FirstEnergy®

Davis-Besse Nuclear Power Station
5501 North State Route 2
Oak Harbor, Ohio 43449-9760

January 21, 2013
L-12-455

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. 37

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 November 14, 2012 (ML12318A246), 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. 37 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 21, 2013.

Sincerely,

David M. Imlay

David M. Imlay
Director, Site Performance Improvement

A145
NRR

Attachment:
Reply to Request for Additional Information for the Review of the Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse), License Renewal Application (LRA), Section B.2.4

Enclosure:
Amendment No. 37 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 RAI B.2.4-1a

Background:

The November 2, 2012, supplemental response to request for additional information (RAI) B.2.4-1 states that American Society of Testing and Materials (ASTM) A-540 bolts are used in structural applications. The response classified ASTM A-325 and A-490 structural bolts as high strength. However, depending on the grade and class of ASTM A-540 bolts, the minimum specified yield strength of the material is specified as 130, 140, or 150 kilo-pounds per square inch (ksi). NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," aging management program (AMP) XI.M18 states, "[p]reventive measures also include using bolting material that has an actual measured yield strength limited to less than 1,034 megapascals (MPa) (150 kilo-pounds per square inch [ksi])." Given the variability in actual yield strength supplied by a material manufacturer, it is possible that some in-service ASTM A-540 bolts should be classified as high strength. GALL Report AMP XI.M18 further states that, "[h]igh strength closure bolting (actual yield strength greater than or equal to 1,034 MPa [150 ksi]), if used, should be monitored for cracking."

The original response to RAI B.2.4-1, provided on May 24, 2011, which stated, "[v]isual examinations of structural assemblies will detect corrosion or conditions indicative of a corrosive environment that could lead to stress corrosion cracking (SCC) in potentially susceptible high strength bolting, and will cause appropriate corrective action to be taken under the Corrective Action Program when necessary," is still applicable if there are high strength ASTM A-540 bolts.

Issue:

The staff lacks sufficient information to determine which ASTM A-540 grade and class materials were used; if grade and class materials were used that have a *minimum specified yield equal to or higher than* 130 ksi; *the actual measured* yield strength of inservice bolts; if none of the currently installed bolts are high strength bolts; what controls will be in place to ensure that the actual measured yield strengths of ASTM A-540 supplied replacements will not exceed 150 ksi; and what inspections will be conducted for these high strength bolts.

In addition, if visual examinations will be used to detect corrosion or conditions indicative of a corrosive environment that could lead to SCC, it is unclear how a

corrosive environment is defined at Davis-Besse Nuclear Power Station (Davis-Besse), and how a non-corrosive environment can be guaranteed to be maintained throughout the period of extended operation.

Request:

The staff requests the applicant state the following:

a) **The ASTM A-540 grade and class of materials that are used in in-scope structural locations**

b) **If grade and class materials were used that have a minimum specified yield equal to or higher than 130 ksi, the actual measured yield strength of in-service bolts**

c) **If none of the currently installed bolts are high strength bolts, what controls will be in place to ensure that the actual measured yield strengths of A-540 supplied replacements will not exceed 150 ksi**

d) **If high strength ASTM A-540 bolting material has been used in in-scope structural applications, what inspections will be conducted**

e) **If visual examinations will be used to detect corrosion or conditions indicative of a corrosive environment in lieu of volumetric or surface (for removed bolts) examinations to detect SCC, the definition for a corrosive environment at Davis-Besse, and the threshold for which an environment will be classified as corrosive**

f) **How it will be demonstrated that a non-corrosive environment is maintained for all high strength bolts, and how visual inspections will be able to detect all instances of corrosion or a corrosive environment, or update the AMP to show that volumetric examinations comparable to that of American Society of Mechanical Engineers Code Section XI, Table IWB-2500-1, Examination Category BG-1 are being performed on high strength bolting**

RESPONSE RAI B.2.4-1a

a) The ASTM A540 bolting materials used at Davis-Besse for in scope structural locations are Grade B23, Class 3. Bolts and studs (rods) are used. The studs are threaded for specified lengths.

