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10 CFR 50
10 CFR 51
10 CFR 54

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

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: Response to NRC Request for Additional Information, dated December 13, 2018, Regarding Peach Bottom Atomic Power Station, Units 2 And 3, Subsequent License Renewal Severe Accident Mitigation Alternatives Requests for Additional Information (EPID L-2018-RNW-0013)

References:

1. Letter from Michael P. Gallagher, Exelon Generation Company, LLC (Exelon), to U.S. Nuclear Regulatory Commission (NRC) Document Control Desk, "Application for Subsequent Renewed Operating Licenses," dated July 10, 2018
2. Email from Barbara Hayes, NRC, to Michael P. Gallagher, Exelon, "Peach Bottom Atomic Power Station, Units 2 and 3, Subsequent License Renewal Severe Accident Mitigation Alternatives Requests for Additional Information (EPID L-2018-RNW-0013) dated December 13, 2018

In the Reference 1 letter, Exelon Generation Company, LLC (Exelon) submitted the Subsequent (i.e., Second) License Renewal Application (SLRA) for the Peach Bottom Atomic Power Station, Units 2 and 3 (PBAPS). In the Reference 2 email, the NRC requested additional information to support the Staff's review of Section 4.15.2 in the PBAPS SLRA Environmental Report (Appendix E to the SLRA).

Enclosure A to this letter contains a response to each of the Staff's questions.

This letter and its enclosures contain no regulatory commitments.

If you have any questions, please contact Ms. Nancy Ranek, Environmental Lead, Exelon Generation License Renewal, at 267-533-1506.

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

Executed on the 28th day of January 2019.

Respectfully,

Michael P. Gallagher
Vice President - License Renewal and Decommissioning
Exelon Generation Company, LLC

Enclosure:

A. Peach Bottom Atomic Power Station, Units 2 & 3. Responses to NRC's Requests for Additional Information Regarding Subsequent License Renewal New & Significant Information Review for Severe Accident Mitigation Alternatives

cc: Regional Administrator - NRC Region I (w/o Enclosures)
NRC Project Manager (Environmental Review), NRR-DMLR (w/o Enclosures)
NRC Project Manager (Safety Review), NRR-DMLR (w/o Enclosures)
NRC Project Manager, NRR-DORL Peach Bottom Atomic Power Station (w/o Enclosures)
NRC Senior Resident Inspector, Peach Bottom Atomic Power Station (w/o Enclosures)
Rich Janati, PADEP-BNR (w/o Enclosures)
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ENCLOSURE A

Peach Bottom Atomic Power Station, Units 2 & 3
Responses to NRC's Requests for Additional Information
Regarding
Subsequent License Renewal New & Significant Information Review
for Severe Accident Mitigation Alternatives

**ACRONYMS, ABREVIATIONS, AND INITIALISMS
USED IN RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION
CONCERNING PBAPS SAMA NEW AND SIGNIFICANT INFORMATION REVIEW**

ACRONYM, ABREVIATION OR INITIALISM	FULL TEXT
AC	Accident Class
BWR	Boiling water reactor
CCF	Common cause failure
CDF	Core damage frequency
CRD	Control rod drive
DR	Dose risk
EPU	Extended power uprate
FLEX	Diverse and Flexible Mitigation Capability
FPIE	Full Power Internal Events
FPRA	Fire Probabilistic Risk Assessment
FV	Fussell-Vesely
HCVS	Hardened containment ventilation system
H/E	High/Early
HE-BOC	High Early-Break outside containment
H/I	High/Intermediate
HRA	Human reliability analysis
L/E	Large/Early
LERF	Large early release frequency
L/I	Large/Intermediate
L/L	Large/Late
LOCA	Loss of coolant accident
LOOP	Loss of offsite power
LRA	License renewal application
MAAP	Modular Accident Analysis Program
MACR	Maximum averted cost risk
MB	Maximum benefit
NEI	Nuclear Energy Institute
OECR	Offsite economic cost-risk
PBAPS	Peach Bottom Atomic Power Station
PRA	Probabilistic Risk Assessment
RAI	Request for additional information
SAMA	Severe accident mitigation alternative
SGTR	Steam generator tube rupture
SLR	Subsequent license renewal
SPRA	Seismic Probabilistic Risk Assessment
yr	year

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 1.a **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

Specific additional documentation the staff needs to complete the review relating to SAMA new and significant information include:

...

a. Provide a summary of probabilistic risk assessment (PRA) revisions and the description of changes to the risk models since the 40-to-60-year initial LRA (Include a description of the changes made at the plant that have reduced or increased risk). Also, provide the current core damage frequency (CDF) and large early release frequency (LERF) of record for all applicable hazards.

Response:

The information requested in this question has been provided in the following subheadings:

- Model Revision History
- Summary of Current CDF and LERF Values

Model Revision History

Revisions to the PBAPS Full Power Internal Events (FPIE) risk model and descriptions of plant changes and other considerations for each revision are listed in the table below. The Fire and Seismic risk models have been completely redeveloped since the 40-to-60-year initial License Renewal Application (LRA) was submitted. Accordingly, a list of revisions to those risk models has not been provided because such information would not help in understanding the current Fire and Seismic risk models in comparison to those used in the 40-to-60-year initial LRA.

Table 1.a-1: PBAPS FPIE Model Change Summary Since the 40-to-60-Year Initial LRA

Model Name	Model Date	Major Model Changes for the PRA Revision	Unit 2 CDF (per reactor-year)	Unit 3 CDF (per reactor-year)
PB202/PB302	2003	• Incorporation of more Feedwater System detail. • Incorporation of a high-level reactor protection system (RPS) system model	4.6×10^{-6}	4.2×10^{-6}

Table 1.a-1: PBAPS FPIE Model Change Summary Since the 40-to-60-Year Initial LRA

Model Name	Model Date	Major Model Changes for the PRA Revision	Unit 2 CDF (per reactor-year)	Unit 3 CDF (per reactor-year)
		• Selected Pre-initiator human reliability analysis (HRA) updates • Success criteria updates		
PB205C/PB305C	2006	• Conversion to CAFTA • Modular Accident Analysis Program (MAAP) parameter file revisions and use of MAAP 4.0.5 • Plant specific and generic data updates • Control rod drive (CRD) success criteria and timing adjustments • Initiating Event data updates • Common cause failure (CCF) parameter updates • Maintenance data updates • HRA updated to use Exelon standard HRA approach • Revised loss of offsite power (LOOP) initiating event frequencies • Streamlined accident sequence modeling • Streamlined system fault tree modeling	3.9×10^{-6}	3.6×10^{-6}
PB209A/PB309A	2010	• Revised transient initiating event data • Updated LOOP initiating event data and made event categories consistent with industry • Expanded support system initiating event models • Enhanced loss of intake evaluation	3.6×10^{-6}	3.4×10^{-6}

Table 1.a-1: PBAPS FPIE Model Change Summary Since the 40-to-60-Year Initial LRA

Model Name	Model Date	Major Model Changes for the PRA Revision	Unit 2 CDF (per reactor-year)	Unit 3 CDF (per reactor-year)
		• Complete HRA update, including results of some MAAP 4.0.6 runs • Data updates: Plant-specific and generic component data, CCF, maintenance unavailability. • Internal flooding model updated • Level 2 model updated • Loss of coolant accident (LOCA) success criteria revised • Other system modeling improvements		
PB214A/PB314A	2015	• Data updates: Plant-specific and generic component data, CCF, maintenance unavailability • Initiating event update using PBAPS operating data • HRA update to address latest Emergency Operating Procedures (EOPs) and latest timing • All MAAP runs reperformed with MAAP 4.0.6 for Extended Power Uprate (EPU) conditions • Selected system model updates, including those to reflect EPU changes • Inclusion of preliminary diverse and flexible mitigation capability (FLEX) logic (not used in baseline quantification)	3.1×10^{-6}	3.1×10^{-6}

Table 1.a-2: Summary of Current CDF and LERF Values

Hazard	U2 CDF (per year)	U2 LERF (per year)	U3 CDF (per year)	U3 LERF (per year)
FPIE (with internal flooding)	3.1E-06	3.8E-07	3.1E-06	4.0E-07
Fire[1]	3.5E-05	5.5E-06	4.1E-06	6.8E-06
Seismic (2012 Phase I SPRA, used in SLR analysis)[2]	8.3E-06	2.3E-06	Same as Unit 2	
Seismic (2018 Phase II SPRA, completed after SLR analysis)[3]	2.1E-05	4.0E-06	2.1E-05	4.1E-06
Other	Not significant contributors to PBAPS risk.[4]			

[1] The fire results are the "factored" results. The "un-factored" results are slightly larger (e.g., U2 CDF = 3.6E-05/yr and U2 LERF = 5.6E-06/yr).

