and circumferential cracks (six cases). For all six crack growth cases, no fatigue or PWSCC growth was predicted, as both K_{max} and K_{min} were negative for an assumed initial flaw size of one-third of the original base metal thickness.

Plant design cycles multiplied by a factor of 1.5 were used as an input to the structural weld overlay fatigue crack growth analysis. Therefore, the fatigue crack growth analysis is a time-limited aging analysis that requires disposition for license renewal. FENOC performed a comparison of the design cycles (original design cycles multiplied by a factor of 1.5) that were used in the fatigue crack growth analysis to the 60-year projected cycles provided in LRA Table 4.3-1, "60-Year Projected Cycles," and determined that the analyzed cycles bound the 60-year projected cycles. Therefore, the fatigue crack growth analysis associated with the RCS Loop 1 cold leg drain structural weld overlay remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

LRA Table 4.1-1, "Time-Limited Aging Analyses," and Sections 4.7.5.1 and A.2.6.1, both titled "Reactor Coolant System Loop 1 Cold Leg Drain Line Weld Overlay Repair," are revised consistent with this response.

See the Enclosure to this letter for the revision to the Davis-Besse LRA.

Enclosure

Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse)

Letter L-12-225

Amendment No. 27 to the
Davis-Besse License Renewal Application

Page 1 of 6

License Renewal Application
Sections Affected

Table 4.1-1

Section 4.7.5.1

Section A.2.6.1

The Enclosure identifies the change to the License Renewal Application (LRA) by Affected LRA Section, LRA Page No., and Affected Paragraph and Sentence. The count for the affected paragraph, sentence, bullet, etc. starts at the beginning of the affected Section or at the top of the affected page, as appropriate. Below each section the reason for the change is identified, and the sentence affected is printed in *italics* with deleted text ~~*lined-out*~~ and added text <u>*underlined*</u>.

Affected LRA Section	**LRA Page No.**	**Affected Paragraph and Sentence**
Table 4.1-1	**Page 4.1-4**	**"RCS Loop 1 Cold Leg drain line weld overlay repair" row, "54.21(c)(1) Paragraph" column**

In the supplemental response to request for additional information (RAI) 4.7.5.1-1, the "RCS Loop 1 Cold Leg drain line weld overlay repair" row, "54.21(c)(1) Paragraph" column of LRA Table 4.1-1, "Time-Limited Aging Analyses," is revised as follows:

Table 4.1-1 Time-Limited Aging Analyses

Results of TLAA Evaluation by Category	**54.21(c)(1) Paragraph**	**LRA Section**
Other Plant-Specific Time-Limited Aging Analyses		4.7
RCS Loop 1 Cold Leg drain line weld overlay repair	*(i) and (iii)*	4.7.5.1

Affected LRA Section	LRA Page No.	Affected Paragraph and Sentence
4.7.5.1	**Pages 4.7-5 and 4.7-6**	**Paragraph 2, and new Disposition**

In the supplemental response to RAI 4.7.5.1-1, LRA Section 4.7.5.1, "Reactor Coolant System Loop 1 Cold Leg Drain Line Weld Overlay Repair," is revised to read as follows:

4.7.5.1 Reactor Coolant System Loop 1 Cold Leg Drain Line Weld Overlay Repair

FENOC performed a full structural overlay repair for an axial indication found on the Reactor Coolant System Loop 1 cold leg drain line during the Cycle 14 refueling outage. The structural weld overlay of the cold leg drain nozzle was designed consistent with the requirements of ASME Section XI; Code Case N-504-2; non-mandatory Appendix Q; and was supplemented by additional design considerations specific to the unique nature of the geometry and materials of the cold leg drain nozzle-to-elbow weld.

Fatigue Crack Growth Analysis

~~*The overlay is designed as a full structural overlay that assumes the as-found flaw propagates to a 100% through-wall 360-degree crack rather than performing a crack growth analysis of the as-found flaw. Thus there is no time dependency in the weld overlay design.*~~

With respect to the potential for flaw growth, the reactor coolant pump 1-1 inlet cold leg drain line nozzle-to-elbow weld overlay is designed as a standard overlay (full structural) assuming a 360-degree flaw through the original pipe wall. As such, no credit is taken for any of the original pipe wall. The overlay material is Alloy 52, which is resistant to stress-corrosion cracking, and as such, flaw growth into the overlay by this mechanism is not expected. The presence of compressive residual stresses on the inside of the component after the overlay application also mitigates stress-corrosion cracking and minimizes fatigue crack growth into the overlay.

A fatigue crack growth analysis was performed to demonstrate that flaws equal to, or greater than, the maximum flaw sizes that could have escaped detection during the performance of the ultrasonic examinations would not grow unacceptably in the nozzle, so as to undermine the basis for the weld overlay. The dissimilar metal weld (DMW) contained an axial indication in the nozzle weld butter material (Alloy 182) for which no qualified depth sizing was performed.

However, supplemental examinations confirmed that the indication was not present in the outer two-thirds of the wall thickness. Therefore, a flaw depth of one-third of the wall thickness was assumed for the axial and circumferential crack growth evaluation. Stress intensity factors (K) versus flaw depth were computed for three paths through the original DMW and butter, for both axial and circumferential cracks (six cases). For all six crack growth cases, no fatigue or PWSCC growth was predicted, as both K_{max} and K_{min} were negative for an assumed initial flaw size of one-third of the original base metal thickness.

