5.0 Environmental Impacts of Postulated Accidents

Environmental issues associated with postulated accidents are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999a).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) Single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off site radiological impacts from the fuel cycle and from high level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter describes the environmental impacts from postulated accidents that might occur during the license renewal term.

5.1 Postulated Plant Accidents

Two classes of accidents are evaluated in the GEIS. These are design-basis accidents (DBAs) and severe accidents, as discussed below.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and Addendum 1.

5.1.1 Design-Basis Accidents

In order to receive NRC approval to operate a nuclear power facility, an applicant must submit a safety analysis report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

DBAs are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant, but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in 10 CFR Part 50 and 10 CFR Part 100.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license (OL). The results of these evaluations are found in license documentation such as the staff's Safety Evaluation Report (SER), the Final Environmental Statement (FES), the licensee's Updated Final Safety Analysis Report (UFSAR), and Section 5.1 of this supplemental environmental impact statement (SEIS). The licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximum exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, design-basis events are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs make them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to Peach Bottom Units 2 and 3, is listed in Table 5-1.

Table 5-1. Category 1 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
POSTULATED ACCIDENTS	
Design-basis accidents	5.3.2; 5.5.1

Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER; Exelon 2001) that it is not aware of any new and significant information associated with the renewal of the Peach Bottom Units 2 and 3 OLs. The staff has not identified any significant new information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS.

5.1.2 Severe Accidents

Severe nuclear accidents are more severe than DBAs because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. The GEIS assessed the impacts of severe accidents during the license renewal period, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the renewal period.

Based on information in the GEIS, the Commission found that

> The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to Peach Bottom Units 2 and 3, is listed in Table 5-2.

Table 5-2. Category 2 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	POSTULATED ACCIDENTS		
Severe Accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	L	5.2

The staff has not identified any significant new information with regard to the consequences from severe accidents during its independent review of the Exelon ER (Exelon 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of severe accidents beyond those discussed in the GEIS. However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the staff has reviewed severe accident mitigation alternatives (SAMAs) for Peach Bottom Units 2 and 3. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

10 CFR 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated severe accident mitigation alternatives (SAMAs) for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for Peach Bottom Units 2 and 3; therefore, the following addresses those alternatives.

5.2.1 Introduction

Exelon submitted an assessment of SAMAs for Peach Bottom Units 2 and 3 as part of the ER (Exelon 2001). This assessment was based on the current Peach Bottom Probabilistic Safety Analysis (PSA), a plant-specific adaptation of the offsite consequence analysis performed as part of the NRC-sponsored probabilistic safety assessment for Peach Bottom Units 2 and 3 and documented in NUREG/CR-4551 (NRC 1990b), and insights from the Peach Bottom Individual Plant Examination of External Events (IPEEE) (PECO 1996). In identifying and evaluating potential SAMAs, Exelon considered several SAMA analyses for other plants (Limerick, Watts Bar, Comanche Peak, and Hatch) and other documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997a) and NUREG-1462 (NRC 1994a). Exelon identified and evaluated 204 potential SAMA candidates. This list was reduced to 30 unique SAMA candidates by eliminating SAMAs that were either not applicable to Peach Bottom Units 2 and 3, were related to phenomena that are not risk-significant in BWRs, or were similar to other SAMAs being considered. Other SAMAs were excluded because they had already been implemented at Peach Bottom Units 2 and 3. This list was further screened and the remaining SAMAs were evaluated in detail. The study concluded that none of the SAMAs identified would be cost-beneficial.

Based on a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to Exelon by letter dated December 20, 2001 (NRC 2001). Key questions concerned differences between the updated PSA used for the SAMA analysis and earlier risk assessments for Peach Bottom Units 2 and 3, the potential impact of uncertainties and external event risk contributors on the study results, the role of the plant-specific risk study in the SAMA identification process, and the effects of the power uprate on the risk profile. Exelon submitted additional information on January 30, 2002 (Exelon 2002) in response to the RAIs. In these responses, Exelon included supplemental tables showing the impacts of uncertainties, additional sensitivity analyses, and an assessment of the impact of the power uprate on accident progression. Exelon submitted further information on April 8, 2002 (Enclosure 3 to NRC 2002) clarifying remaining issues. In these responses, Exelon provided additional information on the jockey pump SAMA and on the averted risk values determined for SAMA candidates. Exelon's responses addressed the staff's concerns and reaffirmed that none of the SAMAs would be cost-beneficial.

An assessment of SAMAs for Peach Bottom Units 2 and 3 is presented below.

5.2.2 Estimate of Risk for Peach Bottom Units 2 and 3

Exelon's estimates of offsite risk at Peach Bottom Units 2 and 3 are summarized in Section 5.2.2.1. The summary is followed by a review of Exelon's risk estimates in Section 5.2.2.2.

5.2.2.1 Exelon's Risk Estimates

The SAMA analysis is based on two distinct analyses: (1) the Level 1 and 2 probabilistic safety assessment performed by Exelon and documented as Peach Bottom PSA, Revision 1, and (2) the extension of the Level 2 PSA to a Level 3 assessment based on application of the NUREG-1150 (NRC 1990a) consequence analysis results for Peach Bottom Units 2 and 3, as reported in NUREG/CR-4551 (NRC 1990b). The Peach Bottom PSA is an update to the Peach Bottom IPE submittal (PECO 1992) and reflects plant changes since the issuance of NUREG-1150 (NRC 1990a) and NUREG/CR-4551 (NRC 1990b). The scope of the Peach Bottom PSA does not include seismic or fire PSA models. As such, the Peach Bottom PSA does not permit either the numerical assessment of the baseline risk or identification of the quantitative change in risk that could be attributed to any proposed SAMA due to seismic or fire accident initiators. As described in Section 5.2.2.2, Exelon chose to evaluate the potential effects associated with these initiators through a sensitivity study.

The total core damage frequency (CDF) for internal events is 4.5×10^{-6} per reactor-year. The breakdown of CDF is provided in Table 5-3 . As shown in this table, the current analyses show that loss of offsite power (LOOP) and transient events, including station blackout (SBO) and anticipated transient without scram (ATWS), are the dominant contributors to CDF. The contribution of loss-of-coolant accidents (LOCAs) and other internal event initiators to CDF is less than 8 percent.

