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January 28, 2015
L-15-037

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
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. 54

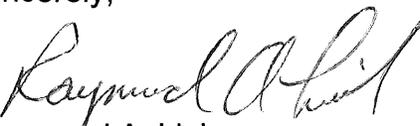
By letter dated August 27, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102450565), FirstEnergy Nuclear Operating Company (FENOC) submitted an application pursuant to Title 10 of the *Code of Federal Regulations*, Part 54 for renewal of Operating License NPF-3 for the Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse). By letter dated December 30, 2014 (ML14353A425), the Nuclear Regulatory Commission (NRC) requested additional information to complete its review of the License Renewal Application (LRA).

The Attachment provides the FENOC reply to the NRC request for additional information. The NRC request is shown in bold text followed by the FENOC response. The Enclosure provides Amendment No. 54 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 January 28th, 2015.

Sincerely,



Raymond A. Lieb

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Attachment:

Reply to Requests for Additional Information for the Review of the Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse), License Renewal Application (LRA), Section B.2.43

Enclosure:

Amendment No. 54 to the Davis-Besse License Renewal Application

cc: NRC DLR Project Manager
NRC Region III Administrator

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

Attachment
L-15-037

Reply to Requests for Additional Information for the Review of the
Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse),
License Renewal Application (LRA),
Section B.2.43
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Question RAI B.2.43-7

Background:

License Renewal Application (LRA) Amendment No. 51 submitted by letter dated July 3, 2014, updated the plant-specific Shield Building Monitoring Program (SBMP) in LRA Section B.2.43 to incorporate the 2013 operating experience of propagation of laminar cracking in the Davis-Besse Nuclear Power Station, Unit 1 (Davis-Besse) shield building. The “operating experience” program element of the updated SBMP described conditions involving propagation of the shield building laminar cracks by ice-wedging identified during a 2013 base line inspection, and states in part:

[...] The condition was not passive; however, it was bounded by design basis documentation. The Shield Building Monitoring Program was changed to ensure conformance with the design requirements and to maintain the [updated safety analysis report (USAR)] functions.

The Shield Building laminar cracking condition has been evaluated with respect to the design basis functions of the Shield Building. The condition is documented in [First Energy Nuclear Operating Company (FENOC)] Calculation C-CSS-099.20-063, as supported by Bechtel Report, “Effect of Laminar Cracks on Splice Capacity of No. 11 Bars based on Testing Conducted at Purdue University and University of Kansas for Davis-Besse Shield Building,” that the Shield Building, “... meets all design requirements specified in USAR and will perform its USAR described design functions.” This analysis bounds the identified changes in the laminar cracking condition from the conditions identified in 2011.

Referencing the Evaluation criteria hierarchy of [American Concrete Institute (ACI)] 349.3R, Figure 5.1, the 2013 condition was determined to be acceptable through evaluation. The condition was not passive; however, it was bounded by design basis documentation. The condition will therefore be subjected to increased monitoring to ensure conformance with the design requirements and USAR functions.

The “acceptance criteria” program element of the updated SBMP, states in part:

Indications of relevant conditions of degradation detected during the inspections will be evaluated and compared to *pre-determined* acceptance

criteria. The acceptance criteria *will be defined* to ensure that the need for corrective actions is identified before loss of structure or component intended functions. If the acceptance criteria are not met, then the indications or conditions will be evaluated under the FENOC Corrective Action Program.

Engineering evaluation by qualified personnel will be used for disposition of inspection findings that do not meet the acceptance criteria.

For core bore inspections, unacceptable inspection findings will include any indication of new cracking or a “discernable change” in previously identified cracks. Any indication of new cracking is defined as a visual inspection finding that visible cracks have developed in core bores that previously had no visible cracks. A discernable change in a previously identified crack is defined as a visual inspection finding that there has been a discernable change in general appearance or in crack width as identified by crack comparator measurement. Conditions to be evaluated following each inspection cycle for determination of “acceptable results” include conformance with the plant design and licensing basis as well as with previously determined crack propagation rates. Comparison with previously determined propagation rates will be to identify any potential changes in the driving force of the condition.

The acceptance criteria for any identified loss of material or change of material properties will be as described in Chapter 5 of ACI Report 349.3R.

