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U.S. Nuclear Regulatory Commission
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Peach Bottom Atomic Power Station, Units 2 and 3
Facility Operating License Nos. DPR-44 and DPR-56
NRC Docket Nos. 50-277 and 50-278

Subject: Response to Request for Additional Information Related to Aging Management of Containment, Structures, and Component Supports

Reference: Letter from R. K. Anand (USNRC) to M. P. Gallagher (Exelon), dated March 1, 2002

Dear Sir/Madam:

Exelon Generation Company, LLC (Exelon) hereby submits the enclosed responses to the request for additional information transmitted in the reference letter. For your convenience, attachment 1 restates the questions from the reference letter and provides our responses.

If you have any questions or require additional information, please do not hesitate to call.

I declare under penalty of perjury that the foregoing is true and correct.

Respectfully,

Executed on 5-21-02

Michael P. Gallagher
Director, Licensing & Regulatory Affairs
Mid-Atlantic Regional Operating Group

Enclosures: Attachment 1

cc: H. J. Miller, Administrator, Region I, USNRC
A. C. McMurtray, USNRC Senior Resident Inspector, PBAPS

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ATTACHMENT 1

Exelon Generation Company, LLC (Exelon)
License Renewal Application (LRA)
Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3

Request for Additional Information

3.5 AGING MANAGEMENT OF CONTAINMENT, STRUCTURES, AND COMPONENT SUPPORTS

RAI 3.5-1 Considering the vulnerability of concrete components, the staff has required previous license renewal applicants to implement an aging management program to manage the aging of concrete components. The staff position is that cracking, loss of material, and change in material properties are plausible and applicable aging effects for concrete components inside containment as well as for other structures outside containment. For inaccessible concrete components the staff does not require aging management if the applicant is able to show that the soil/water environment is nonaggressive; however, for all other concrete components inspection through an aging management program is required. Provide justification for concluding that there are no applicable aging effects for each of the concrete components, including concrete block walls, listed in Section 3.5 of the LRA.

Response:

PBAPS aging management reviews (AMRs) concluded that concrete and block wall aging effects are non-significant, will not result in a loss of intended function, and thus require no aging management. The AMRs are based on guidelines for implementing the requirements of 10CFR Part 54, developed jointly by the NRC and the industry, that are documented in NEI 95-10. The AMR results are also confirmed by PBAPS operating experience.

Exelon therefore is not in agreement with the staff's position, that PBAPS concrete and block wall aging effects require aging management. However, we recognize that, contrary to our experience, the staff is concerned that unless concrete and block wall aging effects are monitored they may lead to a loss of intended function. As a result, we will monitor concrete and block wall structures, in accessible areas, for loss of material, cracking and change in material properties. The PBAPS Maintenance Rule Structural Monitoring Program (B.1.16) will be used to monitor the structures.

As indicated in the RAI, the staff does require aging management of concrete in inaccessible areas if the soil/water environment is not aggressive. According to NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal," the water environment is considered aggressive for concrete if pH < 5.5, sulfates > 1500 ppm, and chlorides > 500 ppm. In response to RAI B.1.16-1 we provided water chemistry results that show the PBAPS water environment is not aggressive (pH = 7.2, sulfates = 38 ppm, and chlorides = 24 ppm). Consequently, aging management of concrete in inaccessible areas is not required.

RAI 3.5-2 Considering the vulnerability of steel components, the staff has required all previous license renewal applicants to implement an aging management program to manage the aging of steel components. The staff position is that loss of material is a plausible and applicable aging effect for steel components inside containment as well as for other structures outside containment. For steel imbedded in concrete in inaccessible areas, the staff does not require aging management if the applicant is able to show that the soil/water environment is nonaggressive. Provide justification for concluding that there are no applicable aging effects for each of the following steel components:

1. all carbon steel components inside containment (i.e., structural supports, pipe whip restraints, missile barriers, and radiation shields)