[2] The PBAPS Phase I seismic PRA does not include a LERF model. The LERF was estimated by assuming the fraction of each accident class that is distributed to a large early release is the same for seismic events as it is for Internal Events (accident class frequencies are available for both the Seismic and Internal Events models and were used for the calculation of LERF).

[3] Letter from Exelon Generation Company, LLC to NRC (RS-18-098) regarding "Seismic Probabilistic Risk Assessment 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," August 28, 2018 (ML18240A065), p.66 of 192 (CDF) and p. 89 of 192 (LERF).

[4] Based on the PBAPS external hazards assessment completed in 2017.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 1.b **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

Specific additional documentation the staff needs to complete the review relating to SAMA new and significant information include:

...

b. NEI 17-04 Section 3.1 "Data Collection" specifies that information elements that should be collected and identified as "new" information for the Stage 1 assessment include plant changes not yet incorporated into plant risk models. Are there any forthcoming model revisions and/or updated modeling techniques that may significantly impact the results of the SAMA evaluation?

Response:

No forthcoming model revisions, including the updated Seismic model (the 2018 Phase II SPRA), or updated modeling techniques have been identified for PBAPS that would significantly impact the SAMA results or alter the conclusions of the analysis.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 1.c **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

Specific additional documentation the staff needs to complete the review relating to SAMA new and significant information include:

...

c. Identify and summarize examples of changes that have been implemented at Peach Bottom since the performance of the Peach Bottom SAMA analysis that are "risk-beneficial."

Response:

Since performance of the PBAPS initial 40-to-60-year SAMA analysis, several changes have been implemented at the site that are "risk-beneficial". While some of these changes were performed as part of efforts that resulted in a net reduction in plant risk (such as FLEX), others were part of plant programs that resulted in a net risk increase, but included risk-beneficial attributes (e.g., Extended Power Uprate). The following list summarizes the major changes with risk-beneficial attributes for PBAPS:

- B.5.b related changes (includes alternate reactor pressure vessel (RPV) injection capability)
- Implementation of NRC orders regarding FLEX (NRC 2012) and HCVS (NRC 2013), which includes:
    - Procedure changes to allow long term operation of reactor core isolation cooling (RCIC) (e.g., partial depressurization when required for adequate core cooling)[1]
    - Implementation of procedures and hardware for long term station battery power supply
    - Procedure changes to allow anticipatory venting to allow reactor pressure vessel (RPV) injection from low pressure sources and to limit suppression pool temperature rise
    - Severe Accident Water Addition
        - Allows injection of water to the RPV or Drywell from outside of the reactor building
    - Implementation of the Reliable Hard-pipe Containment Vent

[1] Implementation of Revision 3 of the EPG/SAGs encompassed some of the changes required to implement FLEX, in addition to other updates.

- Changes Made to Support Extended Power Uprate, including:
    - Addition of residual heat removal (RHR) Heat Exchanger Cross-tie Capabilities (improved flexibility for RHR operation)
    - Addition of condensate storage tank (CST) standpipe and swapover point (eliminated potential for inadvertent drain down of CST inventory to hotwell)
    - Backup power supplies provided for many key motor operated valves (MOVs) (improved diversity for power dependencies)
- Other Risk-Beneficial Changes
    - Replacement of motor-generator (MG) Sets with adjustable speed drives (eliminated fire risk from oil fires in MG Sets)

References:

(NRC 2012) U.S. Nuclear Regulatory Commission. 2012. NRC Order Number EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." ADAMS Accession Number ML12054A736. March 12.

(NRC 2013) U.S. Nuclear Regulatory Commission. 2013. NRC Order Number EA-13-109, "Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions." ADAMS Accession Number ML13143A334. June 6.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 1.d **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

Specific additional documentation the staff needs to complete the review relating to SAMA new and significant information include:

...

d. Describe any Peach Bottom power uprates and the impacts on risk at Peach Bottom. What was the change in CDF and LERF as a result of the extended power uprate, measurement uncertainty recapture and conversion to MELLLA+. Was the total change to CDF and LERF as a result of the uprates less than 30%?

Response:

The NRC approved a 12.4 percent EPU for PBAPS Units 2 and 3 on August 25, 2014 (NRC 2014). Because plant modifications associated with power uprates could change the calculated radioactive releases for PBAPS, Exelon Generation and the NRC evaluated the effects of the uprates in the EPU License Amendment Request [Exelon Generation 2012a] and the EPU - Safety Evaluation (NRC 2014), respectively. The NRC staff's review covered the impact of the proposed EPU on CDF and LERF for the plant due to changes in the risks associated with internal events, external events, and shutdown operations. The following table summarizes the results of the risk evaluation for internal events before and after the EPU was implemented.

	Pre-EPU	**Post-EPU**	**Delta Change**	**Percent Increase**
Unit 2 CDF*	3.6×10^{-6} /year	3.7×10^{-6} /year	1×10^{-7}	2.8
Unit 2 LERF*	4.6×10^{-7} /year	4.7×10^{-7} /year	1.6×10^{-8}	3.5

Source: Exelon Generation 2012a.

* Based on a review of the changes in CDF and LERF for the EPU assessment and because the base case CDF and LERF are slightly lower for Unit 3, the EPU is expected to provide very similar impacts for Unit 3.

In its review of the proposed PBAPS EPU, the NRC staff found that estimated doses associated with PBAPS will comply with applicable NRC guidelines, and PBAPS will continue to provide sufficient safety margins with adequate defense-in-depth to address unanticipated events and to compensate for uncertainties in accident progression and analysis assumptions and parameters. Based on its findings, the NRC staff concluded that the PBAPS EPU was acceptable with respect to the radiological consequences of

design basis accidents. This conclusion implies that changes, if any, in offsite radiological consequences from severe accidents estimated for PBAPS after EPU would also remain within the acceptable bounds of the 1996 GEIS evaluation.

In March 2016, the NRC approved another license amendment request in which Exelon Generation reported increases in CDF and LERF due to the transition of plant operation from the Maximum Extended Load Line Limit Analysis (MELLLA) domain to the expanded MELLLA Plus (MELLLA+) domain as a result of the previously approved increase in core thermal power due to the EPU. The reported increases were determined using a plant-specific probabilistic risk assessment in which the generic risk discussion was augmented with plant-specific information on initiating event frequencies, component reliability, operator response, success criteria, external events, shutdown risk, and PRA quality. The increases were 3.7×10^{-8} per year for CDF and 3.6×10^{-8} per year for LERF, primarily due to slight changes to human error probabilities associated with anticipated transients without scram (ATWS) sequences (NRC 2016 at SER page 67 [PDF page 103 of 174]). The NRC concluded that these expected increases in risk at PBAPS would be well within the risk acceptance guidelines delineated by Regulatory Guide 1.174 and did not warrant further review (NRC 2016 at SER page 67 [PDF page 103 of 174]).

	Pre-MELLLA+	**Post-MELLLA+**	**Delta Change**	**Percent Increase**
CDF	3.7×10^{-6} /year	3.7×10^{-6} /year	3.7×10^{-8}	1.0
LERF	4.7×10^{-7} /year	5.1×10^{-7} /year	3.6×10^{-8}	7.7

In the Safety Analysis Report for a license amendment request regarding a 1.62 percent measurement uncertainty recapture (MUR) power uprate for PBAPS (Exelon Generation 2017b), Exelon Generation reviewed and determined that the PBAPS probabilistic risk assessment would not need to be updated, because the change in plant risk due to the MUR power uprate would be insignificant (Exelon Generation 2017b at Attachment 7 [PDF page 220 of 482]). This conclusion is supported by NRC Regulatory Issue Summary (RIS) 2002-03 (NRC 2002). The NRC's safety analysis report for the MUR power uprate found reasonable assurance that the current licensing basis dose consequence analyses for design basis accidents will remain bounding at the proposed MUR uprated power level with a margin that is within the assumed uncertainty associated with the leading-edge flow meter system (NRC 2017a).

As noted above, CDF and LERF increased respectively by 2.8% and 3.5% due to the EPU. The reported increases in CDF and LERF due to MELLLA+ were 1% and 7.7%, respectively. MUR increases in CDF and LERF were not quantified but are characterized as "insignificant." Accordingly, changes to CDF and LERF, if fully quantified, would be less than 30%. Further, Exelon Generation is aware of no additional plant uprates likely to occur during the second license renewal term that would lead to additional increases in risk.

References:

(Exelon Generation 2012a) Exelon Generation Company, LLC. 2012. Letter to NRC regarding License Amendment Request – Extended Power Uprate, Attachment 12, "Risk Assessment". ADAMS Accession Number ML12286A012. September 28.