b) The ASTM A540 bolting materials used at Davis-Besse for in scope structural locations have a minimum specified yield strength of equal to or higher than 130 kilo-pounds per square inch (ksi). FENOC has reviewed available records of installed ASTM A540 bolting materials that have a nominal diameter of greater than

one inch. The actual measured yield strength of such in-service bolts and studs varies with the bolting material supplied under various purchase orders. For example, FENOC has identified A540 bolting material that has undergone mechanical testing that measured bolting material yield strengths of 154 ksi and 161.5 ksi. Some of the A540 bolting material had measured yield strengths below 150 ksi. As a result of review of the available bolting material records, FENOC has identified 216 ASTM A540 bolts or studs that may be susceptible to stress corrosion cracking (SCC). The susceptible population includes bolts and studs with certified mill test reports (CMTR) that show yield strength greater than 150 ksi, and studs with currently unknown yield strengths. The population of studs with currently unknown yield strengths has been conservatively assumed to have yield strengths greater than 150 ksi. If CMTRs are located that verify yield strengths are less than 150 ksi, then those particular bolts and studs will be removed from the susceptible population. The bolts and studs in the population of susceptible components are anchor bolts in containment that are embedded in concrete and have their exposed portions (i.e., support plate, nut[s]) coated. The A540 bolting material anchors safety-related component and piping supports to the structural concrete in containment.

c) As noted in the response to request (b), above, FENOC has determined that some currently installed A540 bolts or studs are high strength bolts or studs. Because the identified A540 bolting materials are used as embedded anchors, it is unlikely that the material will be replaced. However, to preclude the future use of A540 bolting susceptible to SCC, FENOC provides a license renewal future commitment to revise the applicable structural bolting specifications to prevent future use of A540 bolting with measured yield strength equal to or exceeding 150 ksi.

d) Periodic visual inspections of the entire population of susceptible high strength bolting locations will be conducted, with each inspection being completed prior to the period of extended operation and at an interval not to exceed five years. At each bolting location, the visible bolting material will be inspected along with the immediately adjacent support and structural materials.

   A review of both Davis-Besse specific and industry generic Operating Experience for A540 bolting has not identified a history of failures related to SCC. Molybdenum Disulfide (MoS_2) was not required, nor prohibited, for any of the bolts in the structural bolting population during installation.

   Davis-Besse has an extensive history of volumetric examinations of the Reactor Head Closure Studs (RHCS). The RHCS material is SA-540, Grade B-23. These studs also have a measured yield strength greater than 150 ksi, falling into a range of 151 to 159 ksi. One hundred percent of the RHCS population has been subject to volumetric examination each ten-year inservice inspection interval, with no evidence of SCC identified. Davis-Besse concludes that reasonable assurance of structural integrity exists such that performing a threshold visual inspection of susceptible high

strength bolting locations to determine the potential volumetric examination population is warranted.

e) For the purpose of high strength bolting SCC, the FENOC definition of a corrosive environment for Davis-Besse is a moist or wetted environment that includes contaminants that could aid in the inducement of SCC. Because bolts and studs in the population of susceptible components are anchor bolts in containment that are embedded in concrete and have their exposed portions (i.e., support plate, nut[s]) coated, FENOC will use a process to identify and evaluate a potential corrosive environment that could contribute to SCC of high strength bolting material. Evidence of a potential corrosive environment will be documented in the FENOC Corrective Action Program. This includes any visual identification of current or past presence of a moist or wetted environment on or adjacent to a susceptible A540 bolt or stud. Some examples would include standing water, visible moisture from condensation, residue of evaporated water, water trails or stains to or from the bolting area, evidence of corrosion on bolting or adjacent metal support components, corrosion stains on adjacent concrete surfaces, and residue on adjacent concrete surfaces suggesting that a water trail might have existed. In addition to evidence of a corrosive environment, the inspection process will also be required to record evidence of potential bolt failures, which could be indicative of SCC. Indications include visual evidence of a loss of preload or bolt misalignment. All evidence of potential corrosive environments or potential bolt failures will be entered into the FENOC Corrective Action Program and subjected to an engineering evaluation. If the engineering evaluation determines that the observed condition is an indicator of current or past presence of a corrosive environment or SCC, then the affected bolting will be subject to the volumetric examinations described in the response to request (f), below.