2. all carbon steel components in outdoor, sheltered, buried, and water environments outside containment:
   a. reactor building (Table 3.5-2)
   b. radwaste building and reactor auxiliary bay (Table 3.5.3)
   c. turbine building and main control room complex (Table 3.5.4)
   d. emergency cooling tower and reservoir (Table 3.5.5)
   e. station blackout structure and foundation (Table 3.5.6)
   f. yard structures (Table 3.5.7)
   g. nitrogen storage building (Table 3.5.9)
   h. diesel generator building (Table 3.5.10)
   i. circulating water pump structure (Table 3.5.11)
   j. recombiner building (Table 3.5.12)
   k. component supports (Table 3.5.13)
   l. hazard barriers and elastomers (Table 3.5.14)
   m. miscellaneous steel (Table 3.5.15)
   n. electrical and instrumentation enclosures and raceways (Table 3.5.16)

Response:

A. Carbon Steel in Sheltered Environment

PBAPS aging management reviews (AMRs) concluded that carbon steel exposed to a sheltered environment would be subjected to non-significant loss of material due to atmospheric corrosion. The estimated reduction in material thickness will not significantly degrade the load bearing capacity of structural members and thus will not adversely impact their intended function. The AMRs are based on guidelines for implementing the requirements of 10CFR Part 54, developed jointly by the NRC and the industry, and are documented in NEI 95-10. The AMR results are also confirmed by PBAPS operating experience.

Exelon's position is that loss of material for carbon steel in PBAPS sheltered environment is non-significant and requires no aging management. The position is supported by AMRs performed in accordance with industry guidelines for implementing the requirements of 10 CFR Part 54, and by PBAPS operating experience. The position and its justification were discussed with NRC staff on January 28, 2002 in a telephone call. The staff indicated that it does not agree with the Exelon position and an aging management activity is required to ensure the intended function is maintained through the extended term of operation. As a result, Exelon will monitor carbon steel components in the sheltered environment as described below.

1. Containment Structure (Table 3.5-1). Carbon steel components in accessible areas inside containment (i.e., structural supports, pipe whip restraints, missile barriers, and radiation shields) will be monitored for loss of material due to corrosion. The PBAPS Maintenance Rule Structural Monitoring Program (B.1.16) will be used for structural steel components other than Class MC

component supports. Class MC component supports will be monitored using the Primary Containment Inservice Inspection Program (B.1.9).

2. Structural steel components in accessible areas of buildings outside the primary containment will be monitored for loss of material due to corrosion using the PBAPS Maintenance Structural Monitoring Program (B.1.16). Specific buildings are:

    - Reactor building (Table 3.5-2)
    - Radwaste building and reactor auxiliary bay (Table 3.5-3)
    - Turbine building and main control room complex (Table 3.5-4)
    - Emergency cooling tower and reservoir (Table 3.5-5)
    - Station blackout structure and foundation (Table 3.5-6)
    - Yard structures (Table 3.5-7)
    - Nitrogen storage building (Table 3.5-9)
    - Diesel generator building (Table 3.5-10)
    - Circulating water pump structure (Table 3.5-11)
    - Recombiner building (Table 3.5-12)

    Carbon steel components included in the commodity groups listed in LRA Tables 3.5-13 through 3.5-16 will be monitored for loss of material due to corrosion as discussed below:

    - Component supports (Table 3.5-13). Structural steel members, other than ASME Class 1, 2, or 3 component supports, and anchors for all supports will be monitored using the PBAPS Maintenance Rule Structural Monitoring Program (B.1.16). Carbon steel support members for ASME Class 1, 2, or 3 components will be monitored using Inservice Inspection (ISI) Program (B.1.8).

    - Hazard barriers and elastomers (Table 3.5-14). Carbon steel components included in this commodity group are fire barrier doors and other hazard barrier doors. As indicated in the Table 3.5-14, Fire Protection Activities (B.2.9) is credited for managing loss of material of fire barrier doors in the sheltered environment. Loss of material of other hazard barrier doors in the sheltered environment will be monitored using Door Inspection Activities (B.2.6).

    - Miscellaneous Steel (Table 3.5-15). Carbon steel components in the sheltered environment will be monitored by the PBAPS Maintenance Rule Structural Monitoring Program (B.1.16).