(Exelon Generation 2017b) Exelon Generation Company, LLC. 2017. Letter to NRC regarding Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate. ADAMS Accession Number ML17048A444. February 17.

(NRC 2002) U.S. Nuclear Regulatory Commission. 2002. Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications. NRC RIS 2002-03. ADAMS Accession Number ML013530183. January 31.

(NRC 2014) U.S. Nuclear Regulatory Commission. 2014. Letter to Exelon Nuclear regarding Peach Bottom Atomic Power Station, Units 2 and 3 – Issuance of Amendments RE: Extended Power Uprate (TAC NOS. ME9631 and ME9632). ADAMS Accession Number ML14133A046. August 25.

(NRC 2016) U.S. Nuclear Regulatory Commission. 2016. Letter to Exelon Nuclear regarding Peach Bottom Atomic Power Station, Units 2 and 3 – Issuance of Amendments RE: Maximum Extended Load Line Limit Analysis Plus (CAC Nos. MF4760 and MF4761. ADAMS Accession Number ML16034A372. March 21.

(NRC 2017a) U.S. Nuclear Regulatory Commission. 2017. Letter to Exelon Nuclear regarding 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). ADAMS Accession Number ML17286A013. November 15.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 1.e **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

Specific additional documentation the staff needs to complete the review relating to SAMA new and significant information include:

...

e. As provided in the updated 2013 GEIS, peak fuel burnup was considered new information. What is the estimated average peak fuel burnup at Peach Bottom during the subsequent period of extended operation?

Response:

Exelon Generation has no plan to increase average peak rod fuel burn-up beyond 62,000 MWd/MTU for either PBAPS unit during the subsequent period of extended operation.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 2.a **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

a. Describe the pre-screening criterion used to exclude any of the Peach Bottom Phase 2 SAMA candidates from further consideration, including the rationale for any deviations from the screening criteria provided in NEI 17-04. Specifically, justify the screening criterion named "Reclassified as a Phase 1 SAMA." Was the maximum benefit updated for the Stage 1 analysis?

Response:

The second paragraph in Section 3 of NEI 17-04 (NEI 2017) states the following regarding the Stage I evaluation process:

> "The first stage of the process (see Section 3.1) uses PRA risk insights and/or risk model quantifications to estimate the percent MB reduction associated with (1) all unimplemented Phase 2 SAMAs[8] for the analyzed plant and (2) those SAMAs identified as potentially cost beneficial for other industry plants that have been determined to be applicable to the analyzed plant (see subsection 3.1.2)."
>
> "[8] NEI 05-01 [9] provides a description of the Phase 1 and Phase 2 analyses. An unimplemented Phase 2 SAMA is a SAMA that was not screened in the Phase 1 process and has not been implemented at the analyzed plant/site."

Note that the reference to "subsection 3.1.2" in the first paragraph of the text quoted above is a typographical error. The correct subsection number is "subsection 3.2.1", which describes the NEI 17-04 Stage 1 pre-screening criteria for industry SAMAs. Subsection 3.1.2 does not exist in NEI 17-04.

There are two aspects of the quoted text from NEI 17-04, subsection 3.2.1 that are critical to understanding the NEI 17-04 Stage I process and the PBAPS implementation of that process:

1. NEI 17-04 provides a definition of an "unimplemented Phase 2 SAMA".
2. The process of identifying "unimplemented Phase 2 SAMAs" for the analyzed plant and the process of identifying "industry SAMAs" applicable to the analyzed plant are different tasks with different screening criteria.

When NEI 17-04 was written, it was understood that the final NEI 05-01 (NEI 2005) SAMA guidance document was not published until after many industry sites had already performed a SAMA analysis and that there were variations in how Phase 1 and Phase 2 screening processes described in the final NEI 05-01 were named and performed among these pre-NEI 05-01 analyses. For example, the PBAPS SAMA analysis refers

to the phases as Phase I and Phase II. Because of the variations, care was taken in NEI 17-04 to clarify how analysts implementing NEI 17-04 should identify "unimplemented Phase 2 SAMAs" for the analyzed plant. Footnote #8 in NEI 17-04 explicitly defines an "unimplemented Phase 2 SAMA" in terms of the final NEI 05-01 guidance document because the final NEI 05-01 provides a standard definition of the Phase 1 and Phase 2 SAMA screening processes for the industry. Other definitions of a Phase 1 or Phase 2 SAMA, including those used in the previous 40-to-60-year PBAPS SAMA analysis, which was performed before NEI 05-01 was finalized, are not directly relevant to the NEI 17-04 process for identifying "unimplemented Phase 2 SAMAs."

In the NEI 17-04 Stage 1 review, it is assumed that a plant's previous SAMA analysis was performed using the final NEI 05-01 Phase 1 screening process, which includes a screening criterion that would prevent SAMAs with implementation costs that are larger than the plant's Maximum Averted Cost Risk (MACR) from being defined as Phase 2 SAMAs. If the previous SAMA analysis for a plant seeking SLR was performed before NEI 05-01 was finalized, then this assumption would be invalid. Accordingly, the analyst implementing the NEI 17-04 Stage 1 review under such circumstances needs to employ an upfront technique for finding SAMAs for the analyzed plant that meet the NEI 17-04 definition of "unimplemented Phase 2 SAMAs."

In the PBAPS Postulated Accidents New and Significant Information Review (Appendix 3, "Assessment of Significance for New Information Relevant to PBAPS SAMAs"), the technique used to find "unimplemented Phase 2 SAMAs" was to apply a "prescreening criterion" which identified those PBAPS Phase II SAMAs that had implementation costs in excess of the PBAPS MACR at the time of the previous SAMA analysis and label them "Reclassified as a Phase 1 SAMA". SAMAs that were identified using this criterion were excluded from the group of "unimplemented Phase 2 SAMAs" that were considered in the NEI 17-04 Stage 1 screening process, because having implementation costs that exceeded the PBAPS MACR at the time of the previous SAMA analysis is not consistent with the final NEI 05-01 definition of "Phase 2 SAMA." Updating the PBAPS MACR is not necessary to make this determination.

Suggested screening criteria for identifying "industry SAMAs" are provided in Section 3.2.1 of NEI 17-04, as the section's title ("Pre-screening Industry SAMAs") indicates. It is true that Section 3.2.1 characterizes the NEI 17-04 Stage 1 screening process as "similar to the Phase 1 screening process in the final NEI 05-01 with the exception that SAMAs are not eliminated due to excessive implementation cost (because an updated MB [maximum benefit] is not developed for the Stage 1 analysis) …." Even so, this characterization was directed to pre-screening of "industry SAMAs" in Stage 1. The review of relevant "industry SAMAs" in Stage 1 is intended to serve as a check for new information, including more recent SAMA implementation cost estimates suggesting that a previously performed plant-specific SAMA analysis for the analyzed plant, which represents only a snapshot in time, could be outdated. Because of its intended purpose, it is important that the NEI 17-04 Stage 1 process prevent screening of applicable "industry SAMAs" based on previous cost information, which is why NEI 17-04 Section 3.2.1 does not allow applicable "industry SAMAs" to be screened based on high cost.

The "pre-screening criterion" applied to PBAPS "Phase II" SAMAs from the previous PBAPS SAMA analysis was not applied to PBAPS "industry SAMAs." Hence, the PBAPS NEI 17-04 Stage I review is equivalent to the NEI 17-04 Stage 1 review performed for plants that completed their SAMA analyses after NEI 05-01 was finalized (i.e., plant-specific SAMAs originally determined to have implementation costs that exceeded the MACR need not be re-considered).

For PBAPS, the reviews of both "unimplemented Phase 2 SAMAs" and applicable "industry SAMAs" were consolidated and presented in a single table in the PBAPS Postulated Accidents New and Significant Information Review (Appendix 3, "Assessment of Significance for New Information Relevant to PBAPS SAMAs"). By consolidating the review results for the two SAMA categories, it was possible to disposition both categories of SAMAs in one table. However, this does not imply that the same criteria were or should have been used to populate both categories.

In conclusion, the PBAPS implementation of the NEI 17-04 Stage 1 process for identifying "unimplemented Phase 2 SAMAs" and applicable "industry SAMAs" is equivalent to the screening process in the NEI 17-04 Stage 1 guidance. Accordingly, no "deviation" exists, and the "maximum benefit" (MB or MACR) was not updated for PBAPS.

References:

NEI 2005: NEI (Nuclear Energy Institute). 2005. Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document. Rev A. NEI 05-01a. November.