   The threshold for which an environment will be classified as corrosive will be a formal written engineering evaluation that determines that there is not reasonable assurance that the specific bolting environment has remained non-corrosive. The Structures Monitoring AMP is updated to include the definition of a corrosive environment, the process for identifying a corrosive environment, and the threshold for a corrosive environment.

f) The visual inspection method described in the response to request (e), above, will be used to demonstrate that there is reasonable assurance that a non-corrosive environment is maintained for all susceptible high strength bolts, and to detect instances of corrosion or a corrosive environment. Each ASTM A540 bolt or stud that may be susceptible to SCC, as identified in the response to request (b), above, will be inspected periodically, beginning prior to the period of extended operation to verify that they are not and have not been exposed to a corrosive environment.

   The Structures Monitoring AMP is also updated to show that ultrasonic (volumetric) examinations will be performed in accordance with the requirements of the American

Society of Mechanical Engineers (ASME) Code Section V, Article 5, Appendix IV, on a representative sample of susceptible ASTM A540 bolting that is determined to be or to have been subjected to a corrosive environment. Volumetric examinations will be performed no later than the subsequent refueling outage following visual identification of bolting subject to a corrosive environment. Deferral of volumetric examinations to the subsequent refueling outage is not permitted if the visual inspection indicates evidence of contaminant penetration through the coatings. UT examination personnel will be required to have a current ASME Code Section XI, Appendix VIII, Supplement 8 endorsement. The examination area of interest will be from the exposed nut engagement area to an embedded depth of at least 12". The representative sample size will be equal to 20 percent of the population subjected to a corrosive environment, with a maximum of 25 bolts or studs. ALARA and personnel safety will be considered during selection of the representative sample. An engineering evaluation, utilizing the results of the initial UT examinations, will be performed to determine the scope and frequency of any potential future examinations. Those components determined by evaluation to require continuous monitoring will remain in the sample population to be examined at an interval not to exceed five years.

Based on the information provided in the above responses, the Davis-Besse License Renewal Project document titled "Structures Monitoring Program," is revised to include the following information under the program Aging Management Program Element titled "Detection of Aging Effects":

The Structures Monitoring Program procedure will be enhanced to require that high strength structural bolting materials will be monitored for stress corrosion cracking (SCC). Only bolting materials with an actual measured yield strength greater than or equal to 150 ksi and greater than 1 inch in nominal diameter will be monitored. Davis-Besse high strength structural bolting includes materials types ASTM A325, ASTM A490 and ASTM A540 Grade B23, Class 3. As provided in NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," Revision 2, "ASTM A 325, F 1852, and ASTM A 490 bolts used in civil structures have not shown to be prone to SCC. SCC potential need not be evaluated for these bolts." A review of plant records has determined that 216 of the Davis-Besse ASTM A540 Grade B23, Class 3 bolts and studs have actual measured yield strengths greater than or equal to 150 ksi, or the actual measured yield strengths are unknown. The 216 bolts and studs are defined as susceptible ASTM A540 bolting. Periodic visual inspections will be conducted of all 216 locations of susceptible ASTM A540 bolting. The purpose of these inspections will be to identify locations where A540 bolting may be exposed to a potentially corrosive environment for SCC. The initial visual inspections will be completed prior to entering the period of extended operation. The interval between

inspections will not exceed five years. A corrosive environment for SCC will be defined as a moist or wetted environment that includes contaminants that could aid in the inducement of SCC. Documentation of the periodic visual inspections will include a description of any observed potentially corrosive environments for SCC. The description of such potentially corrosive environments will be entered into the FENOC Corrective Action Program and require a formal written engineering evaluation. The following are examples of conditions that will be considered to be evidence of a potentially corrosive environment (this list is not all inclusive):

1. Standing water
2. Residue of evaporated water
3. Visible moisture from condensation or any other source
4. Water trails or stains to or from the bolting location
5. Residue on adjacent concrete surfaces suggesting that a water trail might have existed
6. Evidence of corrosion on bolting or adjacent metal support components
7. Corrosion stains on adjacent concrete surfaces
8. Any other evidence of current or past presence of a moist or wetted environment at or adjacent to a bolting location.