    - Electrical and Instrumentation Enclosures and Raceways (Table 3.5-16). Carbon steel components in this commodity group are constructed of factory baked painted steel or galvanized castings and sheet metal. The components are located in a sheltered environment, which is non-aggressive and does not contain high moisture. In some locations, such as the main control room, and the emergency switchgear room, the environment is air conditioned and controlled. As documented in NUREG/CR-4715, "Aging Assessment of Relays and Circuit Breakers and System Interactions," the components do not have a tendency to age with time.

Industry operating experience with metal housing systems, in similar environments, indicates that they have performed without failure to the present as documented in SAND93-7069, "Aging Management Guideline for Commercial Nuclear Power Plants-Motor Control Centers," and SAND93-7027, "Aging Management Guideline for Commercial Nuclear Power Plants-Electrical Switchgear." PBAPS operating experience is consistent with the industry operating experience. As a result, our position remains that loss of material, due to corrosion, will not impact the intended function of components listed in Table 3.5-16. Thus, no aging management is required.

B. Carbon Steel in Outdoor Environment:

PBAPS aging management reviews (AMRs) concluded that carbon steel exposed to an outdoor environment is susceptible to significant loss of material due to corrosion, except for manhole covers (Table 3.5-15) and galvanized carbon steel electrical conduit (Table 3.5-16). The Maintenance Rule Structural Monitoring Program (B.1.16), the Inservice Inspection (ISI) Program (B.1.8), the Fire Protection Activities (B.2.9), or the Door Inspection Activities (B.2.6) are credited for managing the loss of material aging effect as indicated in Tables 3.5-2, 3.5-6, 3.5-13, and Table 3.5-14. Manhole covers and galvanized carbon steel electrical conduits require no aging management based on the following engineering rationale.

Manhole covers are heavy-duty type gray iron castings, manufactured by NEENAH Foundry Company to ASTM A48.74, AASHTO M105-621, and Federal QQI-625c standards. The higher silicon content and the presence of graphite flakes contained in the ferrous materials for these castings provide natural corrosion resistance. The covers have been widely used by utilities and highway departments in extreme/severe outdoor environment for several decades. Experience with the covers has shown that loss of material due to corrosion is non-significant and will not impact the intended function of the covers. As a result, aging management of manhole covers is not required.

PBAPS AMRs determined that hot dipped galvanized carbon steel components in the outdoor environment are susceptible to loss of material due to corrosion. The corrosion however is limited to surface discoloration and light rust, which has no impact on the intended function of the components. As a result, the AMRs concluded that an aging management activity is not required.

Galvanized carbon steel components in an outdoor environment listed in Table 3.5-16 are limited to rigid electrical conduits, which protect and support cables credited for fire safe shutdown. Exelon's position is that an aging management activity is not required to ensure, with reasonable assurance, the conduits will continue to perform their intended function through the extended term of operation. However, the NRC staff wants an aging management activity. Thus, we will monitor the conduits for loss of material due to corrosion through the PBAPS Fire Protection Activities (B.2.9).

C. Carbon Steel in Buried Environment:

The only carbon steel structural components in a buried environment, which are within the scope of license renewal, are foundation piles for the diesel generator building (Table 3.5-10). As discussed in PBAPS Updated Final Safety Analysis Report (UFSAR) Section 12.2.5, the building is founded on steel H piles and concrete shear walls, which are supported on rock. Selection of steel piles is based on the results of foundation studies considering field explorations and laboratory tests. The piles are driven to refusal and designed for a maximum load of 60 tons per pile. They support only gravity loads while the shear walls support lateral loads.

The piles were driven into the reclaimed area of Conowingo Pond or in the backfilled areas where the rock was excavated during plant construction. According to EPRI TR-103842, "Class I Structures License Renewal Industry Report; Revision 1," and NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal," steel piles driven in undisturbed soils have been unaffected by corrosion and those driven in disturbed soil experience minor to moderate corrosion to a small area of the metal. Thus, the loss of material aging effect, due to corrosion, is non-significant and will not impact the intended function of piles.

D. Carbon Steel in Water Environment:

Carbon steel components in a water environment are susceptible to loss of material aging effect. The aging effect is managed as specified in the LRA Tables; except for sluice gates listed in Table 3.5-11. The sluice gates are discussed in more detail in response to RAI 3.5-3.