NEI 2017. Nuclear Energy Institute. 2017. Model SLR New and Significant Assessment Approach for SAMA. NEI 17-04, [Rev 0]. June 29.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 2.b **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

b. Please clarify how the determination that SAMAs 3, 4, 5, 7, 8, 9, 10, 14, 16, 19, 20, 22, 23, 24, 25, 26, 28, and 29 were screened out in Stage 1 due to cost (exceeding the maximum benefit calculated in the original SAMA analysis) was performed. Were there any SAMAs determined to reduce the CDF or any of the Level 2 release category frequencies by 50 percent or more? Clarify how this screening approach is equivalent to the Stage 1 assessment described in NEI 17-04. If an equivalent process to Stage 1 is not used, please provide an explanation of the process by which they will be further considered/ evaluated by Exelon?

Response:

SAMAs 3, 4, 5, 7, 8, 9, 10, 14, 16, 19, 20, 22, 23, 24, 25, 26, 28, and 29 were among the PBAPS SAMAs evaluated during the NEI 17-04 Stage 1 review for PBAPS. As was discussed in the response to Question 2.a, a "pre-screening criterion" was applied during this review to determine whether the characteristics of each SAMA at the time of the previous PBAPS SAMA analysis were consistent with the final NEI 05-01 definition of a Phase 2 SAMA. The response to Question 2.a also explains why using a "pre-screening criterion" to identify "unimplemented Phase 2 SAMAs" for plants such as PBAPS whose previous SAMA analyses were performed before NEI 05-01 was finalized is equivalent to the NEI 17-04 Stage 1 guidance for plants whose previous SAMA analyses were performed using the final NEI 05 01 Phase 1 screening process.

Application of the "pre-screening criterion" showed that SAMAs 3, 4, 5, 7, 8, 9, 10, 14, 16, 19, 20, 22, 23, 24, 25, 26, 28, and 29 do not meet the final NEI 05-01 definition of a Phase 2 SAMA for PBAPS because their implementation costs at the time of the initial SAMA analysis were larger than the plant's Maximum Averted Cost Risk (MACR). Hence, they were pre-screened from the group of PBAPS "unimplemented Phase 2 SAMAs" analyzed further during the NEI 17-04 Stage 1 review. This approach is equivalent to the NEI 17-04 Stage 1 review to be performed for plants that completed their SAMA analyses after NEI 05-01 was finalized.

Because PBAPS SAMAs 3, 4, 5, 7, 8, 9, 10, 14, 16, 19, 20, 22, 23, 24, 25, 26, 28, and 29 do not meet the final NEI 05-01 definition of a Phase 2 SAMA, risk reductions associated with their implementation were not evaluated as part of the NEI 17-04 Stage I review.

References:

NEI 2005: NEI (Nuclear Energy Institute). 2005. Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document. Rev A. NEI 05-01a. November.

NEI 2017. Nuclear Energy Institute. 2017. Model SLR New and Significant Assessment Approach for SAMA. NEI 17-04, [Rev 0]. June 29.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 3.a **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

Explain how "Other external events such as high wind events, external flooding, transportation and nearby facility accidents" were considered in the Peach Bottom SAMA New and Significant Evaluation. Discuss recommendations to reduce risk due to each of these external events.

Response:

After the 40-to-60-year initial LRA was submitted, PBAPS performed an external hazards assessment, which was most recently revised in October of 2017, to support an application for implementing risk informed processes pursuant to 10 CFR 50.69 (Exelon 2017). The assessment considered High Winds/Tornados, External Flooding, Seismic and other potential external hazards and concluded that other than Seismic events, external events are not significant contributors to PBAPS risk (a PBAPS internal fire PRA model already exists and internal fires were not re-assessed as part of this evaluation). Because these "other" external events are not significant contributors to PBAPS risk, the quantitative risk models used in the PBAPS SAMA New and Significant Information Review do not assess contributions from them. The models used were the Full Power Internal Events (including internal flooding), Fire, and Seismic models.

In addition, because the external hazards assessment indicated that the "other" external events are not significant contributors to PBAPS risk, recommendations to further reduce the risk of those hazards were not developed based on that assessment. Even so, tornado missile protection has recently been identified for additional review. Accordingly, Exelon is in the process of evaluating whether actions (e.g., analyses, plant modifications, etc.) should be implemented to further reduce tornado missile risk at PBAPS.

References:

(Exelon 2017) Exelon Generation Company, LLC. 2017. Letter to NRC regarding Application to Adopt 10 CFR 50.69, "Risk-informed categorization and treatment of structures, systems, and components for nuclear power reactors." Enclosure, Attachment 4, "External Hazards Screening." ADAMS Accession Number ML17243A014. August 30.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 3.b **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

Were there any Peach Bottom or other facility external event SAMAs evaluated? If so, briefly describe. If not, indicate the reason why.

Response:

Several SAMAs related to external events were among the SAMAs evaluated in the PBAPS NEI 17-04 Stage 1 review. For those that were not pre-screened, the core damage, high/early (H/E), and high/intermediate (H/I) frequency reductions associated with implementing these external event SAMAs were evaluated using the Full Power Internal Events (FPIE), Fire, and Seismic risk models. For the reasons described in response to Question 3.a, reductions in core damage, H/E, and H/I frequencies were judged negligible for "other" external events and were not explicitly quantified.

Examples of external event SAMAs that were evaluated include:

- Add automatic fire suppression system (From Brunswick): Stage 1 analysis demonstrated the SAMA does not significantly reduce plant risk.
- Protect critical fire targets (From Nine Mile Point): Stage 1 analysis demonstrated the SAMA does not significantly reduce plant risk.
- Increase combustion turbine building integrity to withstand higher winds so that combustion turbine generators would be capable of withstanding a severe weather event. (From Oyster Creek): Pre-screened. PBAPS does not have combustion turbine generators. In addition, high winds events were determined to be negligible contributors to PBAPS risk.
- Block Wall 43 Reinforcement (From Oyster Creek): Stage 1 analysis demonstrated the SAMA does not significantly reduce plant risk.

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 3.c **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

c. Information from the Peach Bottom Postulated Accidents New and Significant Review Document is needed for the NRC staff's evaluation as it relates to external events.

Table 3 of the Peach Bottom Postulated Accidents New and Significant Review Document lists the fire and seismic CDF estimates for Peach Bottom, as reported during 1990 and 2016. Please confirm the statement, "... the fire and seismic CDFs for PBAPS calculated in 2016, as well as the sum of the two, were less than 5.4E-5 per reactor year, which was the internal events mean value CDF for all BWRs used in the 2013 GEIS to estimate probability-weighted, offsite consequences from airborne, surface water, and groundwater pathways, as well as the resulting economic impacts from such pathways."

Response:

The mean BWR Internal Event (Full Power) CDF of 5.4E-05 per year is provided in Table E-2 of Appendix E, NUREG-1437 (NRC 2013).

The PBAPS Fire and Seismic CDF estimates calculated in 2016 are shown in the following table:

	Unit 2	Unit 3
Fire CDF	3.5E-05 per reactor-yr	4.1E-05 per reactor-yr
Seismic CDF	8.3E-06 per reactor-yr	8.3E-06 per reactor-yr

Taking the larger of the two Fire results (4.1E-05 per reactor year for Unit 3), the sum of the PBAPS Fire and Seismic risk is 4.9E-05 per reactor-year, which is less than the mean BWR Internal Event (Full Power) CDF of 5.4E-05 per year.

References:

(NRC 2013) U.S. Nuclear Regulatory Commission. 2013. Generic Environmental Impact Statement for License Renewal of Nuclear Plants. NUREG-1437, Revision 1, pages 4-161 to 4-162 (Table 4.9-5, "Summary of Issues Covered in Appendix E,") and Appendix E, "Environmental Impact of Postulated Accidents." Washington, D.C. June.

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SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 4 **Category:** SAMA **ER Section:** 4.15.2

Statement of Question:

Guidance in NEI 17-04 Section 3.1 "Data Collection" specifies:

> "The following is one of the information elements that should be collected and identified as "new" information for the Stage 1 assessment:
>
> For those plants that have not maintained a full level 2 model, it will be necessary to either update the Level 2 model or develop a process by which the relevant release category frequencies can be estimated for each SAMA considered to ensure the full spectrum of plant risk can be accounted for in the Stage 1 assessment."
>
> Exelon developed a process by which the relevant release category frequencies can be estimated for each SAMA considered in the supporting documentation (Peach Bottom Postulated Accidents New and Significant Review document). Please provide justification for this new approach including how similar plants were chosen, how the seismic accident class frequencies are used to estimate the relevant Level 2 release category frequencies, how they are used in the Stage 1 assessment for the potential significance of new information, and how specific release categories were considered significant or insignificant. Please provide specific details regarding how the sum of the two release frequencies not exceeding 80% is equivalent to a release frequency of 50% in one release category. Also, provide details regarding how LaSalle (with a Mark 2) containment was considered equivalent in this alternative approach. Further, clarify if SAMAs with very low benefits were exempted from the risk reduction assessment.