Table 5-3. Peach Bottom Units 2 and 3 Core Damage Frequency (Revision 1 of PSA)

Initiating Event	Frequency (per reactor-year)	% Contribution to CDF
Loss of Offsite Power (LOOP)	2.1×10^{-6}	46
Transients	1.2×10^{-6}	28
Station Blackout (SBO)	4.7×10^{-7}	10
Anticipated Transient Without Scram (ATWS)	4.3×10^{-7}	10
Loss-of-Coolant Accident (LOCA)	1.9×10^{-7}	4
Internal floods	6.0×10^{-8}	1
Others	4.8×10^{-8}	1
Total CDF (from internal events)	4.5×10^{-6}	100

The total Peach Bottom Unit 2 Level 1 CDF used in the SAMA submittal is 4.5×10^{-6} per reactor-year. The frequency associated with the plant damage states (PDSs) with significant offsite releases is 2.4×10^{-6} per reactor-year. The difference between the Level 1 CDF and the Level 2 endstate frequency represents those core damage sequences that lead to negligible or no release from the primary containment.

The total CDF for Peach Bottom Unit 3 is 4.2×10^{-6} per reactor-year, which is about 8 percent lower than that of Unit 2. This difference is attributed mostly to LOOP sequences involving the loss of 2 or 3 shared diesel generators. Asymmetry in emergency electric power distribution between the units and the diesel loading capability (one RHR pump per diesel generator) concurrent with the common LOOP initiator result in different diesel failure combinations having different CDF impacts at each unit.

The Peach Bottom PSA is limited to Level 1 and 2 and does not include an assessment of off-site consequences. Exelon extended the Level 2 PSA to a Level 3 assessment based on use of the NUREG/CR-4551 consequence analyses, and then scaled these results to account for increased population in the vicinity of Peach Bottom Units 2 and 3 at end of the license renewal period, as described below.

Each sequence in the Peach Bottom Level 2 PSA was reviewed and binned into one of 10 collapsed accident progression bins (APBs) used in NUREG/CR-4551. NUREG/CR-4551 provides the fractional contribution of the ten collapsed APBs and sufficient information to determine the frequency associated with each of the ten collapsed APBs. Exelon determined the population dose by multiplying the ratio of the CDF in the Peach Bottom PSA to the CDF in the NUREG/CR-4551 study by the product of the fractional contribution of the collapsed APBs and the total risk estimate from NUREG/CR-4551. Specifically, for a given collapsed APB the submittal defines the population dose risk as:

$$PDR_{PBAPS-PSA} = \frac{Frequency_{PBAPS-PSA}}{Frequency_{NUREG/CR-4551}} \bullet f_{APB} \bullet PDR_{NUREG/CR-4551}$$

where

$PDR_{PBAPS-PSA}$ = population dose risk at 50 miles for Peach Bottom (person-rem per reactor-year)

$Frequency_{PBAPS-PSA}$ = frequency of each collapsed APB in Peach Bottom PSA (per reactor-year)

$Frequency_{NUREG/CR-4551}$ = frequency of each collapsed APB in NUREG/CR-4551 (per reactor-year)

f_{APB} = fractional contribution of the collapsed APB to the population dose risk in NUREG/CR-4551

$PDR_{NUREG/CR-4551}$ = population dose risk at 50 miles for NUREG/CR-4551 (person-rem per reactor-year).

The resulting population dose estimates were summed over all bins to arrive at a total population dose.

The NUREG/CR-4551 consequence analyses were based on Version 1.5 of the MACCS computer code and site-specific data available at the time of the study (e.g., meteorology, demographics, and offsite property values). For purposes of the SAMA analysis, the population dose estimates were adjusted to account for the increase in population at the end of the proposed license extension. The population distribution used as input to the NUREG/CR-4551 MACCS analyses is based on the 1980 sector population data for the Peach Bottom site. Using 1990 and 1980 Census data, a growth ratio was developed and used to extrapolate the population out to 2034 to approximate the population at the end of the license renewal period. The ratio of the population density was calculated as:

$$P_{2034/1980} = \frac{\left(\frac{PD_{50(1990)} - PD_{50(1980)}}{1990 - 1980} \bullet 44 \text{ years} + PD_{50(1990)}\right)}{PD_{50(1990)}} \approx 4$$

where

$P_{2034/1980}$ = ratio of the population density for the area within 50 miles of the plant in 2034 to the population density for the area within 50 miles of the plant in 1980

$PD_{50(1980)}$ = population density for the area within 50 miles of the plant in 1980

$PD_{50(1990)}$ = population density for the area within 50 miles of the plant in 1990

Based on this analysis, Exelon estimates the dose to the population within 80 km (50 mi) of the Peach Bottom site to be 0.147 person-Sv (14.7 person-rem) per reactor-year. The contribution to total population dose from the various containment release modes is shown in Table 5-4. Early containment failure dominates the population dose risk at Peach Bottom Units 2 and 3.

Table 5-4. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose [person-Sv (person-rem) per reactor-year]	
Late containment failure	0.006	0.6
Early containment failure	0.133	13.3
Vessel breach, no containment failure	0.002	0.2
No vessel breach, no containment failure	0.006	0.6
Total	0.147	14.7

5.2.2.2 Review of Exelon's Risk Estimates

Exelon's estimate of offsite risk at the Peach Bottom site is based on Revision 1 of the Peach Bottom PSA and the application of the NUREG-1150 Level 3 PSA results as reported in NUREG/CR-4551 (NRC 1990b) to the results of plant-specific Peach Bottom Level 2 PSA. This review considered the following major elements of the analysis:

- the Level 1 and 2 risk models that form the bases for the 1992 IPE and 1996 IPEEE submittals (PECO 1992, 1996)
- the major modifications to the IPE model that have been incorporated in the Peach Bottom PSA
- the extension of the Level 2 PSA to a Level 3 assessment based on use of the NUREG/CR-4551 consequence analyses and subsequent scaling of these results to account for increased population in the vicinity of the Peach Bottom site at the end of the period of extended operation
- the contribution to risk due to internal and external initiating events, as reflected in the NRC-sponsored PSA for Peach Bottom Units 2 and 3 conducted as part of the NUREG-1150 studies.

