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L-15-309

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
License Renewal Application Amendment No. 60 (TAC No. ME4640)

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). Based on the results of the Shield Building monitoring activities performed in 2015, and discussions during the Advisory Committee on Reactor Safeguards License Renewal Subcommittee Meeting held September 23, 2015, the License Renewal Shield Building Monitoring Program is revised to include additional actions.

The Enclosure provides Amendment No. 60 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 October 6, 2015.

Sincerely,

Brian D. Boles

Brian D. Boles

Enclosure:
Amendment No. 60 to the Davis-Besse License Renewal Application

cc: NRC DLR Project Manager
NRC Region III Administrator

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

Enclosure

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

Letter L-15-309

Amendment No. 60 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**	**2 new Paragraphs**

Based on the results of the Shield Building monitoring activities performed in 2015, and discussions during the Advisory Committee on Reactor Safeguards License Renewal Subcommittee Meeting held September 23, 2015, LRA Section A.1.43, "Shield Building Monitoring Program," 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 for the inspections are chosen from the core bores that have been installed in the subcomponents of the Shield Building Wall, including new core bores installed to identify changes in the limits of cracking in areas with previously identified crack propagation. *The representative sample size includes a minimum of ~~23~~28 core bore inspection locations in the subcomponent population (defined as Shield Building Wall subcomponents*

having the same material, environment, and aging effect combination). The ~~23~~28 core bore location distribution has been chosen to include core bore inspections in ~~8~~9 of the 10 flute shoulders with a high prevalance 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. In addition, past evidence of crack propagation is considered in choosing future inspection locations.

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.

The Shield Building Monitoring Program also includes the performance of Impulse Response (IR) mapping. IR mapping will be performed on eight 100 square foot areas; four areas will be performed in 2016, and four areas in 2018. Two of these grids will be in areas away from existing core bores, but in known crack areas to monitor any changes in the leading edges. Two of these grids will be in areas not currently known to contain laminar cracking and away from existing core bores to establish cracking has not expanded into these areas. The locations for inspection by IR will be chosen based on a sample of the exposed exterior of the Shield Building and will be conducted to identify changes in the limits of cracking outside the areas inspected by core bores.

Additionally, IR mapping is used to supplement visual inspections at areas of identified propagation in leading edge core bores. In these cases, IR mapping is completed on a minimum area of 100 square feet in the vicinity of the core bore to provide a relative indication of the extent of cracking propagation for condition monitoring. IR mapping is performed in accordance with vendor procedures.

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; Detection of Aging Effects; Monitoring and Trending; Acceptance Criteria; and Operating Experience (paragraphs 1 & 2)**

Based on the results of the Shield Building monitoring activities performed in 2015 and discussions during a recent Advisory Committee on Reactor Safeguards License Renewal Subcommittee Meeting, LRA Section B.2.43, "Shield Building Monitoring Program," 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.

The Shield Building Monitoring Program will also include the performance of Impulse Response (IR) mapping. IR mapping will be performed on eight 100 square foot areas; four areas will be performed in 2016, and four areas in 2018. Two of these grids will be in areas away from existing core bores, but in known crack areas to monitor any changes in the leading edges. Two of these grids will be in areas not currently known to contain laminar cracking and away from existing core bores to establish cracking has not expanded into these areas. The locations for inspection by IR will be chosen based on a sample of the exposed exterior of the Shield Building and will be conducted to identify changes in the limits of cracking outside the areas inspected by core bores.

Additionally, IR mapping will be used to supplement visual inspections at areas of identified propagation in leading edge core bores. In these cases, IR mapping will be completed on a minimum area of 100 square feet in the vicinity of the core bore to provide a relative indication of the extent of cracking propagation for condition monitoring. IR mapping will be performed in accordance with vendor procedures.

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 at a five-year interval 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 Methods**
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", and the followup report, "Shield Building Laminar Crack Propagation", 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 inspections will be chosen from the core bores that have been installed in the subcomponents of the Shield Building Wall, including new core bores installed to identify changes in the limits of cracking in areas with previously identified crack propagation. *The representative sample size includes ~~23~~28 core bore inspection locations in the subcomponent population (defined as Shield Building Wall subcomponents having the same material, environment, and aging effect combination).* A minimum of 10 of the core bores at inspection locations are currently uncracked; however, are adjacent to areas of known cracking. This strategic location, and selection of core bores provides FENOC with the ability to monitor for crack propagation. *The ~~23~~28 core bore location distribution has been chosen to include core bore*

inspections in ~~8~~9 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. In addition, past evidence of crack propagation will be considered in choosing future inspection locations. ~~*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. The first inspection conducted during the period of extended operation is scheduled for 2017 and the next inspection is scheduled for 2018. If no aging effects are identified by the one-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 two years through 2026. If no aging effects are identified by the two-year interval visual inspections, then the frequency of visual inspections may be changed to at least once every four 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 or parameters that need to be inspected.