Plant design cycles multiplied by a factor of 1.5 were used as an input to the structural weld overlay fatigue crack growth analysis. Therefore, the fatigue crack growth analysis is a time-limited aging analysis that requires disposition for license renewal. FENOC performed a comparison of the design cycles (original design cycles multiplied by a factor of 1.5) that were used in the fatigue crack growth analysis to the 60-year projected cycles provided in LRA Table 4.3-1 and determined that the analyzed cycles bound the 60-year projected cycles. Therefore, the fatigue crack growth analysis associated with the RCS Loop 1 cold leg drain structural weld overlay remains valid for the period of extended operation.

Disposition: *10 CFR 54.21(c)(1)(i)* *The fatigue crack growth analysis associated with the RCS Loop 1 cold leg drain structural weld overlay remains valid for the period of extended operation.*

Fatigue Analysis

The fatigue analysis for the repaired configuration conservatively estimated cycles for 60 years at 1.5 times the original design cycles. Because this analysis is based on a specific number of cycles, it is a TLAA. The Fatigue Monitoring Program manages the effects of fatigue on the reactor coolant system drain line weld overlay repair by counting the thermal cycles incurred through the period of extended operation.

Disposition: 10 CFR 54.21(c)(1)(iii) The effects of fatigue on the reactor coolant system cold leg drain line nozzle weld overlay repair will be managed for the period of extended operation by the Fatigue Monitoring Program.

Affected LRA Section	**LRA Page No.**	**Affected Paragraph and Sentence**
A.2.6.1	**Page A-46**	**Paragraph 2**

In the supplemental response to RAI 4.7.5.1-1, LRA Section A.2.6.1, "Reactor Coolant System Loop 1 Cold Leg Drain Line Weld Overlay Repair," is revised to read as follows:

A.2.6.1 Reactor Coolant System Loop 1 Cold Leg Drain Line Weld Overlay Repair

A full structural overlay repair was performed for an axial indication found on the Reactor Coolant System Loop 1 cold leg drain line during the Cycle 14 refueling outage. The structural weld overlay of the cold leg drain nozzle was designed consistent with the requirements of ASME Section XI; Code Case N-504-2; Non-mandatory Appendix Q; and was supplemented by additional design considerations specific to the cold leg drain nozzle-to-elbow weld.

Fatigue Crack Growth Analysis

~~*The overlay is designed as a full structural overlay that assumes the as-found flaw propagates to a 100% through-wall 360-degree crack rather than performing a crack growth analysis of the as-found flaw. Thus there is no time dependency in the weld overlay design.*~~

With respect to the potential for flaw growth, the reactor coolant pump 1-1 inlet cold leg drain line nozzle-to-elbow weld overlay is designed as a standard overlay (full structural) assuming a 360-degree flaw through the original pipe wall. As such, no credit is taken for any of the original pipe wall. The overlay material is Alloy 52, which is resistant to stress-corrosion cracking, and as such, flaw growth into the overlay by this mechanism is not expected. The presence of compressive residual stresses on the inside of the component after the overlay application also mitigates stress-corrosion cracking and minimizes fatigue crack growth into the overlay.

A fatigue crack growth analysis was performed to demonstrate that flaws equal to, or greater than, the maximum flaw sizes that could have escaped detection during the performance of the ultrasonic examinations would not grow unacceptably in the nozzle, so as to undermine the basis for the weld overlay. The dissimilar metal weld (DMW) contained an axial indication in the nozzle weld butter material (Alloy 182) for which no qualified depth sizing was performed. However, supplemental examinations confirmed that the indication was not present in the outer two-thirds of the wall thickness. Therefore, a flaw depth of *one-third of the wall thickness was assumed for the axial and circumferential crack growth evaluation. Stress intensity factors (K) versus flaw depth were computed for three paths through the original DMW and butter, for both axial and circumferential cracks (six cases). For all six crack growth cases, no fatigue or PWSCC growth was predicted, as both K_{max} and K_{min} were negative for an assumed initial flaw size of one-third of the original base metal thickness.*

Plant design cycles multiplied by a factor of 1.5 were used as an input to the structural weld overlay fatigue crack growth analysis. Therefore, the fatigue crack growth analysis is a time-limited aging analysis that requires disposition for license renewal. FENOC performed a comparison of the design cycles (original design cycles multiplied by a factor of 1.5) that were used in the fatigue crack growth analysis to the 60-year projected cycles provided in LRA Table 4.3-1 and determined that the analyzed cycles bound the 60-year projected cycles. Therefore, the fatigue crack growth analysis associated with the RCS Loop 1 cold leg drain structural weld overlay remains valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

Fatigue Analysis

The fatigue analysis estimated cycles for 60 years based on the original design cycles. Because this analysis is based on a specific number of cycles, it is considered a TLAA. All cumulative usage factors for the reactor coolant pump drain line weld overlay are less than 1.0.

The effects of fatigue on the reactor coolant pump drain line weld overlay repair will be managed by the Fatigue Monitoring Program for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).