Each of these analyses was reviewed to determine the acceptability of Exelon's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the Peach Bottom IPE is described in an NRC safety evaluation dated October 25, 1995 (NRC 1995). The review was based on a comparison between the results reported in the IPE submittal and the results of the staff study documented in NUREG-1150 and NUREG/CR-4551. Based on this review, the staff concluded that Exelon's analysis met the intent of Generic Letter 88-20 (NRC 1988); that is, the IPE was of adequate quality to be used to look for design or operational vulnerabilities. Overall, the staff believed that the Peach Bottom IPE was of adequate quality to be used as a tool in searching for areas with high potential for risk reduction and to assess such risk reductions.

A comparison of risk profiles between the original IPE (which was reviewed by the NRC staff) and the current PSA used in the SAMA analysis indicates a 20 percent reduction in the total Peach Bottom Unit 2 CDF. The PSA was updated twice (in 1997 and again in 1999) since the original IPE was submitted to the NRC to reflect model enhancements and plant changes, such as a 5 percent power uprate approved in 1994. The specific changes since the Peach Bottom IPE include (Exelon 2002):

- improved plant operating experience was reflected in the overall frequency of initiating events

- initiating events that were previously subsumed within other initiators (e.g., loss of instrument air and service water) were modeled as separate initiating events

- more detailed modeling of operator actions directed by procedures during LOOP events was incorporated, including credit for the Conowingo tie-line

- common cause failure terms for high pressure coolant injection (HPCI)/reactor core isolation cooling (RCIC), direct current (dc) battery pairs, and other miscellaneous systems were added

- treatment of common cause failures was reevaluated using the new Idaho National Engineering and Environmental Laboratory (INEEL) database (INEEL 1998)

- implementation of improved technical specifications was reflected in the model.

The incorporation of lower initiating event frequencies, additional LOOP recovery capabilities such as the Conowingo tie-line, and the INEEL common cause database have resulted in a reduction in total internal events CDF from that reported in the IPE. On the other hand, modeling of additional initiating events, detailed operator actions for LOOP, and common cause terms for HPCI/RCIC and dc batteries have resulted in increasing the total internal events CDF. Collectively, the incorporation of all the changes have resulted in a 20 percent reduction in the total CDF, as compared with the original IPE CDF estimate of about 5.5×10^{-6} per reactor-year. This is a relatively small change. The revised CDF estimate for Peach Bottom Units 2 and 3 is still comparable to values estimated for other BWR/3 and BWR/4 model plants, which Figure 11.2 of NUREG-1560 (NRC 1997a) shows to range from 9×10^{-6} to 8×10^{-5} per reactor-year, with a point estimate value of 2×10^{-5} per reactor-year.

The staff noted that the Peach Bottom PSA has been subjected to peer review at various stages, by internal and external reviewers, including a 1998 review of Revision 1 using the BWR Owners Group (BWROG) PSA Peer Review Certification Implementation Guidelines (Exelon 2002).

Exelon submitted an IPEEE by letter dated May 29, 1996 (PECO 1996), in response to Supplement 4 of Generic Letter 88-20 (NRC 1991). Exelon did not identify fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events related to seismic, fire, or other external events. However, a number of areas were identified for improvement in both the seismic and fire areas. In a letter dated November 22, 1999, the staff concluded that the submittal met the intent of Supplement 4 to Generic Letter 88-20 (NRC 1999b).

In a response to an RAI, Exelon acknowledged (Exelon 2002) that the risk assessment methods used for the Peach Bottom IPEEE do not provide the means to determine the numerical estimates of the CDF contributions from seismic and fire initiators. However, the licensee states that the current risk associated with external events at Peach Bottom Units 2 and 3 is much lower than that which existed at the time of the publication of NUREG/CR-4551 because of many plant improvements that have been made since that time, mostly as a result of the insights gained from the Peach Bottom IPEEE. These improvements include:

- Increased fire brigade awareness of important fire areas
- Incorporated automatic sprinklers in 4 kV switchgear areas
- Incorporated sprinklers in the 13 kV area and added sprinkler heads on the 116 ft elevation between the 13 kV area and the remainder of the turbine building (i.e., creating a water curtain at the openings)
- Replaced or upgraded Thermo-lag fire barriers in several fire areas
- Replaced or upgraded miscellaneous equipment for resolution of Generic Safety Issue A-46, "Seismic Qualification of Equipment in Operating Plants."

In addition, Exelon notes that the quantitative contributions from external events, as estimated in NUREG/CR-4551 for Peach Bottom Units 2 and 3, would be bounded by the 95th percentile CDF estimate for internal events (see Table 5-6). An associated sensitivity study by Exelon shows that use of the 95th percentile CDF in the cost-benefit evaluation in lieu of the point estimate value impacts the screening for only two SAMAs. However, a further evaluation of these two SAMAs indicates that they would not be cost-beneficial (Exelon 2002). This is discussed further in Section 5.2.6.2.

The failure to consider the quantitative impact of external events by the licensee is acceptable given: (1) the IPEEE process has led to the identification and disposition of potential external events vulnerabilities; and (2) the insights from the consideration of the 95th percentile of the risk of core damage, which bound the potential impact if the quantitative risk of external events were included.

The process used by Exelon to extend the Peach Bottom PSA to an assessment of offsite consequences was reviewed. That process involved binning the sequences in the Peach Bottom Level 2 PSA into one of 10 collapsed APBs used in NUREG/CR-4551 and determining the population dose based on the APB frequency and the consequences of the APBs reported in NUREG/CR-4551. The relative distribution of the site-specific economic data utilized in NUREG/CR-4551 was assumed to remain constant. However, the overall growth in economy and agriculture were assumed to be reflected by the growth in the population. This increase was accounted for by scaling the population dose estimates by a factor of 4. Evacuation modeling remained unchanged from what was utilized in NUREG/CR-4551. The staff concludes that the process used by Exelon to extend the Level 2 PSA results to a Level 3 assessment, and to scale the results to account for subsequent population growth is technically sound and properly implemented, and therefore is acceptable. Furthermore, the staff concludes that the evacuation assumptions and analysis are reasonable and acceptable for the purposes of the SAMA evaluation.

The Exelon assessment has focused on the risk based on the uprate power of 3458 MW(t). In response to an RAI, Exelon qualitatively assessed the influence of the 5 percent power uprate on the containment response and radiological releases to be negligible (Exelon 2002). The staff concludes that the basis for the licensee's qualitative assessment of the 5 percent power uprate is reasonable, and that the methodology used by Exelon to estimate the CDF and offsite consequences for Peach Bottom Units 2 and 3 provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of risk on the CDF and population doses reported by Exelon.