RAI 3.5-3 No aging effects are identified in Table 3.5.1- 3.5.14 in the LRA for the components listed below:

1. Bronze/graphite pressure suppression chamber lubrite plates (Table 3.5-1)
2. Cast iron sluice gates in raw water (Table 3.5-11)
3. Grout (Table 3.5-13)
4. Bronze/graphite lubrite plates (Table 3.5-13)
5. Neoprene Reactor Building blowout panel seals (Table 3.5-14)
6. Silicone Reactor Building metal siding gap seals (Table 3.5-14)

Lubrite plates are susceptible to loss of mechanical function, cast iron sluice gates in raw water are susceptible to loss of material, grout is susceptible to cracking, and neoprene and silicone seals are susceptible to change in material properties and cracking. Provide justification for concluding that there are no aging effects for each of these components.

Response:

1. Bronze/graphite pressure suppression chamber lubrite plates (Table 3.5-1). Lubrite is the trade name for a low-friction lubricant material used in applications where relative motion (sliding) is desired. At PBAPS, lubrite plates are incorporated in the design of limited

component supports to reduce or release horizontal loads due to temperature transients and SRV discharges.

PBAPS AMRs determined that there are no known aging effects for the lubrite material that would lead to a loss of intended function. As explained by previous applicants and concurred by the staff, lubrite resists deformation, has a low coefficient of friction, resists softening at elevated temperatures, absorbs grit and abrasive particles, is not susceptible to corrosion, withstands high intensities of radiation, and will not score or mar. In addition, lubrite products are solid, permanent, completely self-lubricating, and require no maintenance as documented in NUREG-1759, "Safety Evaluation Report Related to the License Renewal of Turkey Point Nuclear Plant, Units 3 and 4." A search of PBAPS and industry operating experience found no reported instances of lubrite plate degradation or failure to perform their intended function. On this basis Exelon maintains that lubrite plates require no aging management.

2. Cast iron sluice gates in raw water (Table 3.5-11). We concur that cast iron in a raw water environment is susceptible to loss of material aging effect. However, the cast iron sluice gates are designed to operate in PBAPS raw water environment and conform to American Water Works Association (AWWA) Specification C-501. The heavy-duty gates are constructed from high-strength gray iron, which conforms to ASTM A-126, Class B. We expect, therefore, that any loss of material will be non-significant and will not impact the intended function of the sluice gates. On this basis we concluded an aging management activity is not required.

   Considering that the staff expects an aging management activity for all plausible aging effects, whether they impact an intended function or not, we will monitor loss of material of the sluice gates using the Outdoor, Buried, and Submerged Component Inspection Activities (B.2.5).

3. Grout (Table 3.5-13). As in concrete components, PBAPS AMRs did not identify any aging effect for grout that will result in a loss of its intended function. As a result, we concluded that an aging management activity is not required. However, considering the staff's position on concrete, we will monitor accessible grout for cracking using the PBAPS Maintenance Rule Structural Monitoring Program (B.1.16).

4. Bronze/graphite lubrite plates (Table 3.5-13). See item 1 above.

5. Neoprene Reactor Building blowout panel seals (Table 3.5-14). PBAPS AMRs determined that the neoprene seals are susceptible to change in material properties and cracking, due to thermal exposure and ionizing radiation, only if the operating temperature exceeds 160°F or the radiation limits exceed 10^6 rads. The seals for the reactor building blowout panels are located in an environment where the temperature does not exceed 112° F and the maximum total integrated gamma dose is less than 3.5×10^5 rads for 60 years. On this basis the AMRs concluded that change in material properties and cracking aging effects are not applicable to the reactor building blowout panel seals.

6. Silicone Reactor Building metal siding gap seals (Table 3.5-14). The silicone seal specified for the reactor building metal siding is either Dow Corning product No. 732 or 790. According to Dow Corning materials group the products are capable of sustaining long-term temperature greater than 158° F. The lowest threshold radiation dose for silicone is 10^6 Rads. The silicone seals for the reactor building metal siding are located in an environment

where the temperature does not exceed 112° F and the maximum total integrated gamma dose is less than $3.5x10^5$ rads for 60 years. On this basis, PBAPS AMRs concluded that change in material properties and cracking aging effects are not applicable to the reactor building metal siding silicone seals.