Response:

Use of Accident Class Frequencies to Quantify
Fire and Seismic Release Category Frequencies:

The current PBAPS Full Power Internal Events (FPIE) Probabilistic Risk Assessment (PRA) includes a full, up to date, Level 2 model.

The PBAPS "official" Fire PRA (FPRA) has the capability to quantify Large Early Release Frequency (LERF) (called the High/Early (H/E) release category in the PBAPS Level 2 model). It does not include the capability to quantify the High/Intermediate (H/I) release category. However, a modification was made to the FPRA to provide a version of the model capable of quantifying the H/I release category in support of SLR work. Changes were not made to the

FPRA to support quantification of the remaining Level 2 release categories. The 2012 Phase I Seismic PRA (SPRA) does not have the capability to quantify any Level 2 release category frequencies.

To perform the NEI 17-04 Stage 1 evaluation process, it is necessary to estimate the changes in release category frequencies associated with the implementation of the Stage I SAMAs for the analyzed plant for the non-negligible hazards. Because fire and seismic events are significant contributors to PBAPS plant risk but the PBAPS FPRA and SPRA models cannot quantify all Level 2 release category frequencies, it was necessary to develop an alternative strategy to estimate the PBAPS Level 2 release category frequencies.

The approach taken was to assume that the distribution of the CDF to the Level 2 release categories is the same for the FPRA and SPRA as it is for the FPIE PRA. Accident Classes (ACs), which are used in all three models to bin core damage sequences based on a common set of accident sequence characteristics, provide a means of determining how the CDF is distributed among the Level 2 release categories in the FPIE. For example, the total frequency of AC 1A in the FPIE model is 1.14E-06/yr and the frequency of the AC 1A contributions to the H/E release category is 5.5E-08/yr, which indicates that 4.84 percent of AC 1A frequency is distributed to the H/E release category. Because the FPRA and SPRA CDF results include AC identifiers, the contribution of the FPRA and SPRA AC 1A frequency that is binned to the H/E release category can be estimated by multiplying the FPRA and SPRA AC 1A frequencies by 4.84E-02. If the same process is used for all release categories using all of the available ACs, the full range of release category frequencies can be obtained for both the FPRA and SPRA.

Table 4-1 provides the fraction of each AC that is distributed to each release category in the PBAPS FPIE model (calculated using the process described above).

Tables 4-2 and 4-3 provide the estimated release category frequencies for the FPRA and SPRA based on the fractions documented in Table 4-1. In Table 4-2, the first step was to obtain the AC frequencies for the Fire model. This was performed by multiplying the Fussell-Vesely (FV) value for the AC marker event by the total "unfactored" Fire CDF[2]. For AC 1A, the Fussell-Vesely value is 6.28E-01, which was multiplied by the total "unfactored" Fire CDF of 3.64E-05/yr to obtain a Fire AC 1A frequency of 2.28E-05/yr. The FV values for the ACs are provided in the second column of Table 4-2 (Fire Base F-V) and the AC frequencies that were calculated are provided in the third column ("Fire Base Freq").

To obtain the Fire AC 1A contribution to the Fire H/E release category, the Fire AC 1A frequency of 2.28E-05 was multiplied by the fractional multiplier of the AC 1A frequency that is distributed to the H/E release category (4.84E-02) from Table 4-1 to obtain 1.11E-06 (the 4th column of Table 4-2 entitled "HE-BOC"). The Fire H/E frequency can be obtained by summing the contributions to the H/E release category over all ACs, which is shown at the bottom of the "HE-BOC" column (3.06E-06). As shown in Table 4-2, the same process was applied for all release categories for the FPRA. Table 4-3 documents the same approach for the SPRA.

[2] The "unfactored" results, which are slightly larger than the "factored" results, were used for the convenience of the analyst.

Justification of the Use of Changes to the Core Damage, H/E, and H/I Frequencies to Determine Significance:

The following quote from Section 3.2.2 of the NEI 17-04 guidance indicates that if there are SAMAs for which one or more release category frequency reductions are greater than 50 percent, a justification may be provided to demonstrate that the overall risk reduction for the SAMA would not be greater than 50 percent:

> "A potential difficulty is a scenario in which implementation of a SAMA reduces some frequencies by more than 50 percent while it does not impact others at all. In these "borderline" cases, it may be possible to justify that the SAMA's averted cost-risk would still be less than 50 percent of the MB if the release category with the reduction that is greater than 50 percent is a low consequence release category. For example, if a SAMA has a large impact on steam generator tube rupture (SGTR) scenarios in which steam generator makeup is available (i.e., the releases are scrubbed), a discussion could be provided that includes both qualitative and quantitative insights about why the reduction in that release category frequency would not also reduce the MB by more than 50 percent."

Rather than write such a justification for individual PBAPS SAMAs, a generic approach was developed to demonstrate that even if the frequencies of all release categories other than H/E and H/I were reduced by 100 percent, it would not be possible for a SAMA to be cost beneficial unless the H/E and H/I frequency reductions were also both large. This approach was taken to eliminate the time-consuming need to manually develop the frequency reductions for the eleven additional release categories.

Because PBAPS does not have a Level 3 model that correlates to the Level 2 release category structure, it was not possible to use plant-specific results to identify the release categories that are negligible contributors to plant risk. In order to determine the relative importance of the release categories, the results from two different publicly available BWR Level 2 models that use the same release category definitions as PBAPS (Hope Creek and LaSalle) were used to estimate the consequences associated with each of the release categories. While the demographics of the analyzed sites are not necessarily the same such that the absolute values of the offsite economic costs and dose estimates would be different for each site, the results for a given site are expected to be internally consistent and useful to establishing the dominant contributors when considered in conjunction with the release category frequencies (i.e., the dose-risk and offsite economic cost-risk, which are used as input to the cost-benefit analysis). Information about other BWRs, including those with containments similar to PBAPS, are also publicly available, but because the definitions of the release categories used in the initial SAMA analyses for LaSalle and Hope Creek are the same as for PBAPS, use of the information from those plants supported a more direct mapping of release category results to PBAPS. Hope Creek, a Mark I containment plant, was considered to be the primary information source for PBAPS, and the Mark II containment results from LaSalle were only included as a source of additional information (LaSalle's Mark II containment was not considered to be equivalent to the PBAPS containment). The Hope Creek reactor building is not the same as the PBAPS plant reactor buildings, but the vulnerabilities are generally the same (e.g., blowout panels on both types) and the impact on the releases related to the differences between the Hope Creek and PBAPS reactor buildings are expected to be small. As a result, the Hope Creek Level 3 results from its initial SAMA analysis were considered to be suitable for this application.

Using the results of the LaSalle and Hope Creek initial SAMA Level 3 models, it was demonstrated that the contributions to dose-risk and offsite economic cost-risk from all internal events non-H/E and non-H/I release categories are less than 10 percent of the total values. For a case in which a SAMA reduced all non-H/E and non-H/I release category frequencies to zero (and did not impact the H/E or H/I categories), the reduction in the dose-risk (DR) and offsite economic cost-risk (OECR) would be limited to about 10 percent of the total OECR and DR. If a SAMA reduced the H/E release category frequency by 40 percent, the H/I release category frequency by 40 percent, and the remaining release categories by 100 percent, the total reduction of the DR and OECR for the SAMA would be around 50 percent (40 percent from the reduction of the H/E and H/I release categories and 10 percent from bounding case in which all other release category frequencies are reduced to zero). This information was used to develop the following simplified quantification approach for the PBAPS SAMAs:

Even in the bounding condition in which a SAMA reduces all non-H/E and non-H/I release category frequencies to zero, plant risk would not be reduced by 50 percent or more if (1) CDF reduction is less than 50 percent and (2) neither H/I nor H/E release category frequency reduction is greater than 40 percent.

However, during the quantification process for PBAPS, it was determined that SLR SAMA 44 (CRD cross-tie) reduced the H/I frequency by 44.7%, which was greater than the limit of 40 percent for either the H/E or H/I release category defined in the quantification approach. To accommodate this case in the quantification approach, the consequence results were reviewed and the evaluation criteria were modified to the following:

Even in the bounding condition in which a SAMA reduces all non-H/E and non-H/I release category frequencies to zero, plant risk would not be reduced by 50 percent or more if:

1) CDF reduction is less than 50 percent, AND
2) Neither the H/E nor the H/I release category reductions are greater than 50 percent, AND
3) The sum of the H/E and H/I frequency reductions are less than 80 percent.