5.2.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by Exelon are discussed in this section.

5.2.3.1 Process for Identifying Potential Plant Improvements

Exelon's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of SAMA analyses submitted in support of original licensing and license renewal activities for other operating nuclear power plants and advanced light-water reactor plants
- review of other NRC and industry documentation
- review of plant-specific risk management insights developed as part of the accident management implementation process at Peach Bottom Units 2 and 3

Those accident management strategies that were identified in the IPE as beneficial in reducing risk in a measurable manner and applicable to Peach Bottom Units 2 and 3 have already been implemented by Exelon. These include an enhanced version of the procedure for loss of offsite power events (SE-11), and the Torus Hard Piped Vent. The review of the updated PSA in 1997 and 1999 did not reveal any significant changes in the risk profile originally assessed as part of the IPE process (Exelon 2002).

Based on this process, an initial list of 204 candidate improvements was identified, as reported in Table G.4-16 of Appendix G to the ER. Exelon performed a qualitative, Phase I screening of the initial list of SAMAs using the following criteria:

- The SAMA is not applicable to Peach Bottom Units 2 and 3 due to design differences (e.g., not applicable to the BWR/4 Mark I design).
- The SAMA is related to an interfacing system loss-of-coolant accident (ISLOCA). These types of events are not considered to be significant risk contributors for BWRs, as described in NRC Information Notice 92-36 (NRC 1992) and its supplement (NRC 1994b).
- The SAMA is related to the mitigation of recirculation pump seal failures. NUREG-1560 indicates that although reactor coolant pump (RCP) seal leakage is important to pressurized water reactors (PWRs), it does not significantly contribute to CDF in BWRs [NRC 1997a].
- The SAMA has already been implemented at Peach Bottom Units 2 and 3.
- The SAMA is related to design changes that would be implemented prior to construction (primarily those taken from the severe accident mitigation design alternative analysis for the Advanced Boiling Water Reactor).
- The SAMA was known to have an implementation cost that far exceeds any possible risk benefit.

Any SAMA candidates that were sufficiently similar to other SAMA candidates were either combined or screened from further consideration. Based on the Phase I screening, 174 SAMAs were eliminated, leaving 30 SAMAs which were considered applicable to Peach Bottom Units 2 and 3 and of potential value in reducing the risk of severe accidents.

These 30 candidate SAMAs were further evaluated and screened as part of a Phase II evaluation. Exelon quantitatively evaluated the risk-reduction potential and the implementation costs for each of the 30 SAMA candidates, as described in Sections 5.2.4 and 5.2.5, respectively. If the implementation costs were greater than the maximum benefit, then the SAMA was screened from further consideration. Using this approach, all but 12 SAMAs were eliminated because the cost was expected to exceed the maximum benefit. Of the 12 remaining candidates, 7 were screened from further analysis based on plant-specific risk insights regarding the systems that would be affected by the proposed SAMA (i.e., a more realistic evaluation of the benefit that would be obtained). These are:

- SAMA 2 - Improved ability to cool the residual heat removal (RHR) heat exchangers. This was screened out on the basis that a procedure is already in-place to cross-tie to the opposite unit High Pressure Service Water (HPSW) pumps, a cross-tie to the Fire Protection System (FPS) would not provide sufficient flow for cooling, and the cost of new hardware addition would be more than $2 million.

- SAMA 6 - Use the fire protection system as a backup source for the containment spray system. This was originally screened out on the basis that adding a backup source would not contribute to risk reduction because the Emergency Operating Procedures (EOPs), based on EPG Revision 4 guidance, would preclude using the sprays. In a response to an RAI (Exelon 2002), Exelon did clarify that new in-place procedures, based on Revision 1 of the Emergency Procedure and Severe Accident Guidelines (EP/SAG), would allow for the drywell sprays to be used to cool debris and thereby reduce probability for shell melt-through. Thus a backup source could possibly contribute to risk reduction. However, Exelon points our that the maximum benefit resulting from using the fire protection system is $284,000. This is contrasted with the cost of $0.5M/unit or $1.0M/site, which would include hardware changes to enhance the flow rate and to supply supplemental power to the RHR injection valves.

- SAMA 15 - Proceduralize intermittent operation of HPCI. This was screened out based on Exelon's judgement that intermittent operation of HPCI during SBO events would be detrimental to battery life and would not be desirable.

- SAMA 17 - Enhance procedure to instruct operators to trip unneeded RHR/containment spray (CS) pumps on loss of room ventilation. This was screened out on the basis that the risk reduction worth associated with CS, LPCI, and Normal Service Water (NSW) is minimal and therefore only a small change in the CDF would be expected due to improvements in room cooling dependency.

- SAMA 19 - Modify Reactor Water Cleanup (RWCU) for use as decay heat removal system and proceduralize use. This was screened out on the basis that the Peach Bottom RWCU system is incapable of serving as the sole decay heat removal system until many days after reactor shutdown.

- SAMA 27 - Improve Uninterruptible Power Supplies (UPS). This was screened out on the basis that the UPSs are not considered by Exelon to be risk significant, although they would increase the reliability of power supplies supporting front-line safety equipment. Because they are considered risk insignificant, the UPSs are not even modeled in the Peach Bottom PRA. Thus, no quantitative measure of averted risk, however small, could be made by Exelon.

- SAMA 30 - DC Cross-ties. This was screened out on the basis that a procedure (SE-11) has already been developed to optimize cross-tie capabilities of the 4 kV buses and various power supplies afforded by the emergency diesel generators and the dedicated power source from Conowingo Dam. Because the benefit is already obtained from the SE-11 procedure, the addition of the DC cross-ties would not be cost effective.

The five remaining SAMA candidates are listed in Table 5-5. For each of the five remaining SAMA candidates, a more detailed conceptual design was prepared along with a more detailed estimated cost, as described in Section 5.2.5.