The “acceptance criteria” element for plant-specific aging management programs (AMPs) described in NUREG-1800, Revision 2, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants” (SRP-LR), Appendix A.1, “Aging Management Review – Generic (Branch Technical Position RLSB-1)” states, in part:

1. The quantitative or qualitative acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions are evaluated, should ensure that the structure- and component-intended function(s) are maintained consistent with all current licensing basis (CLB) design conditions during the period of extended operation. The program should include a methodology for analyzing the results against applicable acceptance criteria.

For example, carbon steel pipe wall thinning may occur under certain conditions due to [flow accelerated corrosion (FAC)]. An AMP for FAC may consist of periodically measuring the pipe wall thickness and comparing that to a specific minimum wall acceptance criterion.

Corrective action is taken, such as piping replacement, before deadweight, seismic, and other loads, and this acceptance criterion must be appropriate to ensure that the thinned piping would be able to carry these CLB design loads. This acceptance criterion should provide for timely corrective action before loss of intended function under these CLB design loads.

2. Acceptance criteria could be specific numerical values, or could consist of a discussion of the process for calculating specific numerical values of conditional acceptance criteria to ensure that the structure- and component-intended function(s) will be maintained under all CLB design conditions. Information from available references may be cited.

Issue:

The staff identified the following concerns:

- The primary structural concern of the laminar cracking and its propagation with regard to the capability of the shield building to perform its intended functions is the potential loss of bond between the concrete and the rebar at the location of the laminar cracks and the ability for stress transfer to take place between the concrete and the rebar. This would be a function of the laminar crack width and length (or planar limit) along the rebar or rebar lap-splice. In this regard, it is not clear to the staff what quantitative (numerical) limits of laminar cracking characteristics [i.e., crack width, crack length (or planar limit), number of locations, and distribution, etc.] is bounded by the design basis documentation referenced in the SBMP to determine the need for corrective actions (e.g., re-evaluation of design basis documentation, repair, etc.).
- The “acceptance criteria” program element of the SBMP specifies that the core bore inspection findings on the concrete laminar cracking be compared and evaluated against two sets of pre-determined criteria to identify the need for corrective actions prior to loss of structure or component intended functions. These criteria include: (1) whether the laminar cracking is not passive (i.e., indications of new cracking, discernible change in previously identified cracks, or changes in previously determined crack propagation rates), and (2) whether the overall observed conditions are bounded by evaluations in the plant design and licensing basis documentation. With regard to the second case, the program does not appear to provide pre-determined quantitative acceptance criteria against which quantitative inspection findings can be compared and evaluated to determine the need for corrective actions (e.g., re-evaluation of design basis documentation, repair, etc.).

- Chapter 5 of ACI 349.3R does not provide quantitative acceptance criteria applicable to concrete laminar cracking. It is not clear to the staff how the evaluation criteria hierarchy in Figure 5.1 of ACI 349.3R will be applied to the core hole inspection findings of concrete laminar cracking from the SBMP considering that only qualitative criteria related to whether laminar cracks are active or passive is available from Chapter 5 ACI 349.3R that would apply to laminar cracking.

Request:

1) Considering the discussion in the “Issue” section related to implementation of the “acceptance criteria” program element of the SBMP, provide additional information as below.

a) Provide information of quantitative (numerical) acceptance criteria for the shield building laminar cracking defined by bounding limits of laminar cracking characterized in terms of crack width, crack length (or planar limit), distribution, and/or any other appropriate parameters. This information may cite applicable references and should include the quantitative criteria against which the core hole inspection findings are compared and evaluated to determine (i) if the condition is bounded by and conforms to the design basis documentation referenced in the AMP (e.g., FENOC calculation C-CSS-099.20-063), and (ii) if corrective actions (e.g., re-evaluation of design basis documentation, repair, etc.) are needed to ensure that the structure and component intended functions are maintained consistent with all CLB design conditions during the period of extended operation. Update the SBMP accordingly.

Or,

b) Alternatively, if the quantitative acceptance criteria for laminar cracking requested in Request (a) above is conditional, provide a sufficient discussion and basis of the process(es) for developing specific numerical values of the acceptance criteria against which the core hole inspection findings are compared and evaluated to determine (i) if the condition is bounded by and conforms to the design basis documentation referenced in the AMP (e.g., FENOC calculation C-CSS-099.20-063), and (ii) if corrective actions (e.g., re-evaluation of design basis documentation, repair, etc.) are needed to ensure that the structure and component intended functions are maintained consistent with all CLB design conditions during the period of extended operation. Update the SBMP accordingly.

2) Explain how the evaluation criteria hierarchy in Figure 5.1 of ACI 349.3R will be applied to the core hole inspection findings of laminar cracking from the SBMP to determine whether or not the condition is acceptable after evaluation.

