FENOC
FirstEnergy Nuclear Operating Company

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

November 20, 2012
L-12-418

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. 36

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 October 26, 2012 (ML12292A627), 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. 36 to the Davis-Besse LRA.

A145
NRR

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 November 20, 2012.

Sincerely,

David M. Imlay
Director, Site Performance Improvement

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. 36 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

Question Follow-up RAI B.2.43-1

Background:

By letter dated August 16, 2012, the applicant responded to an request for additional information (RAI) regarding the protective coatings being applied to the exterior surfaces of the concrete shield building. The response noted that an acrylic waterproofing system would be used on the walls, while a polyurethane elastomeric coating would be used on the dome. The RAI response provided information on the selected coatings and how they would be inspected.

Issue:

1. **The RAI response provides qualitative acceptance criteria for the new shield building coating. In an earlier RAI response, dated May 24, 2011, the applicant committed (Commitment No. 20) to use quantitative acceptance criteria based on the guidelines of Chapter 5 of American Concrete Institute (ACI) 349.3R for inspections conducted under the Structures Monitoring Program. It is not clear if Commitment No. 20 applies to the new coating inspections conducted under the Shield Building Monitoring Program.**

2. **The RAI response notes that coating inspections will be conducted on at least a five year frequency and that a preventive maintenance task has been established to reapply the coating on a 15 year interval. This information is not in the license renewal application (LRA) Appendix A Updated Safety Analysis Report (USAR) supplement.**

3. **The RAI response discusses the qualifications of the coating system being applied to the shield building walls; however, it does not provide similar information for the shield building dome.**

Request:

1. **Clarify whether or not the quantitative acceptance criteria in Chapter 5 of ACI 349.3R will be applied to the coating inspections conducted under the Shield Building Monitoring Program. Specifically the guidance and quantitative limits for coatings discussed in Section 5.1.4. If the ACI 349.3R acceptance criteria will be used, include a statement to that effect in the USAR supplement. If the ACI 349.3R criteria will not be used, provide a justification for the acceptance criteria being used.**

2. Include the inspection interval and the recoating interval in the LRA Appendix A USAR supplement. This information, along with the information requested in Part 1, is necessary to provide the appropriate level of detail in the USAR supplement, per 10 CFR 54.21(d).

3. Provide information that demonstrates that the selected coating for the shield building dome will be capable of preventing moisture ingress during an extreme weather event, similar to the blizzard of 1978.

RESPONSE FOLLOW-UP RAI B.2.43-1

1. LRA Sections A.1.43 and B.2.43, both titled, "Shield Building Monitoring Program," are revised to include the quantitative acceptance criteria for coatings from American Concrete Institute (ACI) Report 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures," Chapter 5, "Evaluation Criteria," Sections 5.1.4 and 5.2.4.

2. LRA Sections A.1.43 and B.2.43 are revised to include the Shield Building coatings inspection interval (five-year interval) and the recoating interval (fifteen year interval).

3. The protective coating system applied to the vertical wall of the Shield Building is not qualified for application to horizontal or near horizontal surfaces. Therefore, a different weatherproofing coating system was selected for the Shield Building dome. The dome coating system, manufactured by Sika Corporation, U.S., consists of a primer (Sika Concrete Primer), a base coat (Sikalastic 601 BC) and a top coat (Sikalastic 621 TC) which are cold applied, highly elastic, aliphatic, single component, moisture-triggered polyurethane materials. The coating system has been qualified on a concrete surface to FM Approvals (formerly Factory Mutual) Standard FM 4470, "Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction," and has achieved a Class 1-990 rating. The published service temperature range for the coating system is -22 to +176 degrees Fahrenheit and the coating system has a vapor permeability of 0.55 perms. Vapor permeability is the material's ability to allow water "vapor" to pass from the substrate to the atmosphere. The coating materials meet the requirements of ASTM International (ASTM) D7311-07, "Standard Specification for Liquid-Applied, Single-Pack, Moisture-Triggered, Aliphatic Polyurethane Roofing Membrane." The coating system applied is capable of providing the required weather proofing of the Shield Building dome during environmental conditions similar to those experienced at Davis-Besse during the 1978 blizzard.