5.2.3.2 Staff Evaluation

Exelon's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. The initial list of SAMAs generally addressed the accident categories that are dominant CDF contributors or issues that tend to have a large impact on a number of accident sequences at Peach Bottom Units 2 and 3. The preliminary review of Exelon's SAMA identification process raised some concerns that plant-specific risk contributors were not fully considered. The staff requested additional plant-specific risk information (e.g. importance measures) to determine if any significant SAMAs might have been overlooked. Exelon's response to the RAI indicated that all important plant-specific candidate SAMAs had been considered (Exelon 2002). However, importance measures were only used on a selected basis. Exelon did not provide information indicating that they had performed a systematic and comprehensive evaluation of importance measures and their relation to potential SAMAs. Exelon indicated that, because there are only small differences between the IPE PRA and the current (Revision 1) PSA, the original and subsequent evaluations of plant-specific accident mitigation strategies is sufficient for SAMA candidate determination. While the staff's position is that a comprehensive assessment of importance measures and/or cut sets is important to determining SAMA candidates, it does recognize that Exelon used the plant-specific risk study to identify candidate SAMAs and therefore concludes that the list of SAMA candidates appears to address the major contributors to risk for both the IPE and the PSA.

The list of 204 candidate SAMAs focuses on hardware changes that tend to be expensive to implement. However, about one-third of the 204 candidate SAMAs involve something other than hardware changes. These options could provide marginally smaller risk reductions with much smaller implementation costs.

Of the 204 SAMA candidates, Exelon eliminated 26 because they were associated with reactor coolant pump seal failures or ISLOCA (both considered to be too insignificant with respect to BWR risk to pursue), 31 were eliminated because they were determined to not be applicable to Peach Bottom Units 2 and 3 (for various reasons), 39 were combined with other similar candidate SAMAs, 61 were already implemented at Peach Bottom Units 2 and 3, 10 were determined to not be cost beneficial (cost of implementation would exceed risk benefit), and 7 were judged to provide no safety benefit. This left 30 SAMA candidates for further consideration. Of the 30 remaining SAMAs that were applicable to Peach Bottom Units 2 and 3 and were of potential value in averting the risk of severe accidents, 7 were not hardware changes.

As described in Section 5.2.3.1, Exelon eliminated 18 of the remaining 30 SAMA candidates as part of the Phase II screening by comparing the estimated costs of the candidates to the maximum benefit ($2.04M/site, see Section 5.2.6 for further discussion) attained by eliminating all risk, and finding that costs for each of the eighteen were much greater than the maximum benefit. Because the actual benefit for any of the eighteen would be considerably less than this maximum, the staff concludes that these eighteen were properly eliminated.

The next step in the process was to reduce the remaining 12 SAMA candidates further. Seven were eliminated by Exelon by considering cost, enhancements and qualitative arguments for disposition. The staff considered each and concluded that the Exelon position was acceptable except for the matter of the fire protection system as a containment spray source backup (SAMA 6). In response to RAIs, Exelon addressed this matter further and also addressed a SAMA candidate not considered in its original SAMA list. These two potential SAMAs are discussed below.

The staff questioned Exelon's basis for screening out SAMA 6 (use the fire protection system [FPS] as a backup source for the containment spray system) given that the plant-specific emergency operating procedures had been modified since the original screening, potentially impacting the value of this SAMA. In response to an RAI, Exelon indicated that the SAMAs were dispositioned when procedures based on Revision 4 of the Emergency Procedure Guidelines (EPG) were in place at Peach Bottom Units 2 and 3. These guidelines severely restricted the ability to use drywell sprays, making this hardware modification ineffective. Since that time, the procedures have been revised based on Revision 1 of the Emergency Procedure and Severe Accident Guidelines (EP/SAG), which provide less restrictive guidance concerning the use of drywell sprays for accident mitigation. Revision 2 of the EP/SAG, which was issued by the Boiling Water Reactor Owners Group in 2001 but is not yet implemented at Peach Bottom Units 2 and 3, provides additional flexibility in the use of sprays.

In response to the staff's request, Exelon provided additional information regarding the benefits and costs of this SAMA. Exelon noted that the diesel fire pump could be used to supply the drywell sprays in those accident sequences for which AC power or DC power may not be available to operate RHR or HPSW. The Fussell-Vesely importance for these sequences leading to core damage is approximately 0.1. Thus, only about 10 percent of the core damage scenarios leading to possible radionuclide releases could be influenced by the use of FPS for drywell sprays. Exelon noted that FPS as a backup source for the containment spray system would require a modification to enhance the system flow rate and add supplemental power to the RHR injection values, and estimated the cost of these modifications at $0.5M/unit. The maximum benefit was estimated to be $284K based on a conservative assumption that all SBO events would be successfully mitigated using the fire protection system. On the basis of this information, Exelon concluded that this SAMA will not provide sufficient risk reduction to warrant its expense. The staff considers Exelon's dispositioning of this SAMA based on the above costs and benefits to be reasonable.

The staff's risk study of Peach Bottom Units 2 and 3 (NRC 1990b) concluded that a potentially beneficial procedural modification might be one to reduce the probability of a common-mode DC power failure. Exelon addressed this possible additional candidate in their responses to RAIs (Exelon 2002). They state that the DC system and associated common cause events have a low impact on the baseline CDF and risk (e.g., the Fussell-Vesely importance is $4.3x10^{-5}$) and that therefore, justification for a modification is not supported as being cost beneficial. The staff concludes that the Exelon evaluation is reasonable.

The remaining 5 SAMA candidates are addressed quantitatively in Sections 5.2.4 and 5.2.5.

The NRC notes that the set of SAMAs submitted is not all inclusive, because additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered. On this basis, the NRC concludes that the set of potential SAMA alternatives identified by Exelon is acceptable.

5.2.4 Risk Reduction Potential of Plant Improvements

Exelon developed a quantitative estimate of the risk reduction for each of the 5 SAMAs remaining after the Phase II screening. The specific impacts on the CDF and the population dose were identified, the appropriate model elements were changed to reflect the plant or procedure enhancement, and the models were requantified. Table 5-5 lists the assumptions used to estimate the risk reduction, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk for each of the 5 SAMAs.

In response to an RAI, Exelon estimated the uncertainties associated with the calculated CDF, and reassessed the Phase II screening based on use of the 95th percentile value of the CDF in the cost-benefit analysis instead of the point estimate value. Exelon found that two of the SAMAs would no longer be screened out; however, a more detailed examination by Exelon concluded that these two SAMAs would not be justified on a cost-benefit basis (Exelon 2002). In addition, Exelon states that even if the impact of external events on the CDF, as estimated in NUREG/CR-4551 in the late 1980s, were to be included in the evaluation, the increase would be less than that provided by the 95th percentile CDF estimate from internal events (Exelon 2002). These assessments are discussed further in Section 5.2.6.2.