Because it is possible for the relative contributions of the H/E and H/I release categories to the OECR and DR totals to be significantly different, this additional screening criterion is not exact, but Table 4-4 (using Hope Creek initial SAMA Level 3 results) and Table 4-5 (using LaSalle initial SAMA Level 3 results) demonstrate that if the sum of the H/E and H/I frequency reductions meet the limits identified above, and all other release categories are reduced to zero, the reduction in the OECR and DR are only slightly greater than 50 percent. Two cases were examined in each table:

- Case A in which the H/E and H/I release category frequencies are reduced by 50 percent and 30 percent respectively, and
- Case B, in which H/E and H/I release category frequencies are reduced by 30 percent and 50 percent, respectively.

Because of the larger consequences associated with the H/E release category, Case A results in a reduction of the OECR and DR slightly above 50% for both Hope Creek and LaSalle. However, Table 4-6 demonstrates that when the more limiting LaSalle results are used with

SLR SAMA 44, the reductions in the OECR and DR are well below 50 percent even if all release category frequencies other than H/E and H/I are reduced to zero.

With regard to exempting SAMAs with "very low benefits", SAMAs with very low benefits were not exempted from the evaluation process at PBAPS.

Table 4-1
Accident Class (AC) Multipliers for the PBAPS Level 2 Release Categories (based on Internal Events results)

Class	H/E Freq (/yr)	AC Fractional Multiplier - H/E	H/I Freq (/yr)	AC Fractional Multiplier - H/I	H/L Freq (/yr)	AC Fractional Multiplier - H/L	M/E Freq (/yr)	AC Fractional Multiplier - M/E	M/I Freq (/yr)	AC Fractional Multiplier - M/I	M/L Freq (/yr)	AC Fractional Multiplier - M/L	AC Freq. (/yr) From Table 4.1-1
1A	5.50E-08	4.84E-02	---	0.00E+00	4.80E-11	4.22E-05	---	0	1.88E-09	1.65E-03	1.59E-07	1.40E-01	1.14E-06
1B	8.09E-08	2.48E-01	3.17E-10	9.71E-04	---	0.00E+00	---	0	---	0.00E+00	7.95E-09	2.44E-02	3.26E-07
1C	5.77E-09	1.43E-01	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	8.02E-10	1.98E-02	4.04E-08
1D	2.56E-08	1.96E-01	5.11E-11	3.91E-04	1.33E-09	1.02E-02	---	0	1.64E-10	0.00E+00	---	0.00E+00	1.31E-07
1E	5.35E-10	1.58E-01	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	5.70E-10	1.68E-01	3.39E-09
2A	1.29E-08	4.57E-02	2.71E-07	9.61E-01	---	0.00E+00	---	0	---	0.00E+00	---	0.00E+00	2.82E-07
2F	3.67E-08	4.80E-02	7.40E-07	9.67E-01	---	0.00E+00	---	0	---	0.00E+00	---	0.00E+00	7.65E-07
2L	1.68E-10	4.00E-02	3.97E-09	9.46E-01	---	0.00E+00	---	0	---	0.00E+00	---	0.00E+00	4.20E-09
3A	6.50E-11	7.56E-03	9.19E-11	1.07E-02	---	0.00E+00	---	0	---	0.00E+00	---	0.00E+00	8.60E-09
3B	1.28E-09	7.09E-03	1.80E-09	9.97E-03	---	0.00E+00	---	0	7.57E-11	4.19E-04	---	0.00E+00	1.81E-07
3C	5.39E-09	6.65E-02	4.48E-09	5.53E-02	---	0.00E+00	---	0	1.95E-10	2.41E-03	---	0.00E+00	8.11E-08
3D	1.43E-08	9.99E-01	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0.00E+00	1.43E-08
4A	1.27E-07	9.74E-01	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0.00E+00	1.30E-07
4L	4.54E-09	9.66E-01	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0.00E+00	4.70E-09
5	1.20E-08	9.89E-01	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0.00E+00	1.21E-08

Table 4-1 (continued)
Accident Class (AC) Multipliers for the PBAPS Level 2 Release Categories (based on Internal Events results)

Class	L/E Freq (/yr)	AC Fractional Multiplier - L/E	L/I Freq (/yr)	AC Fractional Multiplier - L/I	L/L Freq (/yr)	AC Fractional Multiplier - L/L	LL/E Freq (/yr)	AC Fractional Multiplier - LL/E	LL/I Freq (/yr)	AC Fractional Multiplier - LL/I	LL/L Freq (/yr)	AC Fractional Multiplier - LL/L	AC Freq. (/yr) From Table 4.1-1
1A	7.42E-09	6.53E-03	5.24E-07	4.61E-01	1.22E-08	1.07E-02	---	0	5.44E-08	4.78E-02	---	0	1.14E-06
1B	7.44E-10	2.28E-03	2.25E-08	6.89E-02	1.60E-08	4.90E-02	---	0	1.00E-07	3.06E-01	---	0	3.26E-07
1C	3.12E-10	7.72E-03	1.60E-09	3.96E-02	9.75E-10	2.41E-02	---	0	4.38E-09	1.08E-01	---	0	4.04E-08
1D	---	0.00E+00	3.40E-09	2.60E-02	---	0.00E+00	---	0	1.10E-08	8.42E-02	2.79E-09	0.021368	1.31E-07
1E	1.53E-11	4.52E-03	1.54E-09	4.55E-01	6.92E-10	2.04E-01	---	0	4.25E-09	1.26E+00	---	0	3.39E-09
2A	---	0.00E+00	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0	2.82E-07
2F	---	0.00E+00	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0	7.65E-07
2L	---	0.00E+00	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0	4.20E-09
3A	8.58E-11	9.98E-03	---	0.00E+00	---	0.00E+00	---	0	8.66E-10	1.01E-01	---	0	8.60E-09
3B	1.73E-09	9.58E-03	---	0.00E+00	---	0.00E+00	---	0	1.80E-08	9.97E-02	---	0	1.81E-07
3C	4.38E-10	5.40E-03	---	0.00E+00	---	0.00E+00	---	0	3.52E-08	4.34E-01	---	0	8.11E-08
3D	---	0.00E+00	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0	1.43E-08
4A	---	0.00E+00	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0	1.30E-07
4L	---	0.00E+00	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0	4.70E-09
5	---	0.00E+00	---	0.00E+00	---	0.00E+00	---	0	---	0.00E+00	---	0	1.21E-08

Table 4-2
PBAPS Release Category Frequencies for the Fire Model Based on FPIE Multipliers (/yr)

Class	Fire Base F-V	Fire Base Freq	HE-BOC	H/I	H/L	M/E	M/I	M/L	L/E	L/I	L/L	LL/E	LL/I	LL/L
1A	6.28E-01	2.28E-05	1.11E-06	0.00E+00	9.65E-10	0.00E+00	3.78E-08	3.20E-06	1.49E-07	1.05E-05	2.45E-07	0.00E+00	1.09E-06	0.00E+00
1B	1.21E-01	4.40E-06	1.09E-06	4.27E-09	0.00E+00	0.00E+00	0.00E+00	1.07E-07	1.00E-08	3.03E-07	2.16E-07	0.00E+00	1.35E-06	0.00E+00
1C	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1D	7.70E-02	2.80E-06	5.50E-07	1.10E-09	2.86E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.30E-08	0.00E+00	0.00E+00	2.36E-07	5.99E-08
1E	1.42E-05	5.15E-10	8.14E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.67E-11	2.33E-12	2.34E-10	1.05E-10	0.00E+00	6.47E-10	0.00E+00
2A	3.73E-02	1.36E-06	6.21E-08	1.30E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2F	1.34E-01	4.89E-06	2.35E-07	4.73E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2L	2.23E-03	8.10E-08	3.24E-09	7.67E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3B	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3C	3.09E-04	1.13E-08	7.49E-10	6.22E-10	0.00E+00	0.00E+00	2.71E-11	0.00E+00	6.09E-11	0.00E+00	0.00E+00	0.00E+00	4.89E-09	0.00E+00
3D	2.83E-04	1.03E-08	1.03E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4L	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL		3.64E-05	3.06E-06	6.12E-06	2.95E-08	0.00E+00	3.78E-08	3.30E-06	1.59E-07	1.09E-05	4.61E-07	0.00E+00	2.68E-06	5.99E-08

Table 4-3
PBAPS Release Category Frequencies for the Seismic Model Based on FPIE Multipliers (/yr)