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

Question Follow-up RAI B.2.43-2

Background:

By letter dated August 16, 2012, the applicant responded to an RAI regarding the proposed monitoring methods for the shield building cracking. The RAI response notes that non-destructive impulse response (IR) testing had been completed on all accessible portions of the shield building wall and the testing confirmed the assumed crack locations. The response also notes that the proposed inspection sample size of six cracked and six uncracked core bores is adequate to identify any changes in the laminar cracking.

Issue:

1. **The RAI response does not clearly explain why six pairs (1 cracked, 1 uncracked) of core bores is an adequate sample size to detect changes in the laminar cracking, when indications of cracking were identified in all 16 shoulder regions.**

2. **The RAI response does not explain why one-time IR testing of the shield building is adequate.**

Request:

1. **Provide justification for the use of six core bore pairs to monitor cracking and explain how this value was chosen. The response should provide a justification for not including at least one core bore pair in each flute shoulder.**

2. **Identify a frequency for conducting IR testing (or equivalent non-destructive examination), on the shield building during the period of extended operation, or explain why additional testing is unnecessary.**

RESPONSE FOLLOW-UP RAI B.2.43-2

1. The 12 core bores noted in the August 16, 2012 RAI response were selected as a combination of stand-alone (not paired) core bores and paired core bores, based on evaluation of the locations of the installed core bores.

   The use of 12 core bores is justified by the application of the NUREG-1801 (GALL) technical methodology of using a representative sample to monitor for the existence of a plausible aging effect that has not previously been discovered. The size of the representative sample was chosen based on an engineering evaluation that conformed with the GALL technical bases for establishing the size of a representative sample for such undiscovered aging effects. Although no plausible aging effect has been identified, FENOC conservatively chose to compare the Davis-Besse Shield Building core bore sample size to these GALL technical bases. However, FENOC will add 8 core bore inspection locations to the representative sample at the locations discussed below.

FENOC determined that the laminar cracking in the Shield Building Wall was event-driven degradation. The root cause investigation of the Shield Building Wall laminar cracking provided data supporting this conclusion. Although these results also support the expectation that an aging effect related to laminar cracking will not occur, FENOC has concluded that it is prudent to establish a periodic, plant-specific, condition monitoring and prevention program to confirm that an aging effect, related to laminar cracking, does not occur in the future.

Evaluation of Impulse-Response (IR) testing results of over 60,000 sample points taken across the entire accessible Shield Building wall surface and the Shield Building Laminar Cracking Root Cause determined that the southern exposures of the Shield Building Wall were most susceptible to event-driven laminar cracking. Core bores taken at these, and other, locations validated the IR testing results. These areas are therefore targeted for the distribution of the core bores used for condition monitoring. The chosen core bore distribution uses representative sampling for condition monitoring which is distributed to focus on the detection of changes in all three of the areas with previously identified event-driven laminar cracking (Shoulders, Main Steam Line penetration areas and the area within the top 20 feet of the Shield Building).

The flute shoulders have been designated as Shoulders 1 through 16. Given that this is a directionally driven condition, the cracking is more prevalent on 10 of the 16 shoulders (Shoulders 4 through 13). Shoulders 4 through 13 also bound the areas of high prevalence cracking within the top 20 feet of the building (above elevation 780 feet), and the Main Steam Line penetration areas. Therefore, the twelve core bores originally chosen are located to assess crack change determinations on 4 of the 10 shoulders with a high prevalence of event-driven laminar cracking. This distribution also covers shell sections, above elevation 780 feet, with 4 core bores (2 pairs), and each Main Steam Line penetration area with one core bore.

To further enhance the monitoring plan for the period of extended operation, FENOC will revise the sample size from 12 core bore inspection locations to include 8 additional core bore inspection locations for a total of 20 inspection locations. The addition of these 8 core bore inspection locations will bring the number of shoulders sampled with high prevalence cracking from 4 of 10 to 8 of 10. The 8 additional core bore inspection locations will include a combination of cracked and un-cracked core bores installed and examined as part of the initial condition assessment. They will be monitored, in addition to the 12 previously chosen core bore locations, for crack condition changes.