3.5.1 Containment Structure

RAI 3.5.1-1 The environment inside containment may accelerate the aging (i.e., cracking loss of material, change in material properties) of the structural steel and concrete components listed in Table 3.5-1 of the LRA. Please provide information regarding the operating temperature (range), humidity, cumulative radiation (neutron, gamma) and medium (nitrogen, water, etc) for all the components in Table 3.5-1.

Response:

The two environments listed in Table 3.5-1 are "Sheltered" and "Torus Water". Sheltered environment applies to components in the drywell and pressure suppression chamber air space. Torus water environment applies only to the submerged components inside the suppression chamber. Operating conditions for each environment are:

> Drywell sheltered environment is described on LRA page 3-6. The environment is inerted with nitrogen to maintain oxygen content at less than 4%. The normal operating temperature range is 65° F - 145° F (Note: 150° F in the LRA for the drywell is in error. The Technical Specification limit is 145° F.) and the relative humidity range is 10% - 90%. The suppression chamber air space sheltered environment operating temperature ranges from 65° F - 135° F and relative humidity range is 10% -90%.
>
> Cumulative radiation limits inside the primary containment are location specific. The projected cumulative neutron fluence radiation for 60 years inside primary containment drywell, just outside the sacrificial shield wall, is $1.16x10^{15}$ n/cm^2. The bounding gamma radiation dose for 60 years is estimated to be $8.0x10^9$ Rads. Components in Table 3.5-1 were evaluated for these values.
>
> Torus water environment is described on LRA page 3-5 under the heading of Torus Grade Water. Quality of this water is monitored periodically and maintained in accordance with station procedures that include recommendations from EPRI TR-103515, "BWR Water Chemistry Guidelines." Average normal water temperature is equal to or less than 95° F.

RAI 3.5.1-2 The reactor pedestal, foundation, and floor slab support the reactor vessel, interior floors, equipment, and piping in the drywell. Since these concrete components are also subjected to the harsh environment of containment (i.e., high temperatures and radiation), the staff considers cracking and possibly change in material properties to be plausible and applicable aging effects. Please provide justification as to how their intended functions will be maintained without some type of aging management program during the period of extended operation.

Response:

The normal operating temperature range for the primary containment drywell is 65° F to145° F. The cumulative gamma radiation level is $8.0x10^9$ Rads and neutron fluence limit is 1.16×10^{15}

n/cm^2. The temperature range and irradiation limits do not exceed the level specified in NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal." Thus, the impact of temperature and irradiation on the reactor pedestal, foundation, and floor slab are non-significant and require no aging management during the period of extended operation.

Therefore, Exelon believes that concrete for the reactor pedestal, foundation, and floor slab requires no aging management activity. However, as stated in response to RAI 3.5-1, we will monitor concrete structures, in accessible areas, for loss of material, cracking, and change in material properties. The PBAPS Maintenance Rule Structural Monitoring Program (B.1.16) will be used to monitor the structures.

RAI 3.5.1-3 The sacrificial shield wall performs the function of providing shielding as well as support for earthquake ties, which are required to stabilize the drywell during a postulated earthquake. The shield wall is subjected to varying temperatures (expansion and contraction), vibratory loads during SRV discharges (steam environment), and significant radiation. As such, the staff considers cracking, loss of material, and possibly change in material properties to be plausible and applicable aging effects for the sacrificial shield wall. Please provide justification as to how their intended functions will be maintained without some type of aging management program during the period of extended operation.

Response:

Design basis of the sacrificial shield wall is described in UFSAR Section C.4.6. The wall is composed of concrete and embedded structural steel columns continuously tied with ¼ inch thick steel plate. The concrete, which is encased in the ¼ inch steel plate, is designed primarily for shielding. The steel columns and the ¼ inch thick steel plate are designed to transfer seismic and service loads to the supporting reactor pedestal. The sacrificial shield wall is not subject to SRV loads or steam environment during normal plant operation. Each SRV discharge is piped through its own discharge line to a point below the minimum water level in the primary containment suppression chamber (torus). The primary containment drywell and the suppression chamber are separate structures; thus, the SRV vibratory loads are not applicable to the sacrificial shield wall.