Also, evidence of potential bolt failure, which could be due to SCC, will be recorded in the visual inspection documentation. The following are examples of conditions considered to be evidence of a potential bolt failure (this list is not all inclusive):

1. Visible evidence of a loss of preload
2. Visible evidence of bolt misalignment

Any of the indications described above, or other evidence that is observed, will be entered into the FENOC Corrective Action Program and be the subject of a written engineering evaluation that will be retained with the Corrective Action Program documentation. The engineering evaluation will determine whether or not the documented evidence is an indicator of current or past presence of a corrosive environment for SCC or of the occurrence of SCC. If the engineering evaluation determines that the observed evidence is an indicator of current or past presence of a corrosive environment for SCC or of the occurrence of SCC, then the affected bolting will be included in the bolting population from which a representative sample for volumetric examination will be drawn. If the engineering evaluation determines that there is reasonable assurance that the observed evidence is not an indicator of a corrosive environment for SCC or of the occurrence of SCC, then the associated bolting will continue to be subject to periodic visual inspections.

The threshold for which an environment will be classified as corrosive for SCC will be a completed formal engineering evaluation that determines that there is not reasonable assurance that a specific bolting environment has remained non-corrosive for SCC. Periodic volumetric examinations will be performed on a representative sample of susceptible ASTM A540 bolting materials that are determined to be or to have been subjected to a corrosive environment for SCC. UT will be the method of examination. The UT examinations will be performed in accordance with the requirements of the ASME Code Section V, Article 5, Appendix IV. If UT examinations are required, then the initial examinations will be performed no later than the subsequent refueling outage following visual identification of bolting subject to a corrosive environment. Deferral of volumetric examinations to the subsequent refueling outage is not permitted if the visual inspection indicates evidence of contaminant penetration through the associated coatings. The examination area of interest will be from the exposed nut area to an embedded depth of at least 12". The representative sample size will be equal to 20 percent of the susceptible bolts or studs determined to be or to have been subjected to a corrosive environment for SCC, with a maximum of 25 bolts or studs. As low as reasonably achievable (ALARA) radiation evaluations and personnel safety will be considered in selection of the representative sample population. An engineering evaluation, utilizing the results of the initial ultrasonic examinations, will be performed to determine the scope and frequency of any potential future examinations. Those components determined by evaluation to require continuous UT monitoring will remain in the sample population to be examined periodically at an interval not to exceed five years.

LRA Sections A.1.39 and B.2.39, both titled, "Structures Monitoring Program," and LRA Table A-1, "Davis-Besse License Renewal Commitments," Commitment No. 20, have been revised based on the above responses.

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-12-455

Amendment No. 37 to the
Davis-Besse License Renewal Application

License Renewal Application
Sections Affected

Section A.1.39

Table A-1

Section B.2.39

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.1.39	**Page A-25**	**New Sentence in Paragraph**

In response to request for additional information (RAI) B.2.4-1a regarding aging management of high strength structural bolting and related Structures Monitoring Program enhancements, LRA Section A.1.39, "Structures Monitoring Program," is revised to read as follows:

A.1.39 Structures Monitoring Program

The Structures Monitoring Program manages age-related degradation of plant structures and structural components within the scope of the program to ensure that each structure or structural component retains the ability to perform its intended function. Aging effects are detected by visual inspection of external surfaces prior to the loss of the structure's or component's intended function. Visual inspections are supplemented by volumetric examination or by feel (for elastomers), as needed. The Structures Monitoring Program encompasses and implements the Water Control Structures Inspection and the Masonry Wall Inspection. This program implements provisions of the Maintenance Rule, 10 CFR 50.65, that relate to structures, masonry walls, and water control structures. Concrete, masonry walls and other structural components that perform a fire barrier intended function are also managed by the Fire Protection Program.