The GALL does not provide program guidance for this described condition. However, GALL recommends one-time aging management programs for situations where an aging effect is not expected to occur as described by the One-Time Inspection Program (XI.M32). The GALL technical bases for XI.M32 recommend a sample size of 20% of a defined population to be inspected one time prior to the period of extended operation as representative of material/environment/aging effect combinations. The GALL technical bases for XI.M32 note that a representative sample should be drawn from a population of components having the same material, environment, and aging effect combination. The GALL technical bases for XI.M32 also recommend the representative sample should be focused on the bounding or lead components most susceptible to aging due to time in service and severity of operating conditions. The 16 flute shoulders are subcomponents of the Shield Building Wall structural component, they are constructed of the same material, they are exposed to the same environment and have the same aging effect combination (no aging effects). The flute shoulders have been designated as Shoulders 1 through 16. The core bores chosen for monitoring include core bores in Shoulders 4, 5, 9 and 12. The 4 flute shoulders examined by core bore inspections are a representative 25% sample of the flute shoulder subcomponent population. The flute shoulders all have the same time in service. Although there are only slight variations in flute shoulder subcomponent operating conditions, the representative sample is focused on the subcomponents that operating experience and analysis have indicated are most likely to exhibit a previously unidentified aging effect related to Shield Building laminar cracking. Therefore, the periodic inspections of core bores in 4 flute shoulders provide reasonable assurance that any laminar-cracking-related new aging effect would be detected before there is loss of Shield Building intended functions. However, to provide additional assurance, FENOC will increase the sample size to provide an 8 of 16 flute shoulder representative sample for future monitoring. The increased sample population will include 8 of the 10 flute shoulders considered to be most likely to exhibit a previously unidentified aging effect related to Shield Building Wall laminar cracking.

LRA Sections A.1.43 and B.2.43 are revised to include the core bore inspection sample size and additional inspection details. See the Enclosure to this letter for the revision to the Davis-Besse LRA.

2. With the exception of core bore inspections, no Impulse-Response (IR) or other non-destructive examinations (NDE) are planned during the period of extended operation. Additional IR or other NDE testing is unnecessary because the IR testing completed earlier, in combination with the core boring, provided a comprehensive condition assessment that confirmed the determinations of the Root Cause Report. There is reasonable assurance that changes in the laminar cracking will be detected by the periodic visual inspections of core bores as described in the response to Part 1 of this RAI. The core bore inspections discussed above are the

definitive basis for identifying any changes to the existing condition, and the only required monitoring.

Core bore inspections confirmed the accuracy of the IR testing. IR testing cannot measure the width of cracking; therefore, visual inspection of core bores and the use of a crack comparator is the definitive method to monitor Shield Building cracks and uncracked Shield Building concrete for changes in crack width or the development of cracking in a previously uncracked surface. IR testing was used to identify the extent of cracking. The accuracy of the condition identified by IR testing was validated by the initial visual examination of 70 core bores. An additional 17 core bores were performed in 2012; these core bores confirmed the accuracy of the IR testing.

As specified in the Shield Building Monitoring Program, a new condition report (CR) will be initiated upon discovery of any discernable changes to the cracking condition. The evaluation of a new CR would determine the necessary corrective actions, including consideration of the potential for additional IR testing or other appropriate NDE methods.

As described in the August 16, 2012 FENOC response to RAI B.2.43-2 Part 2, the frequency of the periodic core bore inspections described in the response to Part 1 of this RAI will initially be scheduled at a more aggressive frequency than recommended by American Concrete Institute (ACI) Report 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures". The maximum interval between inspections for the Shield Building Monitoring Program will not exceed the five-year interval recommended in ACI 349.3R.

Question Follow-up RAI B.2.43-3

<u>Background</u>:

By letter dated August 16, 2012, the applicant responded to an RAI regarding the scope of the proposed Shield Building Monitoring Program. The RAI response notes that there were four conditions required to cause the laminar cracking and that the shield building is the only plant structure that has all four conditions. Per the RAI response, the conditions are: significant moisture intrusion, low temperatures, the flute shoulder configuration, and an unsealed concrete surface. The response further states that the design features of all other concrete structures within the scope of license renewal prevent the occurrence of similar cracking. To verify this, core bores were taken and IR testing was conducted on one wall of the auxiliary building. The results showed no indications of laminar cracking.