Of the five candidates described in Table 5-5, the one that has costs and benefits that are of the same order is SAMA 21, suppression pool jockey pump. This pump would provide an independent means of providing long term injection into the reactor pressure vessel following venting or containment failure. In the PSA, the jockey pump was initially simulated by changing the failure probability for the fire pump from 0.8 to 0.01 (the PSA includes a simple representation of the fire pump to perform a similar function). This is considered optimistic by Exelon. The resulting risk reduction translated into a benefit value of $351,000. Because this risk-reduction value was large, the staff asked Exelon for additional information regarding the costs and the risk-reduction potential of this SAMA. Exelon claimed that a more realistic benefit value for SAMA 21 is about $152,000 (Enclosure 3 to NRC 2002). The PSA evaluation for the more realistic case assumed that the jockey pump is supplied by the E2 480V bus, i.e., the bus with the lowest risk achievement worth in the model, with a total system reliability of 0.05 (including human error) instead of the optimistic value of 0.01. The staff concurs that the reliability value of 0.05 is a reasonable best-estimate, and that the more realistic risk reduction estimates provided by Exelon are appropriate values to use in the SAMA assessment.

The NRC staff has reviewed Exelon's bases for calculating the risk reduction for the various plant improvements and concludes that the methodology is sound and that the values calculated are reasonable for SAMA purposes.

5.2.5 Cost Impacts of Candidate Plant Improvements

As part of the Phase II screening, Exelon developed a preliminary cost estimate for each of the 30 unique SAMA candidates remaining after the qualitative (Phase I) screening. These preliminary cost estimates, reported in Table G.4-2 of the ER, were developed to determine which SAMA candidates would clearly cost more than $2.04M (the maximum benefit associated with completely eliminating all risk, as described in Section 5.2.6.1) and could readily be dismissed. The cost estimates were based on the total costs associated with engineering, procurement, and construction. All costs for all SAMAs were provided on a per site basis. Where applicable, costs were determined on dual-unit basis (rather than doubling a single-unit estimate) to give a more accurate overall cost estimate.

Table 5-5. SAMA Cost/Benefit Screening Analysis

Phase II SAMA #	SAMA	Assumptions	% Risk Reduction: CDF	% Risk Reduction: Population Dose	Total Benefit	Cost (2001 dollars)	Net Value ($): Base Case	Net Value ($): 3% Discount Rate
1	Enhance procedural guidance for use of cross-tied component cooling or service water pumps	Eliminate initiating events related to loss of service water, by setting basic events involving failure of service water, turbine building closed cooling water, and reactor building closed cooling water pumps to zero	0.7	0.07	$8400	$50,000	(41,600)	(39,000)
11	Provide additional DC battery capacity	Extend battery life 4 hours to simulate additional battery capability. Impacts the loss of offsite power cases with HPCI and/or RCIC available.	19	13	$265,000	$1,600,000	(1,330,000)	(1,250,000)
13	Develop procedures to repair or replace failed 4-kV breakers	Improved procedures to repair or replace failed 4 kV breakers would reduce 4 kV breaker "fail to close" rates to zero, and reduce 4kV bus failure rates by a factor of 10.	0.1	very small	$400	$50,000	(49,600)	(49,500)
18	Increase the safety relief valve reseat reliability (case A)	Safety relief valve (SRV) "failure to reseat" probabilities reduced by a factor of 10.	4	5	$94,000	$2,000,000	(1,910,000)	(1,890,000)
18	Increase the safety relief valve reseat reliability (case B)	SRV "failure to reseat" probabilities reduced by a factor of 10, and stuck-open safety relief valve initiating event frequency reduced by a factor of 10.	6	10	$174,000	$2,000,000	(1,830,000)	(1,770,000)
21	Install suppression pool jockey pump for alternate injection to the reactor pressure vessel (optimistic)	Installation of a suppression pool jockey pump simulated by reducing the failure probability for the fire pump to 0.01	8	27	$351,000	$480,000	(129,000)	(19,400)
21	Install suppression pool jockey pump for alternate injection to the reactor pressure vessel (realistic)	Installation of a suppression pool jockey pump simulated by reducing the failure probability for the fire pump to 0.05	5	9	$152,000	480,000	(328,000)	(280,000)

Using the $2.04M screening value, 18 candidate SAMAs were eliminated. Of the 12 remaining candidates, 7 were screened from further analysis based on plant-specific risk insights regarding the systems that would be affected by the proposed SAMA, as described in Section 5.2.3.1 and 5.2.3.2. For the five remaining SAMA candidates, a more detailed conceptual design was prepared along with a more detailed cost estimate based on the same set of cost elements considered. Table 5-5 shows the cost estimates for the five remaining SAMAs.

The staff compared the cost estimates in Table G.4-2 of the ER to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The Exelon estimates were found to be consistent and reasonable for the SAMAs under consideration. For SAMAs 1 and 13, the estimate of $50,000 for a site procedural change is consistent with other cost assessments for similar actions. The range determined from other SAMA studies is $30,000 to $70,000.

For SAMA 18, the cost estimate of $2M is based on $200K/safety relief valve (SRV) times 10 automatic depressurization system SRVs (5 per unit). Because this SAMA assumes replacing the SRVs with new models, the cost is reasonable.

For SAMA 11, the cost estimate of $1.6M is based on $200K/battery times 8 batteries. This cost includes engineering analysis, equipment (new battery capability), and modification implementation. The cost is reasonable for a "hardware" SAMA of this size.

For SAMA 21, Exelon provided an estimated implementation cost of $480K (for both units) based on a previous cost estimate for the Advanced Boiling Water Reactor (ABWR). The ABWR cost estimate was doubled to account for the higher cost of installing the modification in an operating plant, versus during new plant construction. In response to a staff request, Exelon noted that this cost estimate was optimistic and that, in reality, when considering the costs associated with the installation of a totally independent system (new pump, power supply cables, and new piping) capable of injecting saturated water from the suppression pool, the costs would be much higher (Enclosure 3 to NRC 2002). Based on these comments from Exelon and further consideration of the modification, the staff considers the cost estimate of $480,000 not unreasonable but certainly optimistic. The lower-bound nature of this estimate should be taken into account in the cost-benefit comparison.

The staff concludes that the cost estimates are sufficient and appropriate for use in the SAMA evaluations.

5.2.6 Cost-Benefit Comparison

The staff's evaluation of Exelon's cost-benefit analysis is described in the following sections.