Affected LRA Section	LRA Page No.	Affected Paragraph and Sentence
Table A-1	**Page A-67**	**Commitment No. 20**

In response to RAI B.2.4-1a regarding aging management of high strength structural bolting and related Structures Monitoring Program enhancements, license renewal future Commitment 20 in LRA Table A-1, "Davis-Besse License Renewal Commitments," is revised to include three new bulleted commitments as follows:

Table A-1
Davis-Besse License Renewal Commitments

Item Number	Commitment	Implementation Schedule	Source	Related LRA Section No./ Comments
20	Enhance the Structures Monitoring Program to: • *Require that high strength (i.e., ASTM A540 Grade B23) structural bolting materials with an actual measured yield strength greater than or equal to 150 kilo-pounds per square inch (ksi) and greater than 1 inch in nominal diameter are monitored for stress corrosion cracking (SCC). Perform periodic visual inspections of susceptible ASTM A540 bolting to identify locations where A540 bolting may be exposed to a potentially corrosive environment for SCC. Complete the initial visual inspections prior to entering the period of extended operation, and perform recurring inspections at an interval not to exceed five years. Perform volumetric examination (i.e., ultrasonic testing) on a sampling basis of bolting exposed to a corrosive environment, as determined by engineering evaluation, to a depth of at least 12 inches.*	Prior to April 22, 2017	LRA and *FENOC Letters L-11-153, L-11-237, L-11-292, L-11-317, and L-12-455*	A.1.39 B.2.39 *Responses to NRC RAIs B.2.39-4, B.2.39-5, B.2.39-6 and B.2.39-7 from NRC Letter dated April 5, 2011, B.2.39-11 and*

Table A-1
Davis-Besse License Renewal Commitments

Item Number	Commitment	Implementation Schedule	Source	Related LRA Section No./ Comments
	• *Require that personnel performing ultrasonic testing (UT) examinations of structural bolting have a current ASME Code Section XI, Appendix VIII, Supplement 8 endorsement.* • *Revise the applicable structural bolting specifications to prevent future use of A540 bolting with measured yield strength equal to or exceeding 150 ksi.*			*3.5.2.3.12-4 from NRC Letter dated July 21, 2011, Supplemental RAI B.2.39-11 from telecon held with the NRC on September 13, 2011, Supplemental RAI OIN-380 from Region III IP-71002 Inspection, and, RAI B.2.4-1a from NRC Letter dated November 14, 2012*

Affected LRA Section	LRA Page No.	Affected Paragraph and Sentence
B.2.39	Pages B-154 thru B-160	2 New Enhancements

In response to RAI B.2.4-1a regarding aging management of high strength structural bolting and related Structures Monitoring Program enhancements, LRA Section B.2.39, "Structures Monitoring Program," subsection titled "Enhancements," is revised to include three new enhancements, to read as follows:

Enhancements

- **Preventive Actions**

  Revise the applicable structural bolting specifications to prevent future use of A540 bolting with measured yield strength equal to or exceeding 150 ksi.

- **Detection of Aging Effects**

  Require that high strength (i.e., ASTM A540 Grade B23) structural bolting materials with an actual measured yield strength greater than or equal to 150 kilo-pounds per square inch (ksi) and greater than 1 inch in nominal diameter are monitored for stress corrosion cracking (SCC). Perform periodic visual inspections of susceptible ASTM A540 bolting to identify locations where A540 bolting may be exposed to a potentially corrosive environment for SCC. Complete the initial visual inspections prior to entering the period of extended operation, and perform recurring inspections at an interval not to exceed five years. Perform volumetric examination (i.e., ultrasonic testing) on a sampling basis of bolting exposed to a corrosive environment, as determined by engineering evaluation, to a depth of at least 12 inches.

- **Detection of Aging Effects**

  Require that personnel performing ultrasonic testing (UT) examinations of structural bolting have a current ASME Code Section XI, Appendix VIII, Supplement 8 endorsement.