Issue:

1. **The response states that the flute shoulder configuration was one of the conditions that led to the laminar cracking; however, laminar cracking was also identified around the main steam line penetrations and in the top 20 feet of the shield building. Since cracking was identified outside of the flute shoulders, in areas that are not necessarily unique to the shield building in regards to design, it appears that other structures may be susceptible to similar laminar cracking.**

2. **The response does not explain why the auxiliary building wall was chosen to verify cracking has not occurred in other structures.**

3. **The response does not clearly explain why inspections of one wall are adequate to verify that laminar cracking has not occurred in any other structure within the scope of license renewal. The response also does not discuss whether any testing has been done in areas similar to those where cracking was found in the shield building (e.g., near steam line penetrations).**

4. **If other structures are susceptible to similar cracking, it is unclear how the cracking will be managed during the period of extended operation. The response states that although other structures within the scope of license renewal have exterior coatings, the coating is not relied upon to prevent sub-surface laminar cracking.**

Request:

1. **Explain why no other structures within the scope of license renewal are susceptible to laminar cracking, when shield building laminar cracking was identified in areas outside of the flute shoulders.**

2. **Explain why the auxiliary building wall was chosen for testing and what makes it representative of other walls on-site (e.g., it is uncoated, it faces into the worst wind direction, it bounds other walls on site, etc.).**

3. **Explain why inspections of one wall are adequate to verify laminar cracking has not occurred on any structure within the scope of license renewal, or propose additional testing that will verify cracking has not occurred elsewhere. The response should also include a discussion of any testing done in locations similar to those in the shield building, or why that testing is unnecessary.**

4. **If the response to Part 1 indicates that other structures may be susceptible to laminar cracking, explain how cracking will be managed in susceptible structures during the period of extended operation. If coatings will be relied**

upon (new or existing) to manage aging, the inspection methods, inspector qualifications, acceptance criteria, etc. that are being used for the shield building coatings should apply to all coatings.

RESPONSE FOLLOW-UP RAI B.2.43-3

1. The development of laminar cracking in the Shield Building Wall required four identified conditions to occur (significant moisture intrusion, low temperatures, the flute shoulder configuration, and an unsealed concrete surface). The Shield Building is the only building subject to this combination of identified conditions required for the development of laminar cracking.

   Under the specific conditions described in the Root Cause Report, the design configuration of the flute shoulders established an inherent stress concentration at the outer face of the structural reinforcing steel (rebar) behind the thickest section of each shoulder. This inherent stress concentration enabled additional radial stress from freezing moisture to exceed the concrete tensile strength and initiate a crack. In the concrete that adjoined the outer face of rebar underneath the shoulder region, other horizontal (hoop) and vertical stresses enabled the laminar crack, initiated by the freezing moisture, to propagate along the outer face of rebar.

   Shield Building laminar cracking in the areas of the Main Steam Line penetrations and in the top 20 feet of the Shield Building was determined to be a direct result of crack propagation in the flute shoulder configuration. The required energy for crack propagation decreases with decreasing rebar spacing. This phenomenon allowed crack propagation to the areas beyond flute shoulders within the top 20 feet of the Shield Building, and to the Main Steam Line penetration areas.

   The FENOC Root Cause Report documents that the density of rebar in the areas of the Main Steam Line penetrations, and within the top 20 feet of the Shield Building enabled laminar cracking from the adjacent shoulders to propagate into those areas beyond the shoulders. The investigations completed as part of initial investigations and as supplemented during the summer of 2012 under Root Cause Corrective Actions show the direct connection of cracking within the shoulders to the cracking within the top 20 feet and Main Steam Line penetration areas.

   The Root Cause Report documents that the design configuration of high density (spacing was less than or equal to six inches) rebar within the top 20 feet of the Shield Building, and at the Main Steam Line penetration blockouts (another area with high density rebar) enabled laminar cracks initiated by freezing moisture in the flute shoulder to propagate to these areas.

