Exelon Generation

10 CFR 50.54(f)

RS-17-149

December 15, 2017

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

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

Subject: Spent Fuel Pool Evaluation Supplemental Report, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident

References:

1. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 12, 2012 (ML12053A340)
2. NRC Letter, Final Determination of Licensee Seismic Probabilistic Risk Assessments Under the Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendation 2.1 "Seismic" of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated October 27, 2015, (ML15194A015)
3. NEI Letter, transmits EPRI 3002009564 for NRC endorsement, dated January 31, 2017 (ML17031A171)
4. EPRI 3002009564, Seismic Evaluation Guidance Spent Fuel Pool Integrity Evaluation, dated January 2017
5. NRC Letter, Endorsement of Electric Power Research Institute Report 3002009564, "Seismic Evaluation Guidance: Spent Fuel Pool Integrity Evaluation", dated February 28, 2017 (ML17034A408)
6. Exelon Generation Company, LLC Letter to USNRC, Seismic Hazard and Screening Report (Central and Eastern United States (CEUS) Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 31, 2014 (RS-14-071) (ML14090A247)

7. NRC Letter to Exelon Generation Company, LLC, Peach Bottom Atomic Power Station, Units 2 and 3, Staff Assessment of Information Provided Pursuant to Title 10 of the Code of Federal Regulations Part 50, Section 50.54(f), Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated April 20, 2015 (ML15051A262)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued a Request for Information per 10CFR 50.54(f) (Reference 1) to all power reactor licensees. By letter dated October 27, 2015 (Reference 2), the NRC transmitted final seismic information request tables which identified that Peach Bottom Atomic Power Station, Units 2 and 3 is to conduct a limited scope Spent Fuel Pool Evaluation. By Reference 3, Nuclear Energy Institute (NEI) submitted an Electric Power Research Institute (EPRI) report entitled, Seismic Evaluation Guidance Spent Fuel Pool Integrity Evaluation (EPRI 3002009564) (Reference 4) for NRC review and endorsement. NRC endorsement was provided by Reference 5.

EPRI 3002009564 provides criteria for evaluating the seismic adequacy of a spent fuel pool (SFP) to the reevaluated ground motion response spectrum (GMRS) hazard levels. Section 4.3 of EPRI 3002009564 lists the parameters to be verified to confirm that the results of the report are applicable to Peach Bottom Atomic Power Station, Units 2 and 3, and that the Peach Bottom Atomic Power Station, Units 2 and 3 SFP is seismically adequate in accordance with NTTF 2.1 Seismic evaluation criteria.

The attachment to this letter provides the data for Peach Bottom Atomic Power Station, Units 2 and 3 that confirms applicability of the EPRI 3002009564 criteria and confirms that the SFP is seismically adequate in accordance with NTTF 2.1 Seismic evaluation criteria.

This letter closes Regulatory Commitment No. 2 of Reference 6.

This letter contains no new regulatory commitments or revisions to existing regulatory commitments.

If you have any questions regarding this report, please contact David J. Distel at 610-765-5517.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 15th day of December 2017.

Respectfully submitted,

D. P. Helker

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Attachment: Site-Specific Spent Fuel Pool Criteria for Peach Bottom Atomic Power Station, Units 2 and 3

cc: Regional Administrator - NRC Region I
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ATTACHMENT

Site-Specific Spent Fuel Pool Criteria for Peach Bottom Atomic Station, Units 2 and 3

The 10 CFR 50.54(f) letter requested that, in conjunction with the response to Near Term Task Force (NTTF) Recommendation 2.1, a seismic evaluation be performed for the SFP. More specifically, plants were asked to consider "all seismically induced failures that can lead to draining of the SFP." Such an evaluation would be needed for any plant in which the ground motion response spectrum (GMRS) exceeds the safe shutdown earthquake (SSE) in the 1 to 10 Hz frequency range. The staff confirmed through References A and D that the GMRS exceeds the SSE and concluded that a SFP evaluation is merited for the Peach Bottom Atomic Power Station, Units 2 and 3. By letter dated February 28, 2017 (Reference B) the staff determined that EPRI 3002009564 was an acceptable approach for performing SFP evaluations considering the GMRS hazard levels.