Aging management reviews for the wall considered both concrete and carbon steel components of the wall. For carbon steel components, the aging management reviews identified loss of material due to corrosion, loss of strength and modulus due to elevated temperature, and loss of fracture toughness and ductility due to irradiation as potential aging effects. For concrete components, the reviews identified change in material properties due to elevated temperature and irradiation as a potential aging effect. The reviews concluded that the aging effects for both carbon steel and concrete components are non-significant and will not impact the intended function of the wall; therefore, no aging management is required. Justification for this conclusion is provided in more detail in our response to RAI 3.5-2 above.

Loss of strength and modulus due to elevated temperature for carbon steel is non-significant if the temperature is less than 700° F. The drywell temperature is maintained at 145° F or less. Thus, the aging effect is non-significant and requires no aging management.

According to NUREG-1557, loss of fracture toughness and ductility due to irradiation of carbon steel is non-significant if neutron fluence levels do not exceed 2×10^{17} n/cm^2. EPRI TR-103842, "Class I Structures License Renewal Industry Report; Revision 1," states that currently available data indicate that the effect of irradiation on mechanical properties of steel are measurable at 1 x 10^{18} n/cm^2. The estimated maximum neutron fluence, just outside the sacrificial shield wall is 1.16x 10^{15} n/cm^2 for 60 years. Thus, the aging effect is non-significant and requires no aging management.

For concrete elements of the wall, aging management reviews identified change in material properties due to elevated temperature and irradiation as a potential aging effect that could impact its intended function. The reviews, however, concluded that the effect of temperature is non-significant since containment general air temperature is maintained below 150° F, and there are no known areas of localized air temperatures greater than 200° F. Similarly, irradiation effects are ruled non-significant since the neutron fluence and gamma radiation are below the threshold limits specified in NUREG-1557 (5x 10^{19} n/cm^2 and 1 x 10^{10} rads). Therefore, an aging management activity is not required for concrete elements of the sacrificial shield wall.

Exelon's position is that carbon steel and concrete elements of the sacrificial shield wall require no aging management, as justified above. The position and its justification were discussed with NRC staff on January 28, 2002 in a telephone call. The staff indicated that it does not agree with the Exelon position and an aging management activity is required for accessible areas of the sacrificial shield wall. As a result, we will monitor accessible carbon steel components for loss of material and cracking using PBAPS Maintenance Rule Structural Monitoring Program (B.1.16). Concrete elements of the wall are encased in carbon steel plate and are not accessible for inspection.

RAI 3.5.1-4 The columns, saddle supports, and seismic restraints associated with the pressure suppression chamber are affected by the expansion and contraction of the major diameter of the torus induced by SRV discharges and temperature transients. In one case, the staff has seen pullout of the anchor-bolts of the column supports due to such movements. The staff considers loss of material for the carbon steel components of the suppression chamber and loss of mechanical function of their associated lubrite plates to be plausible and applicable aging effects. Please provide justification as to how their intended functions will be maintained without some type of aging management program during the period of extended operation.

Response:

Columns, saddle supports, and seismic restraints associated with PBAPS suppression chambers are designed with lubrite plates. The design allows for free horizontal movement of the suppression chambers and for release of horizontal loads due to temperature transients and SRV discharges. The supports transmit downward vertical load to the foundation without relying on anchor bolts. The anchor bolts are provided to prevent gross vertical uplift of the suppression chambers, if any, during a seismic event.

Suppression chamber supports and restraints were reviewed for aging effects, which could impact their intended function. Loss of material for carbon steel components due to corrosion and loss of material due to wear of the lubrite plates (caused by thermal, SRV and seismic load cycles) were identified as potential aging effects. The reviews concluded that loss of material due to corrosion in a sheltered environment is non-significant and requires no aging management activity (see RAI 3.5-2). However, as explained in response to RAI 3.5-2, suppression chamber supports and restraints (Class MC component supports) will be monitored for loss of material using PBAPS Primary Containment Inservice Inspection Program (B.1.9). Lubrite plates associated with the supports require no aging management activity as explained in response to RAI 3.5-3.