No other site structures were constructed with the shoulder configuration. Those structures, therefore, do not have similar crack-initiation or propagation conditions and are not susceptible to laminar cracking.

2. The Auxiliary (Aux) Building location was chosen for investigation because of its orientation, rebar density, and the presence of a spray-on waterproof sealant. Specifically, an area above Door 300 on the west wall of the building was investigated with the same Impulse-Reponse (IR) technology and core bore confirmation method used on the Shield Building Wall.

   This Aux Building area has been subjected to a directionally prevalent wind force. It also has a high density of rebar comparable to what is present in the Shield Building top 20 feet. For comparison, the nominal rebar configuration in the Aux Building area of investigation includes #11 bars at 6-inch spacing each way (horizontally and vertically) for each wall face (exterior face and interior face). Additionally, #6 U-bars at 6-inch spacing are provided within the first 3.5 feet above the door. The #11 Aux Building rebar spacing is comparable to the area above elevation 780 feet in the Shield Building where the rebar is #11 at 6 inches horizontally, with #11 at 12 inches vertically.

   Examination of this area confirmed that despite the high density rebar and exposure to wind-driven moisture, laminar cracking had not initiated. The absence of laminar cracking, in turn, confirmed the findings of the Root Cause Report that both the shoulder configuration and lack of a waterproof coating are required to initiate laminar cracking.

3. Inspections of one wall are adequate to envelope other structures within the scope of license renewal. No structures within the scope of license renewal other than the Shield Building contain the four conditions required for laminar cracking (significant moisture intrusion, low temperatures, shoulder configuration, and an unsealed concrete surface).

   The Aux Building wall was selected to be representative of the worst condition for the likelihood of water intrusion (west wall of the building). The west wall is not shielded by another building, and would be subjected to the low temperatures similar to other buildings at the site. No buildings, other than the Shield Building, were constructed with the shoulder configuration. The Aux Building area selected also included the contributing cause of high density rebar. Therefore the area selected is representative for the other structures within the scope of license renewal.

   During the initial investigation of the laminar cracking condition, IR mapping was also completed in the area of the Containment Purge Outlet Line (Penetration 34) of the Shield Building. This area was chosen for the purpose of obtaining data around a penetration of a similar size as that of a Main Steam Line penetration. The

Containment Purge Outlet Line penetration area also has rebar density similar to the Main Steam Line penetration areas. The Containment Purge Outlet Line penetration area was not subjected to the thermal loading of the Main Steam Line penetration areas, it was environmentally sheltered, and it was not adjacent to a shoulder configuration. No laminar cracking was identified in the area of this penetration.

4. The response to Part 1 confirms that no other site structures were constructed with a shoulder configuration similar to the Shield Building wall, and therefore are not susceptible to the identified laminar cracking.

Enclosure

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

Letter L-12-418

Amendment No. 36 to the Davis-Besse License Renewal Application

License Renewal Application Sections Affected

Section A.1.43

Section 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*.

Affected LRA Section	LRA Page No.	Affected Paragraph and Sentence
A.1.43	**Page A-25**	**Paragraphs 2, 3 & 5**

In response to Follow-up RAIs B.2.43-1 and B.2.43-2, LRA Section A.1.43, "Shield Building Monitoring Program," previously replaced in its entirety by FENOC letter dated August 16, 2012 (ML12230A220), is revised to read as follows:

A.1.43 Shield Building Monitoring Program

The Shield Building Monitoring Program is a prevention and condition-monitoring program for Davis-Besse. The program consists of inspections of the Shield Building Wall concrete and reinforcing steel (rebar). The inspections conducted as part of the Shield Building Monitoring Program supplement the inspections conducted as part of the Structures Monitoring Program.

The program monitors for cracking, change of material properties and loss of material of concrete. The program also monitors for corrosion of the concrete rebar. *As a preventive action of this program, the Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure wall exterior concrete coatings are inspected at a five-year interval for evidence of loss of effectiveness. Also, the Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure wall exterior concrete coatings will be reapplied at a fifteen-year interval.*

Visual inspections are performed on rebar (when exposed), coatings, core bore and core bore sample surfaces in accordance with an implementing procedure by inspectors qualified as described in Chapter 7 of American Concrete Institute (ACI) Report ACI 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures." The quantitative acceptance criteria for coatings from Chapter 5, Sections 5.1.4 and 5.2.4, of ACI Report 349.3R are used.