The table below lists the criteria from Sections 4.1 thru 4.3 of EPRI 3002009564 along with data for Peach Bottom Atomic Power Station, Units 2 and 3 that confirms applicability of the EPRI 3002009564 criteria and confirms that the SFP is seismically adequate in accordance with NTTF 2.1 Seismic evaluation criteria.

SFP Criteria from EPRI 3002009564	**Site-Specific Data**
Site Parameters	
1. The site-specific GMRS should be the same as that submitted to the NRC between March 2014 and July 2015, which the NRC has found acceptable for responding to the NRC 50.54(f) letter (Reference D).	The Peach Bottom Atomic Power Station (PBAPS) GMRS used in the SFP evaluation (Reference N) is the GMRS developed for the Peach Bottom Seismic Probabilistic Risk Assessment (SPRA). The SPRA GMRS was developed using the same approach used by EPRI to develop the GMRS that was submitted to the NRC. Additional updated source information and site-specific parameters were used in its development. Note that the GMRS developed by EPRI and submitted to the NRC only provided response spectra in the horizontal direction. For the SPRA, a vertical GMRS was also developed. The resulting vertical in-structure response spectra are used in the SFP evaluation. The GMRS developed for the SPRA was reviewed as part of the full scope peer review performed for the SPRA. The peak horizontal spectral acceleration from the GMRS developed for the SPRA is approximately 0.65g (Reference O).

Structural Parameters	
2. Site-specific calculations, performed in accordance with Section 4.1 of EPRI 3002009564 should demonstrate that the limiting SFP High Confidence of Low Probability of Failure (HCLPF) is greater than the site-specific GMRS in the frequency range of interest (e.g., 10-20 Hz).	Site-specific calculations, performed in accordance with Section 4.1 of EPRI 3002009564, demonstrate that the limiting SFP HCLPF is 0.827g, which exceeds the GMRS of 0.65g in the frequency range of interest (i.e. 10-20 Hz); therefore, this criterion is met for Peach Bottom Atomic Power Station. It should be noted that peak broadening was not used in the PBAPS analysis as used in Section C.3.7 of EPRI 3002009564. The controlling failure mode for the SFP is an out-of-plane shear (diagonal tension) crack of the floor slab, which occurs suddenly. Prior to the formation of the shear crack, there is minimal cracking due to flexure. The panel frequency was calculated using 50% of the un-cracked stiffness, consistent with EPRI Report 3002009564. Therefore, for the controlling failure mode, the frequency calculated is considered a lower bound. Note, given the shape of the in-structure response spectra based on the Peach Bottom GMRS, the lower the frequency, the higher the demand in terms of seismic acceleration. The reason for the further broadening in the EPRI report (Reference P) is to account for uncertainty in the building and soil properties. For PBAPS, there is no variation in the soil properties because the Reactor Building is founded on solid rock. Lower bound structural properties are already considered in the evaluation by use of 50% of the un-cracked stiffness. This was coupled with a conservative damping of 4%. Note that if the stiffness is reduced further, the model becomes equivalent to that of a cracked model. In this case, the damping would increase and the natural frequency of the structure would decrease. The net result would be an overall reduction in the in-structure response spectra. Given the approach used, the controlling failure mode and conservative assumptions regarding damping for generating in-structure response spectra, there is no reason to further lower the calculated frequency of the SFP slab. Therefore, this approach is considered to be consistent with the intent of the EPRI report.