RESPONSE RAI B.2.43-7

- 1) LRA Section B.2.43, "Shield Building Monitoring Program," subsection titled "Acceptance Criteria," is revised to include the following acceptance criteria for core bore inspections of the Shield Building walls:
- a) Maximum crack width is 0.013 inch.
 - b) Maximum circumferential laminar crack planar limits (in percent, rounded to nearest whole number) are identified by Region (elevation) of the structure, as shown in the following table. Percentage values provided are derived with respect to the entire Region surface area (vertical elevation x circumference). Regions 1 and 4 are identified as 0% cracked for the purposes of comparison to surface area. It is acknowledged that minor cracking exists in Region 4 that is negligible when compared to the Region 4 surface area; this minor cracking is accounted for within Calculation C-CSS-099.20-063, "Shield Building Design Calculation," Revision 1.

REGION	ELEVATION (FT)	PLANAR LIMIT (%)
1	801.0 – 812.75	0
2	774.5 – 801.0	70
3	643.0 – 774.5	20
4	565.0 – 643.0	0

Distribution of splices and crack length and width in relation to splice location is not considered an acceptance criteria parameter. The design calculation reflects the results from the University test programs for the design basis capacity of the exterior hoop reinforcing steel as discussed in Section 3.1 of the calculation. However, the testing programs neglected the Shield Building design of staggered lap splices, and developed laminar cracks along the complete length of non-staggered reinforcement splices. Therefore, based on the staggered lap splice design of the Shield Building, the testing programs were bounding and conservative. The structure retains this margin between test programs and as-built condition.

These values for acceptance criteria are bounding values from Calculation C-CSS-099.20-063, "Shield Building Design Calculation." If the acceptance criteria

are not met, then the indications or conditions will be evaluated under the FENOC Corrective Action Program (e.g., re-evaluation of design basis documentation, repair, etc.). Supplemental information regarding laminar cracking and the Shield Building design is located in the Davis-Besse Updated Final Safety Analysis Report (UFSAR), Appendix 3E, "New Design Evaluation of Shield Building Considering Effects of Laminar Cracking."

- 2) American Concrete Institute (ACI) Report 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures," provides guidance on the evaluation of existing nuclear structures for the purposes of condition determination and functionality (ACI 349.3R Chapter 1). Chapter 5 of this document provides guidance on the evaluation of conditions identified. As shown in Figure 5.1, a three-tiered hierarchy is presented. Since the Davis-Besse Shield Building laminar cracking condition is not passive at this time, Sections 5.1 and 5.2 are not applicable, and the structure was placed into the Figure 5.1 category of "CONDUCT FURTHER ENHANCED INSPECTIONS, TESTING AND ANALYSES," under the guidance of Section 5.3.

Inspections and analysis of the structure were completed as described in Section 5.3, inclusive of university research testing and calculations. FENOC has concluded that the structural adequacy is acceptable for the as-found condition. This conclusion is documented in Calculation C-CSS-099.20-063, and places the structure in the "ACCEPT CONDITION WITHOUT FURTHER EVALUATION" conclusion of Figure 5.1 for the current condition.

Because the condition is currently considered 'not passive' and changing over time, the Shield Building is subject to the ongoing monitoring of the Shield Building Aging Management Program during the period of extended operation. This program was previously revised to monitor bores at an increased frequency. Inspection findings will continue to be evaluated under the FENOC Corrective Action Program when conditions adverse to quality are identified.

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

Question RAI B.2.43-8

Background:

The applicant's response to RAI B.2.43-5 (followup) by letter dated October 28, 2014 states, in part: "FENOC is monitoring the crack size, shape and progression by use of 23 strategically-selected core bores, 3 of which were chosen to monitor the leading edge of crack propagation; these 23 bores is representative of the

remaining cracked areas.” The applicant’s response also includes discussion that the bore holes are examined for changes in crack width and any previously identified changes to the width will have been entered into the Corrective Action Program.

Issue:

It is not clear to the staff if the representative sample of 23 core bore holes to be inspected during the period of extended operation includes and tracks core bore holes with worst-case observed crack widths.

Request:

Clarify if core bore holes with worst-case observed laminar crack widths to-date are also included in the representative sample of 23 core bore holes that will be monitored during the period of extended operation to determine if the condition is bounded by the design basis documentation referenced in the AMP. If so, provide the number of such core holes included in the sample and the basis for this number/sample size. If not, provide a basis for their exclusion.