The core bore visual inspections are performed on a representative sample of Shield Building Wall structural subcomponents by inspection of the internal surfaces of core bores. The locations of the core bores have been chosen from the core bores that have been installed in the subcomponents of the Shield Building Wall. The representative sample size includes 20 core bore inspection locations in the subcomponent population (defined as Shield Building Wall subcomponents having the same material, environment, and aging effect combination). The 20 core bore location distribution has been chosen to include core bore inspections in 8 of the 10 flute shoulders with a high prevalence of *event-driven laminar cracking. This distribution also covers shell sections above elevation 780 feet with 4 core bores (2 pairs), and each Main Steam Line penetration area with one core bore.*

The Shield Building Monitoring Program includes periodic scheduled inspections to ensure that the existing environmental conditions are not causing material degradation that could result in loss of Shield Building intended functions during the period of extended operation.

~~*As a preventive action of this program, the Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure wall exterior concrete coatings are inspected for evidence of loss of effectiveness.*~~

Implementation of this program ensures that the intended functions of the Shield Building and Shield Building Emergency Air Lock Enclosure are maintained during the period of extended operation.

Affected LRA Section	LRA Page No.	Affected Paragraph and Sentence
B.2.43	**Page B-166**	**Program Description (paragraphs 2 & 3); Preventive Actions (paragraphs 1 & 2); Detection of Aging Effects (paragraph 2); Monitoring and Trending; Acceptance Criteria (paragraph 6); and Operating Experience (paragraphs 1 & 2)**

In response to Follow-up RAIs B.2.43-1 and B.2.43-2, LRA Section B.2.43, "Shield Building Monitoring Program," previously replaced in its entirety by FENOC letter dated August 16, 2012 (ML12230A220), is revised to read as follows:

B.2.43 SHIELD BUILDING MONITORING PROGRAM

Program Description

The Shield Building Monitoring Program is a new plant-specific prevention and condition-monitoring program for Davis-Besse. The program will consist of inspections of the Shield Building concrete and reinforcing steel (rebar). The inspections, conducted as part of the Shield Building Monitoring Program will supplement the inspections conducted as part of the Structures Monitoring Program.

The program will monitor for cracking, change of material properties and loss of material of concrete. The program also will monitor for corrosion of the concrete rebar. *As a preventive action of this program, the Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure wall exterior concrete coatings will be inspected at a five-year interval for evidence of loss of effectiveness. Also, the Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure wall exterior concrete coatings will be reapplied at a fifteen-year interval.*

Visual inspections will be performed on rebar (when exposed), core bore and core bore sample (concrete core) surfaces in accordance with an implementing procedure by inspectors qualified as described in Chapter 7 of American Concrete Institute (ACI) Report ACI 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures." The quantitative acceptance criteria for coatings from Chapter 5, Sections 5.1.4 and 5.2.4, of ACI Report 349.3R will be used.

The Shield Building Monitoring Program will include periodic scheduled inspections to ensure that the existing environmental conditions are not causing material degradation that could result in loss of Shield Building intended functions during the period of extended operation.

Implementation of this program will ensure that the intended functions of the Shield Building and Shield Building Emergency Air Lock Enclosure are maintained during the period of extended operation.

NUREG-1801 Consistency

The Shield Building Monitoring Program is a new plant-specific Davis-Besse program for license renewal. While NUREG-1801 includes a Structures Monitoring Program (XI.S6), the Davis-Besse Shield Building Monitoring Program is considered plant-specific, and is evaluated against the ten elements described in Appendix A of the Standard Review Plan of License Renewal Applications for Nuclear Power Plants, NUREG-1800.

Aging Management Program Elements

The results of an evaluation of each program element are provided below.

- Scope

  The scope of the Shield Building Monitoring Program includes the Shield Building Wall reinforced concrete and rebar, and the exterior concrete coatings on the Shield Building Wall, the Shield Building Dome and the Shield Building Emergency Air Lock Enclosure walls.