5.2.6.1 Exelon Evaluation

The methodology used by Exelon was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997b). The guidance involves determining the net value for each SAMA according to the following formula:

Net Value = ($APE + $AOC + $AOE + $AOSC) – COE

where

$APE = present value of averted public exposure ($)

$AOC = present value of averted offsite property damage costs ($)

$AOE = present value of averted occupational exposure costs ($)

$AOSC = present value of averted onsite costs ($)

COE = cost of enhancement ($)

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. Exelon's derivation of each of the associated costs is summarized below.

<u>Averted Public Exposure (APE) Costs</u>

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δperson-rem/reactor-year)
x monetary equivalent of unit dose ($2000 per person-rem)
x present value conversion factor (10.76 based on a 20-year period with a 7-percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997b), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the renewal period) of the facility. Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, Exelon calculated an APE of approximately $317,000.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x offsite economic costs associated with a severe accident (on a per-event basis)
x present value conversion factor.

For the purposes of initial screening (severe accident costs eliminated), Exelon cited an annual offsite economic risk of $51,700 based on the Level 3 risk analysis. This results in a discounted value of approximately $557,000.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

AOE = Annual CDF reduction
x occupational exposure per core damage event
x monetary equivalent of unit dose
x present value conversion factor.

Exelon derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997b). Best-estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of $2000 per person-rem, a real discount rate of 7 percent, and a time period of 20 years to represent the license renewal period. For the purposes of initial screening (severe accident costs eliminated), Exelon calculated an AOE of approximately $1,700.

Averted Onsite Costs (AOSC)

Averted onsite costs include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. Exelon derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997b).

Exelon divided this cost element into two parts, the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs (ACC), and the Replacement Power Cost (RPC).

Averted cleanup and decontamination costs (ACC) are calculated using the following formula:

ACC = Annual CDF reduction
x present value of cleanup costs per core damage event
x present value conversion factor.

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $\$1.1 \times 10^9$ (undiscounted). This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial screening (severe accident costs eliminated), Exelon calculated an ACC of approximately $53,600.

Long-term RPC are calculated using the following formula:

RPC = Annual CDF reduction
x present value of replacement power for a single event
x factor to account for remaining service years for which replacement power is required
x reactor power scaling factor

For the purposes of initial screening (severe accident costs eliminated), Exelon calculated an RPC of approximately $91,000.

Exelon evaluated all costs and benefits on a per site rather than per unit basis. Accordingly, they applied a factor of two multiplier to each of the above cost elements to account for the contribution from both units. Using the above equations and applying this multiplier, Exelon estimated the total present dollar value equivalent associated with completely eliminating severe accidents at Peach Bottom Units 2 and 3 to be $2.04M for the site.

Exelon's Results

The cost-benefit results for the individual analysis of the final five SAMA candidates are presented in Table 5-5. All of the SAMAs have negative net values. Exelon concluded that implementation of any of these SAMAs is not justified because the costs of implementation exceed the benefits. Therefore, Exelon has decided not to pursue any of these SAMAs further.

5.2.6.2 Staff Evaluation

The cost-benefit analysis conducted by Exelon was based primarily on the NRC's Regulatory Analysis Technical Evaluation Handbook (NRC 1997b). Averted risks were for the Peach Bottom Units 2 and 3, and thus were twice the values for a single unit. To maintain expenditures on the same scale, Exelon either doubled the single-unit SAMA costs or assessed SAMA costs on a (shared) plant station basis. While this is not a typical practice, it is reasonable.

Exelon originally did not perform sensitivity studies as recommended in the regulatory analysis handbook (NRC 1997b). In response to an RAI, Exelon performed a sensitivity study in which the discount rate was reduced from 7 percent in the baseline analysis to 3 percent. This results in an increase in the maximum benefit (for completely eliminating all risk) from $2.04M to about $2.7M. As a result, five of the SAMAs previously eliminated in the Phase II screening (on the basis that their implementation costs were greater than the maximum benefit) were reassessed because their implementation costs would be less than the revised maximum benefit of $2.7M. These SAMAs were:

- SAMA 3 - Install an independent method of suppression pool cooling
- SAMA 5 - Install a containment vent large enough to remove ATWS decay heat
- SAMA 23 - Install a Safety-Related Condensate Storage Tank
- SAMA 24 - Install improved vacuum breakers (redundant valves in each line)
- SAMA 28 - Dedicated RHR (bunkered) Power Supply

Upon further evaluation, either the risk reduction associated with these additional SAMAs was estimated to be relatively small, or the realistic implementation costs were judged to be greater than the benefits. On this basis, Exelon determined that these SAMAs would not be cost beneficial.

Similarly, implementing any of the SAMAs in the near term instead of waiting until the start of the license renewal period (thereby extending the period in the value-impact analysis) would not increase the net benefit sufficiently to make any of the SAMA candidates cost-beneficial.

Use of a 3 percent discount rate also increases the benefits associated with the 5 candidate SAMAs that had already survived the Phase II screening. Thê net benefits of these SAMAs using a 3 percent discount rate is shown in the last column of Table 5-5. The net benefits for each of the SAMAs remain negative, although SAMA 21 - Install suppression pool jockey pump, is only marginally negative (-$19K), based on an averted risk value of $461K and an estimated cost of $480K.

In their responses to the staff's RAIs (Exelon 2002), Exelon addressed the impact of considering the 95th percentile CDF, a value 7 times larger than the point estimate (see Table 5-6). The resultant increase in the averted risks would tend to make the SAMAs more attractive.

Table 5-6. Uncertainty in the Calculated CDF for Peach Bottom Unit 2

Percentile	CDF (per reactor-year)
5th	$1.6x10^{-6}$
25th	$2.6x10^{-6}$
50th	$4.2x10^{-6}$
75th	$7.8x10^{-6}$
95th	$3.0x10^{-5}$

Exelon reassessed all 30 of the candidate SAMAs and found that two SAMAs became cost-beneficial under the 95th percentile assumption. These were SAMA 11 - Provide additional DC battery capability, and SAMA 21 - Install suppression pool jockey pump. The benefits for SAMA 11 are still relatively close to the costs (i.e., a net value of $145K) when the 95th percentile CDF is used. Since the 95th percentile is an upper bound, and the net value is still relatively small, the staff agrees with Exelon that SAMA 11 is not a candidate for further consideration.