Class	Seismic base F-V (scaled)	Seismic Base Freq	HE-BOC	H/I	H/L	M/E	M/I	M/L	L/E	L/I	L/L	LL/E	LL/I	LL/L
1A	2.21E-01	1.84E-06	8.89E-08	0.00E+00	7.76E-11	0.00E+00	3.04E-09	2.57E-07	1.20E-08	8.47E-07	1.97E-08	0.00E+00	8.79E-08	0.00E+00
1B	3.35E-01	2.79E-06	6.91E-07	2.71E-09	0.00E+00	0.00E+00	0.00E+00	6.79E-08	6.35E-09	1.92E-07	1.37E-07	0.00E+00	8.54E-07	0.00E+00
1C	3.02E-05	2.51E-10	3.58E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.98E-12	1.94E-12	9.93E-12	6.05E-12	0.00E+00	2.72E-11	0.00E+00
1D	9.10E-04	7.56E-09	1.48E-09	2.96E-12	7.70E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.97E-10	0.00E+00	0.00E+00	6.37E-10	1.62E-10
1E	2.69E-01	2.23E-06	3.53E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.76E-07	1.01E-08	1.02E-06	4.56E-07	0.00E+00	2.80E-06	0.00E+00
2A	5.07E-04	4.22E-09	1.93E-10	4.05E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2F	1.67E-02	1.39E-07	6.67E-09	1.35E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2L	5.28E-06	4.39E-11	1.76E-12	4.15E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3A	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3B	5.55E-03	4.61E-08	3.27E-10	4.60E-10	0.00E+00	0.00E+00	1.93E-11	0.00E+00	4.42E-10	0.00E+00	0.00E+00	0.00E+00	4.60E-09	0.00E+00
3C	2.04E-03	1.70E-08	1.13E-09	9.38E-10	0.00E+00	0.00E+00	4.08E-11	0.00E+00	9.17E-11	0.00E+00	0.00E+00	0.00E+00	7.37E-09	0.00E+00
3D	1.02E-07	8.50E-13	8.49E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4A	6.21E-03	5.16E-08	5.03E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4L	3.28E-03	2.72E-08	2.63E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	1.33E-01	1.10E-06	1.09E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL			2.31E-06	1.43E-07	1.55E-10	0.00E+00	3.10E-09	7.01E-07	2.90E-08	2.05E-06	6.13E-07	0.00E+00	3.76E-06	1.62E-10

Table 4-4: Limiting DR and OECR Reductions Using Hope Creek Level 3 Results

		HE-BOC	H/I	H/L	M/E	M/I	M/L	L/E	L/I	L/L	LL/E	LL/I	LL/L	Intact		
Frequencies (per year)	FPIE	3.82E-07	1.02E-06	1.38E-09	0.00E+00	2.31E-09	1.68E-07	1.07E-08	5.53E-07	2.99E-08	0.00E+00	2.28E-07	2.79E-09	7.16E-07		
	Fire	3.06E-06	6.12E-06	2.95E-08	0.00E+00	3.78E-08	3.30E-06	1.59E-07	1.09E-05	4.61E-07	0.00E+00	2.68E-06	5.99E-08	9.59E-06		
	Seismic	2.31E-06	1.43E-07	1.55E-10	0.00E+00	3.10E-09	7.01E-07	2.90E-08	2.05E-06	6.13E-07	0.00E+00	3.76E-06	1.62E-10	neg		
	Aggregate	5.75E-06	7.28E-06	3.11E-08	0.00E+00	4.32E-08	4.17E-06	1.99E-07	1.35E-05	1.10E-06	0.00E+00	6.67E-06	6.29E-08	1.03E-05		
	Case A	2.87E-06	5.09E-06	0	0	0	0	0	0	0	0	0	0	0		
	Percent Reduction	50.0%	30.0%	100.0%	NA	100.0%	100.0%	100.0%	100.0%	100.0%	NA	100.0%	100.0%	100.0%		
	Case B	4.02E-06	3.64E-06	0	0	0	0	0	0	0	0	0	0	0		
	Percent Reduction	30.0%	50.0%	100.0%	NA	100.0%	100.0%	100.0%	100.0%	100.0%	NA	100.0%	100.0%	100.0%		
Dose and Dose-Risk (person-rem and person-rem/yr)	Dose	2.34E+07	8.75E+06	1.10E+07	1.31E+07	6.34E+06	6.38E+06	6.44E+04	6.44E+04	6.87E+05	6.44E+04	6.44E+04	6.87E+05	1.01E+03	Total DR	% Reduction
	Dose-Risk-Base	1.35E+02	6.37E+01	3.42E-01	0.00E+00	2.74E-01	2.66E+01	1.28E-02	8.70E-01	7.58E-01	0.00E+00	4.29E-01	4.32E-02	1.04E-02	2.28E+02	NA
	Dose-Risk Case A	6.73E+01	4.46E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E+02	50.9%
	Dose-Risk Case B	9.42E+01	3.18E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E+02	44.6%
Offsite Economic Cost and Offsite Economic Cost-Risk (dollars and dollars/yr)	Offsite Economic Cost (OEC)	1.15E+11	6.41E+10	9.23E+10	9.17E+10	4.73E+10	5.35E+10	2.54E+05	2.54E+05	7.41E+08	2.54E+05	2.54E+05	7.41E+08	3.63E+04	Total OECR	% Reduction
	OEC-Base	6.61E+05	4.67E+05	2.87E+03	0.00E+00	2.04E+03	2.23E+05	5.05E-02	3.43E+00	8.18E+02	0.00E+00	1.69E+00	4.66E+01	3.74E-01	1.36E+06	NA
	OECR Case A	3.31E+05	3.27E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.57E+05	51.6%
	OECR Case B	4.63E+05	2.33E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.96E+05	48.7%

Table 4-5: Limiting DR and OECR Reductions Using LaSalle Level 3 Results

		HE-BOC	H/I	H/L	M/E	M/I	M/L	L/E	L/I	L/L	LL/E	LL/I	LL/L	Intact		
Frequencies (per year)	FPIE	3.82E-07	1.02E-06	1.38E-09	0.00E+00	2.31E-09	1.68E-07	1.07E-08	5.53E-07	2.99E-08	0.00E+00	2.28E-07	2.79E-09	7.16E-07		
	Fire	3.06E-06	6.12E-06	2.95E-08	0.00E+00	3.78E-08	3.30E-06	1.59E-07	1.09E-05	4.61E-07	0.00E+00	2.68E-06	5.99E-08	9.59E-06		
	Seismic	2.31E-06	1.43E-07	1.55E-10	0.00E+00	3.10E-09	7.01E-07	2.90E-08	2.05E-06	6.13E-07	0.00E+00	3.76E-06	1.62E-10	neg		
	Aggregate	5.75E-06	7.28E-06	3.11E-08	0.00E+00	4.32E-08	4.17E-06	1.99E-07	1.35E-05	1.10E-06	0.00E+00	6.67E-06	6.29E-08	1.03E-05		
	Case A	2.87E-06	5.09E-06	0	0	0	0	0	0	0	0	0	0	0		
	Percent Reduction	50.0%	30.0%	100.0%	NA	100.0%	100.0%	100.0%	100.0%	100.0%	NA	100.0%	100.0%	100.0%		
	Case B	4.02E-06	3.64E-06	0	0	0	0	0	0	0	0	0	0	0		
	Percent Reduction	30.0%	50.0%	100.0%	NA	100.0%	100.0%	100.0%	100.0%	100.0%	NA	100.0%	100.0%	100.0%		
Dose and Dose-Risk (person-rem and person-rem/yr)	Dose	1.61E+07	5.66E+06	5.66E+06	7.39E+06	3.86E+06	3.86E+06	2.21E+05	7.09E+05	7.09E+05	2.21E+05	7.09E+05	2.21E+05	2.17E+03	Total DR	% Reduction
	Dose-Risk-Base	9.26E+01	4.12E+01	1.76E-01	0.00E+00	1.67E-01	1.61E+01	4.40E-02	9.58E+00	7.82E-01	0.00E+00	4.73E+00	1.39E-02	2.24E-02	1.65E+02	NA
	Dose-Risk Case A	4.63E+01	2.88E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.51E+01	54.6%
	Dose-Risk Case B	6.48E+01	2.06E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.54E+01	48.4%
Offsite Economic Cost and Offsite Economic Cost-Risk (dollars and dollars/yr)	Offsite Economic Cost (OEC)	8.68E+10	5.02E+10	5.02E+10	4.39E+10	3.53E+10	3.53E+10	3.19E+08	1.22E+09	1.22E+09	3.19E+08	1.22E+09	3.19E+08	8.57E+05	Total OECR	% Reduction
	OEC-Base	4.99E+05	3.65E+05	1.56E+03	0.00E+00	1.53E+03	1.47E+05	6.34E+01	1.65E+04	1.35E+03	0.00E+00	8.13E+03	2.01E+01	8.83E+00	1.04E+06	NA
	OECR Case A	2.50E+05	2.56E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.05E+05	51.5%
	OECR Case B	3.49E+05	1.83E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.32E+05	48.9%