  The program will include periodic inspections to ensure that the existing environmental conditions are not causing material degradation that could result in a loss of any of the intended functions of the Shield Building or the Shield Building Emergency Air Lock Enclosure during the period of extended operation.

- Preventive Actions

  As part of the Shield Building Monitoring Program, the coatings on the exterior concrete Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure walls will be inspected <u>*at a five-year interval*</u> *to verify continuing effectiveness during the period of extended operation.* The inspections will be conducted in accordance with the implementing procedure by inspectors qualified as described in Chapter 7 of ACI Report 349.3R.

Also, the Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure wall exterior concrete coatings will be reapplied at a fifteen-year interval.

- Parameters Monitored or Inspected

The Shield Building Monitoring Program will inspect parameters directly related to potential degradation of the components under review, including visual evidence of cracking, change of material properties, loss of material and corrosion. Also, the Shield Building Wall, Shield Building Dome and Shield Building Emergency Air Lock Enclosure walls exterior concrete coatings will be inspected for loss of effectiveness in accordance with the implementing procedure by inspectors qualified as described in Chapter 7 of ACI Report 349.3R.

The parameters to be inspected will include visual evidence of surface degradation, such as cracking, change in material properties, loss of material and corrosion. Observed conditions may indicate a need to conduct augmented inspections, testing or analyses. American Concrete Institute (ACI) Report 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures," and ANSI/ASCE 11 90, "Guideline for Structural Condition Assessments of Existing Buildings," provide guidance for the selection of parameters to be monitored or inspected.

Parameters Monitored or Inspected and Potential Aging Effects			
Potential Aging Effect	**Potential Aging Mechanisms**	**Parameters Monitored**	**Inspection and Testing Method(s)**
Cracking (Concrete)	Freezing of water that has permeated the concrete	Surface condition of core bores and core bore samples, and change in crack conditions	Visual
Change of Material Properties	Leaching of calcium hydroxide from concrete	Surface condition of core bores and core bore samples	Visual
Loss of Material (Concrete)	Freezing of water that has permeated the concrete	Surface condition of core bores and core bore samples	Visual
Loss of Material (Rebar)	Corrosion	Surface condition of rebar, when exposed	Visual
Loss of Coating Effectiveness	Loss of ability to perform its protective action	Condition of the coatings	Visual

- Detection of Aging Effects

  The Shield Building Monitoring Program provides for detection of aging effects prior to the loss of Shield Building intended functions. The inspections, testing and analyses of the Shield Building concrete and rebar that was done to support the root cause evaluation report, "Concrete Crack within Shield Building Temporary Access Opening", will provide a baseline for future Shield Building Monitoring Program activities.

  Periodic visual inspections will be performed in accordance with an implementing procedure by inspectors qualified as described in Chapter 7 of ACI Report 349.3R. *The visual inspections will be performed on a representative sample of Shield Building Wall structural subcomponents by inspection of the internal surfaces of core bores. The locations of the core bores have been chosen from the core bores that have been installed in the subcomponents of the Shield Building Wall. The representative sample size includes 20 core bore inspection locations in the subcomponent population (defined as Shield Building Wall subcomponents having the same material, environment, and aging effect combination). The 20 core bore location distribution has been chosen to include core bore inspections in 8 of the 10 flute shoulders with a high prevalence of event-driven laminar cracking. This distribution also covers shell sections above elevation 780 feet with 4 core* *bores (2 pairs), and each Main Steam Line penetration area with one core bore.* Visual inspections will be supplemented by other established nondestructive examination (NDE) techniques and testing, as appropriate.

The initial frequency of visual inspection of core bores and core bore samples will be based on the results of inspections conducted before the period of extended operation. If no aging effects were identified by these visual inspections, then visual inspections will continue to be conducted at least once every two years during the period of extended operation. The first inspection conducted during the period of extended operation is scheduled for 2017 and the next inspection is scheduled for 2019. If no aging effects are identified by the two-year interval visual inspections (defined as no discernable change in crack width or the confirmation that no visible cracks have developed in core bores that previously had no visible cracks), then the frequency of visual inspections may be changed to at least once every five years. Any evidence of degradation will be documented and evaluated through the FENOC Corrective Action Program. The evaluation will include a determination of the need for any required change to the inspection schedule.