3. The SFP structure should be included in the Civil Inspection Program performed in accordance with Maintenance Rule.	The SFP structure is included in the PBAPS Civil Inspection Program in accordance with 10 CFR 50.65 (Reference E); therefore, this criterion is met for PBAPS.
Non-Structural Parameters	
4. To confirm applicability of the piping evaluation in Section 4.2 of EPRI 3002009564, piping attached to the SFP should have penetrations no more than 6 ft below water surface.	As documented in site Drawings M-87 and M-156 (References F and G), the SFP piping penetrations occur at a depth not greater than 6 ft below the normal water level. Therefore, this criterion is met for PBAPS.
5. To confirm ductile behavior under increased seismic demands, SFP gates should be constructed from either aluminum or stainless steel alloys.	The SFP gate is mainly constructed from aluminum with some stainless steel parts as documented in Drawing M-1-M-61 (Reference L); therefore, this criterion is met for PBAPS.
6. Anti-siphoning devices should be installed on any piping that could lead to siphoning water from the SFP. In addition, for any cases where active anti-siphoning devices are attached to 2-inch or smaller piping and have extremely large extended operators, the valves should be walked down to confirm adequate lateral support.	Per Note 3 of Drawings M-363 Sheets 1 and 2 (References H and I), siphon breaker holes are provided on each of the lines that penetrate the SFP to prevent drain-down of the pools. Additionally, check valves are provided on all lines penetrating the pool to prevent drain-down. As described, anti-siphoning devices are installed on all lines penetrating the pool to prevent siphoning. Therefore, this criterion is met for PBAPS. No active anti-siphoning devices attached to 2-inch or smaller piping are present. Therefore, this criterion is met for PBAPS.
7. To confirm applicability of the sloshing evaluation in Section 4.2 of EPRI 3002009564, the maximum SFP horizontal dimension (length or width) should be less than 125 ft and the SFP depth should be greater than 36 ft.	The PBAPS SFP has a maximum length/width dimension of 40 ft and a depth of approximately 38' – 9" based on Drawing S-139 (Reference K); therefore, this criterion is met for PBAPS.

8. To confirm applicability of the evaporation loss evaluation in Section 4.2 of EPRI 3002009564, the SFP surface area should be greater than 500 ft^2 and the licensed reactor core thermal power should be less than 4,000 MW_t per unit.	The PBAPS SFP has a surface area of approximately 1,413 ft^2, which is greater than 500 ft^2. The licensed reactor core thermal power for each unit is 4,016 MW_t (Reference M). This is 0.4% greater than the maximum thermal power of 4,000 MW_t specified in EPRI 3002009564. This slight exceedance is judged to not have a significant impact on the plant-specific evaluations and results described in EPRI 3002009564. Appendix B to EPRI 30020099564 describes the approach for estimating site-specific boil off times. It is noted that 4,000 MW_t maximum thermal core power represents the upper range of several plants that were surveyed for representative heat loads and outage periods, rather than a limit on the applicability of the Appendix B methodology. It is also noted that the sloshing losses, which are used as input to the boil-off calculation, are based on conservative assumptions, as described in Section 3.2.3 of EPRI 3002009564. This report section describes that sloshing losses, computed in accordance with the SPID (Reference Q), are 4-5 times more than those experienced in actual seismic events. On this basis, the conservative sloshing amplitudes are judged to be an additional source of margin in the boil-off calculations. Another source of margin in the boil-off results are the site-specific results shown in Figure 4-3 of EPRI 3002009564. This plot indicates that for the two BWR cases, there is at least 100 hours beyond the required 72 hours (for uncovering upper 1/3 height of fuel assemblies). On this basis, the slight exceedance (0.4%) of reactor core thermal power is not considered to be significant. However, to confirm this assumption, a sensitivity study was performed using the sample SFP heat up and boil-off calculation in EPRI 3002009564, Appendix B. The SFP dimensions used in this calculation are similar to the dimensions of the PBAPS SFP and are therefore appropriate to be used for a sensitivity. Re-performing the sample calculation using a licensed reactor core power of 4,000 MWt provides an estimated time to boil-off to upper 1/3 of fuel assembly height ($T_{upper\text{-}third}$) of 234.6 hours. Using the 84% envelope in figure B-2 of EPRI 3002009564, a heat load of 3.598 MW can