Visual inspections will be supplemented by other established nondestructive examination (NDE) techniques and testing. The Shield Building Monitoring Program includes the performance of IR mapping. IR mapping will be performed on eight 100 square foot areas; four areas will be performed in 2016, and four areas in 2018. Two of these grids will be in areas away from existing core bores, but in known crack areas to monitor any changes in the leading edges. Two of these grids will be in areas not currently known to contain laminar cracking and away from existing core bores to establish cracking has not expanded into these areas. The locations for inspection by IR will be chosen based on a sample of the exposed exterior of the Shield Building and will be conducted to identify changes in the limits of cracking outside the areas inspected by core bores.

Additionally, IR mapping will be used to supplement visual inspections at areas of identified propagation in leading edge core bores. In these cases, IR mapping will be completed on a minimum area of 100 square feet in the vicinity of the core bore to provide a relative indication of the extent of cracking propagation for condition monitoring. IR mapping will be performed

in accordance with vendor procedures. If crack growth is determined to have occurred, it will be entered into the FENOC Corrective Action Program.

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 a minimum of ~~23~~28 core bore inspection locations in the Shield Building Wall subcomponent population having the same material, environment, and aging effect combination. A minimum of ~~10~~14 of the core bores at inspection locations are currently uncracked; however, are adjacent to areas of known cracking.* This strategic location, and selection of core bores provides FENOC with the ability to monitor for crack propagation. *The ~~23~~28 core bore location distribution has been chosen to include core bore inspections in ~~8~~9 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. In addition, past evidence of crack propagation will be considered in choosing inspection locations. *In areas of identified laminar crack planer propagation, IR mapping will be completed on a minimum area of 100 square feet in the vicinity of the core bore to provide a relative indication of the extent of cracking propagation for condition monitoring.* 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. 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:

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

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.

IR mapping is a technique that is used to identify cracked and uncracked concrete, and, as such, there is no acceptance criteria for IR mapping. Concrete determined to be cracked during IR mapping will be compared to

the building baseline inspection. If crack growth is determined to have occurred, it will be entered into the FENOC Corrective Action Program.

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.

- 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. 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 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 has provided OE relevant to the Shield Building Monitoring Program.

Inspections of 12 core bores were completed in 2013 under the "Design Guidelines for Maintenance Rule Evaluation of Structures" Procedure EN-DP-01511. During that cycle of inspections, a newly identified crack was observed in one of the core bores. This finding, upon a review of records, was determined to be a pre-existing crack given that the extracted concrete core was cracked at the location identified. Given this finding, all available core bores were re-inspected. This re-inspection identified a total of 7 core bores with similar conditions of newly identified cracking that were determined to be pre-existing. This re-inspection also identified 8 conditions where the laminar cracking conditions were determined to have undergone a discernable change.

This total of 8 core bores did not represent 8 individual crack leading edges. The findings of discernable change were a combination of:

- previously uncracked core bores now being cracked,
- multiple core bores intersecting advancement in the same crack plane, and
- previously cracked core bores now intersecting multiple crack planes (evidence of new cracking offshoot planes in previously cracked core bores).

The cracking propagation was determined to be a result of ice-wedging (freezing water at a pre-existing crack leading edge). This condition requires water, freezing temperatures and pre-existing cracks. Because the Shield Building has been coated it contains a finite amount of water. It is not practical to remove the water in an accelerated manner given the cumulative magnitude of leading crack edges, and transportability of water. It is also not practical to remove the existing cracks or prevent freezing temperatures. The rate of cracking propagation is estimated at 0.4 to 0.7 inches per freezing cycle based on laboratory simulation. By application of the evaluation criteria

hierarchy of ACI 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures," Figure 5.1, the condition was acceptable through evaluation. 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 USAR functions.

Inspections of 23 core bores were completed in 2015 under procedure EN-DP-01511, "Design Guidelines for Maintenance Rule Evaluation of Structures." During that cycle of inspections, cracking propagation was observed in two of the locations where propagation was identified in 2013, as well as in one additional location.

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 FENOC Calculation C-CSS-099.20-063 and Calculation C-CSS-099.20-069, 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, 2013 and 2015.*

Referencing the Evaluation criteria hierarchy of ACI 349.3R, Figure 5.1, the 2013 condition and the 2015 condition ~~was~~were determined to be acceptable through evaluation. The conditions ~~was~~were not passive; however, ~~it was~~they were bounded by design basis documentation. The laminar cracking condition will therefore be subjected to increased monitoring to ensure conformance with the design requirements and USAR functions.

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.