The exterior concrete coatings of the Shield Building Wall, Shield Building Dome, and Shield Building Emergency Air Lock walls, will be inspected at least once every five years in accordance with the implementing procedure. The coatings inspectors will be qualified as described in Chapter 7 of ACI Report 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures." The frequency of the coatings inspections may be adjusted based on observed coating conditions, any required reapplication of a coating, or on the recommendations of a coating manufacturer.

- Monitoring and Trending

The Shield Building Monitoring Program will include a baseline inspection, followed by periodic inspections. Visual inspections will be performed in accordance with the implementing procedure by personnel qualified as described in Chapter 7 of ACI Report 349.3R. *The representative sample size includes 20 core bore inspection locations in the Shield Building Wall subcomponent population having the same material, environment, and aging effect combination. The 20 core bore location distribution has been chosen to include core bore inspections in 8 of the 10 flute shoulders with a high prevalence of event-driven laminar cracking. This distribution also covers shell sections above elevation 780 feet with 4 core bores (2 pairs), and each Main Steam Line penetration area with one core bore.* Inspection findings will be documented and evaluated by assigned engineering personnel such that the results can be trended. Inspection findings that do not meet acceptance criteria will be evaluated and tracked using the FENOC Corrective Action Program.

- 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.

  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 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 ~~be that the coatings do not have flaking, delamination, peeling or other degraded surface conditions~~ include the quantitative acceptance criteria for coatings in Chapter 5, Sections 5.1.4 and 5.2.4, of ACI Report 349.3R*.

- Corrective Actions

  This element is common to Davis-Besse programs and activities that are credited with aging management during the period of extended operation and is discussed in Section B.1.3.

- Confirmation Process

  This element is common to Davis-Besse programs and activities that are credited with aging management during the period of extended operation and is discussed in Section B.1.3.

- Administrative Controls

  This element is common to Davis-Besse programs and activities that are credited with aging management during the period of extended operation and is discussed in Section B.1.3.

- Operating Experience

  Review of Davis-Besse operating experience identified degradation of the Shield Building concrete wall (above grade) due to internal laminar cracking. The degradation had not been identified by the existing maintenance rule structural inspections which are based on visual inspection of the external surfaces of structures. Although the laminar cracking degradation of the concrete for the Shield Building was not caused by an aging mechanism, it is prudent to establish a plant-specific Aging Management Program to include monitoring methods to identify aging effects that may occur in the future. The Shield Building Monitoring Program is designed to identify and evaluate potential aging effects within the Shield Building walls. *The program is also designed to identify and evaluate any loss of preventive action effectiveness of the exterior Shield Building concrete coatings, which ~~will be~~ were applied in 2012.*

  Industry operating experience regarding similar structures was evaluated for applicability at Davis-Besse. *The only other similar instance of concrete delamination discovery* was *associated with creating a temporary access opening in the post-tensioned containment structure at Crystal River Unit 3.* The root cause of the Crystal River containment concrete delamination was the design of the structure, in combination with the type of concrete used, and the acts of detensioning and opening the containment structure. As part of the root cause analysis of the Davis-Besse Shield Building laminar cracking, FENOC concluded that the subject Crystal River operating experience was not applicable to the Davis-Besse Shield Building.

  The existing long-term corrective actions for Shield Building laminar cracking include inspections of the Shield Building concrete, rebar and coatings. The results of those activities may provide operating experience relevant to the Shield Building Monitoring Program.

The elements that comprise the Shield Building Monitoring Program inspections will be consistent with industry practice. Industry and plant-specific operating experience will be considered in the implementation of this program. As additional operating experience is obtained, lessons learned will be incorporated, as appropriate.

Enhancements

None.

Conclusion

Implementation of the Shield Building Monitoring Program will provide reasonable assurance that the existing environmental conditions will not cause aging effects that could result in a loss of component intended function. Aging effects that are discovered will be managed such that the Shield Building intended functions will be maintained consistent with the current licensing basis during the period of extended operation.