	be extrapolated for a power level of 4,016 MW_t. This heat load provides a $T_{upper\text{-}third}$ of 234.0 hours. This 0.6 hour difference helps to confirm that the 16 MW_t overrun has a negligible impact on the time before uncover of spent fuel relative to the allowable 72 hours (<1%). Additionally, the most recent PBAPS uprate which increased the licensed thermal power from 3,951 MW_t to 4,016 MW_t was a measurement uncertainty uprate. Since this uprate took advantage of existing power measurement uncertainty, the heat load used in the stations SFP time to boil analysis remains unchanged. Therefore, any heat load information potentially used by EPRI from PBAPS in development of EPRI 3002009564 would have remained unchanged from before the power uprate. Considering the negligible exceedance of the 4,000 MW_t limit, the small impact it has on time to spent fuel uncover, and the basis for the most recent uprate, the intent of this criterion is met for PBAPS.

Attachment References:

A. NRC Letter, Final Determination of Licensee Seismic Probabilistic Risk Assessments Under the Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendation 2.1 "Seismic" of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated October 27, 2015 (ML15194A015)

B. NRC Letter, Endorsement of Electric Power Research Institute Report 3002009564, "Seismic Evaluation Guidance: Spent Fuel Pool Integrity Evaluation", dated February 28, 2017 (ML17034A408)

C. Exelon Generation Company, LLC Letter to USNRC, Seismic Hazard and Screening Report (Central and Eastern United States (CEUS) Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 31, 2014 (RS-14-071) (ML14090A247)

D. NRC Letter to Exelon Generation Company, LLC, Peach Bottom Atomic Power Station, Units 2 and 3, Staff Assessment of Information Provided Pursuant to Title 10 of the Code of Federal Regulations Part 50, Section 50.54(f), Seismic Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated April 20, 2015 (ML15051A262)

E. Procedure ER-PB-450-1006, Rev. 4, "Peach Bottom Structures Monitoring Instructions"
F. Drawing M-87, Rev. 17, Piping and Mechanical Reactor Building Unit No. 2 Plan at El. 195' – 0" Area 7
G. Drawing M-156, Rev. 12, Piping and Mechanical Reactor Building Unit No. 3 Plan at El. 195' – 0" Area 15
H. Drawing M-363 Sheet 1, Rev. 43, Unit 2 P&I Diagram Fuel Pool Cooling & Clean-up
I. Drawing M-363 Sheet 2, Rev. 44, Unit 3 P&I Diagram Fuel Pool Cooling & Clean-up
J. Drawing S-211, Rev. 3, Reactor Building – Unit #2 Spent Fuel & Dryer Separator Pools Plan
K. Drawing S-139, Rev. 5, Reactor Building Area 7&8 Interior Wall Elevations 195' – 0" to 234' – 0"
L. Drawing M-1-M-61, Rev. 1, Fuel Pool Gate Fuel Storage, Refueling System
M. NRC Letter to Exelon Generation Company, LLC, Peach Bottom Atomic Power Station, Units 2 and 3 – Issuance of Amendments Re: Measurement Uncertainty Recapture Power Uprate (CAC Nos. MF9289 and MF9290; EPID L-2017-LLS-0001), dated November 15, 2017 (ML17286A013)
N. Peach Bottom Analysis No. PS-1175, Rev. 0, "Spent Fuel Pool Integrity Evaluation"
O. Probabilistic Seismic Hazards Analysis for Peach Bottom Atomic Power Station PSHA Results Report, FUGRO CONSULTANTS, INC. PROJECT REPORT, dated September 5, 2017
P. EPRI 3002009564, Seismic Evaluation Guidance Spent Fuel Pool Integrity Evaluation, dated January 2017
Q. EPRI 1025287, Seismic Evaluation Guidance Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic, dated February 2013