RESPONSE RAI B.2.43-8

The core bore hole with the worst case observed laminar crack width to-date is included in the representative sample of the 23 core bore holes that will be monitored in the period of extended operation. Bore F5-791.0-4 was installed as part of the initial condition investigation in 2011, and was identified as being in an area of laminar cracking. The approximate crack width was recorded at 0.013 inch; this value was, and is, the largest recorded width. Bore F5-791.0-4 is included in the current Long Term Monitoring inspection program as currently governed by Inspection Procedure EN-DP-01511, “Design Guidelines for Maintenance Rule Evaluation of Structures,” and is therefore included within the population of 23 bores to be inspected by the Shield Building Monitoring Program during the period of extended operation.

The current monitoring program includes inspection of 14 bore locations with identified laminar cracking, with crack width sizes as follows:

APPROXIMATE CRACK WIDTH	POPULATION
≤ 0.005 inch	8
0.006-0.009 inch	3
≥0.010 inch	3

Crack width was a parameter inherent to the reinforcement bond and splice evaluations completed at the University of Kansas and Purdue University, and is therefore treated as a limiting parameter. Crack width is monitored for a “discernable change” in general appearance and width as described in the Shield Building Monitoring Program. Crack width is recorded on each bore inspection form, which is retained under the FENOC records management program, and added to site drawings to facilitate trending. The selection of these bores was based on the prevalence of cracking as discussed in the responses to requests for additional information B.2.43-2 and B.2.43-2a.

Enclosure

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

Letter L-15-037

**Amendment No. 54 to the
Davis-Besse License Renewal Application**

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**License Renewal Application
Section Affected**

B.2.43

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 *underlined*.

<u>Affected LRA Section</u>	<u>LRA Page No.</u>	<u>Affected Paragraph and Sentence</u>
B.2.43	Page B-166	Acceptance Criteria

In response to RAI B.2.43-7, LRA Section B.2.43, "Shield Building Monitoring Program," program element "Acceptance Criteria", previously revised by FENOC letter dated July 3, 2014 (ML14184B184), is revised to read as follows:

- **Acceptance Criteria**

Indications of relevant conditions of degradation detected during the inspections will be evaluated and compared to pre-determined acceptance criteria. The acceptance criteria will be defined to ensure that the need for corrective actions is identified before loss of structure or component intended functions. If the acceptance criteria are not met, then the indications or conditions will be evaluated under the FENOC Corrective Action Program.

Engineering evaluation by qualified personnel will be used for disposition of inspection findings that do not meet the acceptance criteria.

For core bore inspections, unacceptable inspection findings will include any indication of new cracking or a "discernable change" in previously identified cracks. Any indication of new cracking is defined as a visual inspection finding that visible cracks have developed in core bores that previously had no visible cracks. A discernable change in a previously identified crack is defined as a visual inspection finding that there has been a discernable change in general appearance or in crack width as identified by crack comparator measurement. Conditions to be evaluated following each inspection cycle for determination of "acceptable results" include conformance with the plant design and licensing basis, as well as with previously determined crack propagation rates. Comparison with previously determined propagation rates will be to identify any potential changes in the driving force of the condition.

The acceptance criteria for any identified loss of material or change of material properties will be as described in Chapter 5 of ACI Report 349.3R.

The acceptance criteria for core bore inspections will be a maximum crack width of 0.013 inch, and maximum circumferential laminar crack planar limits (in percent, rounded to the nearest whole number) identified by region (elevation) of the structure, as follows:

<u>REGION</u>	<u>ELEVATION (FT)</u>	<u>PLANAR LIMIT (%)</u>
<u>1</u>	<u>801.0 – 812.75</u>	<u>0</u>
<u>2</u>	<u>774.5 – 801.0</u>	<u>70</u>
<u>3</u>	<u>643.0 – 774.5</u>	<u>20</u>
<u>4</u>	<u>565.0 – 643.0</u>	<u>0</u>

The acceptance criteria for rebar corrosion found during visual inspections will be that there is no evidence of corrosion indicated by loose, flaky rust or reinforcement section loss. Given the inherent variability of reinforcement cross section, and the encompassing concrete, no measurement technique is employed.

The acceptance criteria for Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure wall coatings will be based on the ability of the coatings to continue to be effective. The acceptance criteria will include the quantitative acceptance criteria for coatings in Chapter 5, Sections 5.1.4 and 5.2.4, of ACI Report 349.3R.