Table 4-6: PBAPS SLR SAMA 44 Evaluation Using LaSalle Level 3 Results

		HE-BOC	H/I	H/L	M/E	M/I	M/L	L/E	L/I	L/L	LL/E	LL/I	LL/L	Intact		
Frequencies (per year)	FPIE	3.82E-07	1.02E-06	1.38E-09	0.00E+00	2.31E-09	1.68E-07	1.07E-08	5.53E-07	2.99E-08	0.00E+00	2.28E-07	2.79E-09	7.16E-07		
	Fire	3.06E-06	6.12E-06	2.95E-08	0.00E+00	3.78E-08	3.30E-06	1.59E-07	1.09E-05	4.61E-07	0.00E+00	2.68E-06	5.99E-08	9.59E-06		
	Seismic	2.31E-06	1.43E-07	1.55E-10	0.00E+00	3.10E-09	7.01E-07	2.90E-08	2.05E-06	6.13E-07	0.00E+00	3.76E-06	1.62E-10	neg		
	Aggregate	5.75E-06	7.28E-06	3.11E-08	0.00E+00	4.32E-08	4.17E-06	1.99E-07	1.35E-05	1.10E-06	0.00E+00	6.67E-06	6.29E-08	1.03E-05		
	SLR SAMA 44	5.32E-06	4.02E-06	0	0	0	0	0	0	0	0	0	0	0		
	Percent Reduction	7.5%	44.7%	100.0%	NA	100.0%	100.0%	100.0%	100.0%	100.0%	NA	100.0%	100.0%	100.0%		
Dose and Dose-Risk (person-rem and person-rem/yr)	Dose	1.61E+07	5.66E+06	5.66E+06	7.39E+06	3.86E+06	3.86E+06	2.21E+05	7.09E+05	7.09E+05	2.21E+05	7.09E+05	2.21E+05	2.17E+03	Total DR	% Reduction
	Dose-Risk-Base	9.26E+01	4.12E+01	1.76E-01	0.00E+00	1.67E-01	1.61E+01	4.40E-02	9.58E+00	7.82E-01	0.00E+00	4.73E+00	1.39E-02	2.24E-02	1.65E+02	NA
	Dose-Risk SLR SAMA 44	8.56E+01	2.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E+02	34.4%
Offsite Economic Cost and Offsite Economic Cost-Risk (dollars and dollars/yr)	Offsite Economic Cost (OEC)	8.68E+10	5.02E+10	5.02E+10	4.39E+10	3.53E+10	3.53E+10	3.19E+08	1.22E+09	1.22E+09	3.19E+08	1.22E+09	3.19E+08	8.57E+05	Total OECR	% Reduction
	OEC-Base	4.99E+05	3.65E+05	1.56E+03	0.00E+00	1.53E+03	1.47E+05	6.34E+01	1.65E+04	1.35E+03	0.00E+00	8.13E+03	2.01E+01	8.83E+00	1.04E+06	
	OECR SLR SAMA 44	4.62E+05	2.02E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.64E+05	36.2%

Peach Bottom Atomic Power Station
SAMA New & Significant Information Review
Response to Request for Additional Information

Question #: 5 **Category:** Severe Accidents **ER Section:** 4.15.2

Statement of Question:

The ER states, "Estimated population increase is within the range determined by the NRC in the 2013 GEIS to not be significant." Please summarize Exelon's evaluation of population.

Response:

The 2013 GEIS, section E.3.9.2 provides a discussion of the effect of population increases, which states the following (NRC 2013a):

> The 1996 GEIS estimated impacts at the mid-year of each plant's license renewal period (i.e., 2030 to 2050). To adjust the impacts estimated in the NUREGs and NUREG/CRs to the mid-year of the assessed plant's license renewal period, the information (i.e., exposure indexes [EIs]) in the 1996 GEIS can be used. The EIs adjust a plant's airborne and economic impacts from the year 2000 to its mid-year license renewal period based on population increases. These adjustments result in anywhere from a 5 to a 30 percent increase in impacts, depending upon the plant being assessed. Given the range of uncertainty in these types of analyses, a 5 to 30 percent change is not considered significant. Therefore, the effect of increased population around the plant does not generally result in significant increases in impacts.

Table 1, below, provides population information for the area within 50 miles of PBAPS. As the table shows, Exelon estimates that in 2044 (i.e., the mid-year of the subsequent license renewal period) the population within the 50-mile radius will be 28 percent higher than in 2010 based on a linear projection of the annual population growth rate calculated using U.S. Census Bureau data for 1990 and 2010.

Exelon assumes that a 28 percent increase in population would yield an approximate 28 percent increase in total off-site dose values. Because this estimated increase is within the range (zero to 30 percent) determined by the NRC in the 2013 GEIS to be not significant, Exelon concludes that no new and significant information exists for PBAPS concerning offsite dose and economic consequences resulting from population growth within the 50-mile radius surrounding the plant.

References:

(Exelon Generation 2001) Exelon Generation Company, LLC. 2001. "Applicant's Environmental Report - Operating License Renewal Stage: Peach Bottom Atomic Power Station Units No. 2 and 3," Docket Numbers 50-277 and 50-278; License Nos. DPR-44 and DPR-56. Appendix G, "Severe Accident Mitigation Alternatives (SAMA). July 2001. https://www.nrc.gov/reactors/operating/licensing/renewal/applications/peach-bottom/peach_bottom-envg.pdf. Accessed January 3, 2019.

(U.S. Census Bureau 2017) U.S. Census Bureau. 2017. American Fact Finder Web Site, Community Facts. https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml. Accessed August 31, 2017.

Table 1. Population Within 50 Miles

County Name	State	Approximate Percent of land within a 50-mile radius[1]	Total Population 1990[2]	Total Population 2000[2]	Total Population 2010[2]	Population within 50 miles 1990	Population within 50 miles 2000	Population within 50 miles 2010	Linearized fraction of 2010 population within 50 miles added each year 1990 to 2010	Estimated Percent Population increase within 50 miles 2010 to 2044[3]	Estimated Population within 50 miles 2044
Frederick	MD	2%	150,208	195,277	233,385	3,004	3,906	4,668			
Cumberland	PA	10%	195,257	213,674	235,406	19,526	21,367	23,541			
Montgomery	PA	15%	678,111	750,097	799,874	101,717	112,515	119,981			
Gloucester	NJ	20%	230,082	254,673	288,288	46,016	50,935	57,658			
Kent	DE	25%	110,993	126,697	162,310	27,748	31,674	40,578			
Anne Arundel	MD	30%	427,239	489,656	537,656	128,172	146,897	161,297			
Adams	PA	40%	78,274	91,292	101,407	31,310	36,517	40,563			
Dauphin	PA	40%	237,813	251,798	268,100	95,125	100,719	107,240			
Berks	PA	50%	336,523	373,638	411,442	168,262	186,819	205,721			
Howard	MD	50%	187,328	247,842	287,085	93,664	123,921	143,543			
Salem	NJ	50%	65,294	64,285	66,083	32,647	32,143	33,042			
Queen Anne's	MD	60%	33,953	40,563	47,798	20,372	24,338	28,679			
Lebanon	PA	75%	113,744	120,327	133,568	85,308	90,245	100,176			
Delaware	PA	85%	547,651	550,864	558,979	465,503	468,234	475,132			
Carroll	MD	85%	123,372	150,897	167,134	104,866	128,262	142,064			
York	PA	100%	339,574	381,751	434,972	339,574	381,751	434,972			
Lancaster	PA	100%	422,822	470,658	519,445	422,822	470,658	519,445			
Chester	PA	100%	376,396	433,501	498,886	376,396	433,501	498,886			
Baltimore	MD	100%	692,134	754,292	805,029	692,134	754,292	805,029			
Baltimore City	MD	100%	736,014	651,154	620,961	736,014	651,154	620,961			
Harford	MD	100%	182,132	218,590	244,826	182,132	218,590	244,826			
Cecil	MD	100%	71,347	85,951	101,108	71,347	85,951	101,108			
Kent	MD	100%	17,842	19,197	20,197	17,842	19,197	20,197			
New Castle	DE	100%	441,946	500,265	538,479	441,946	500,265	538,479			
TOTAL			6,796,049	7,436,939	8,082,418	4,703,447	5,073,851	5,467,783	0.00813	28%	6,978,310

[1] Source: Exelon Generation 2001, Appendix G, Table G.2-2, p. E.G-6.

[2] Source: U.S. Census Bureau 2017.

[3] Assumes linear increases each year at the same fraction of 2010 population as occurred from 1990 to 2010.