The benefits of SAMA 21 are substantially greater than the costs (i.e., a net value of $1.85M) when the 95th percentile CDF and optimistic risk reduction assumptions (see Section 5.2.4) are used, suggesting that the SAMA might also be cost-beneficial given more modest increases in the estimated CDF than a factor of seven. Also, as mentioned above, the net value of SAMA 21 is only marginally negative using a 3 percent discount rate (and point estimate CDF values). However, when averted onsite costs (AOSC) are excluded from the cost benefit, the net value becomes more negative. (The Regulatory Analysis Guidelines direct the staff to display the results with this attribute excluded if such exclusion would change the apparent conclusion to be drawn from the calculated net benefit.) Furthermore, based on a more realistic estimate of the risk reduction for this SAMA provided in Section 5.2.4, the benefits are substantially less and this SAMA would have a negative net value of approximately $300K. The impact of these major assumptions and uncertainties on the cost-benefit results are summarized in Table 5-7.

Table 5-7 Impact of Uncertainties on SAMA #21 Costs and Benefits

Cost-Benefit Element	Analysis Case				
	Base Case	95th Percentile CDF	3% Discount Rate	AOSC excluded	"Realistic" Averted-Risk Benefit
Benefit	$351K	$2,330K	$461K	$339K	$152K
Cost	$480K	$480K	$480K	$480K	$480K
Net Value	–$129K	+$1,850K	–$19K	–$141K	–$328K

Exelon stated that the estimated cost to implement SAMA 21 is conservative (see discussion in Section 5.2.5). The staff acknowledges that the implementation cost may be conservative, and further notes that when AOSC is excluded, the net value of the SAMA is clearly negative.

Although this SAMA may have a positive net value under certain conditions, it does not appear to be justified on a cost-benefit basis, given a broader consideration of the conservatisms, uncertainties, and assumptions inherent in the analysis.

5.2.7 Conclusions

Exelon compiled a list of 204 SAMA candidates using as resources: SAMA analyses submitted in support of licensing activities for other nuclear power plants, NRC and industry documents, and documents related to advanced power reactor designs (ABWR). A qualitative screening removed those SAMA candidates that: (1) did not apply to Peach Bottom Units 2 and 3 due to design differences, (2) were related to the mitigation of recirculation pump seal failures or ISLOCA (not significant risk contributors for BWRs), (3) had already been implemented at Peach Bottom Units 2 and 3, or (4) were related to design changes prior to construction. Using the updated Peach Bottom PSA, a maximum obtainable benefit of about $2.04M was calculated. This value was used in a second screening that eliminated the SAMA candidates whose cost to implement would exceed the maximum obtainable benefit. This process left only 12 SAMA candidates for further analysis. SAMAs related to non-risk significant systems were then screened out because any change in the reliability of these systems was found to have a negligible impact on the PSA evaluation. For the remaining 5 SAMA candidates, a more detailed conceptual design and cost estimate were developed as shown in Table 5-5.

The cost-benefit analyses showed that none of the final five SAMA candidates were cost-beneficial. Exelon concluded that there was no justification to implement any of the SAMA candidates and decided not to pursue any of the SAMA candidates further.

The staff reviewed the Exelon analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Exelon are reasonable and sufficient for the license renewal submittal. The unavailability of a seismic and fire PSA model precluded a quantitative evaluation of SAMAs specifically aimed at reducing risk of these initiators; however, significant improvements have been realized as a result of the IPEEE process at Peach Bottom Units 2 and 3 that would minimize the likelihood of identifying cost-beneficial enhancements in this area.

Based on its review of Exelon's SAMA analyses, the staff concludes that none of the candidate SAMAs are cost-beneficial. This conclusion is consistent with the low residual level of risk indicated in the Peach Bottom PSA and the fact that Peach Bottom Units 2 and 3 has already implemented many plant improvements identified by the IPE and IPEEE.

5.3 References

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U.S. Nuclear Regulatory Commission (NRC). 2002. NRC staff Note to File, from L. L. Wheeler, Subject: Public Availability of Information provided to the NRC Staff in Support of the Environmental Review of the Application Submitted by Exelon Generation Company, LLC, for Renewal of the Operating Licenses for Peach Bottom Atomic Power Station, Units 2 and 3, with enclosures, May 30, 2002.

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off site radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and are applicable to Peach Bottom Units 2 and 3. The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of

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(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Uranium Fuel Cycle Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Peach Bottom Units 2 and 3 from the uranium fuel cycle and solid waste management are listed in Table 6-1.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and high level waste)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2;6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6;6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
On-site spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER; Exelon 2001) that it is not aware of any new and significant information associated with the renewal of the Peach Bottom Units 2 and 3 operating licenses. The staff has not identified any significant new information during its independent review of the Exelon ER (Exelon 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of these issues follows:

- Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste. Based on information in the GEIS, the Commission found that

  > Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.

  The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (collective effects). Based on information in the GEIS, the Commission found that

  > The 100 year environmental dose commitment to the U.S. population from the fuel cycle, high level waste and spent fuel disposal excepted, is calculated to be about 14,800 person rem [148 person Sv], or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be mitigated (for example no cancer cure in the next thousand years), and that these doses projected over thousands of years

> are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.
>
> Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA [National Environmental Policy Act] implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- <u>Offsite radiological impacts (spent fuel and HLW disposal)</u>. Based on information in the GEIS, the Commission found that

> For the high level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 millirem [1 mSv] per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 millirem [1 mSv] per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem [1 mSv] per year. The lifetime individual risk from 100 millirem [1 mSv] annual dose limit is about 3×10^{-3}.

Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980 [DOE 1980]. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a HLW repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 1,000 premature cancer deaths world-wide for a 100,000 metric tonne (MTHM) repository.

Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and HLW disposal, this issue is considered Category 1.

Since the GEIS was originally issued in 1996, the EPA has published radiation protection standards for Yucca Mountain, Nevada, at 40 CFR Part 197 "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada," on June 13, 2001 (66 FR 32132). The Energy Policy Act of 1992 (42 USC 10101 et seq.) directs that the NRC adopt these standards into its regulations for reviewing and licensing the repository. The NRC published its regulations at 10 CFR Part 63, on November 2, 2001 (66 FR 55792). These standards include the following: (1) 0.15 mSv/year (15 mrem/year) dose limit for members of the public during the storage period prior to repository closure, (2) 0.15 mSv/year (15 mrem/year) dose limit for the reasonably maximally exposed individual for 10,000 years following disposal, (3) 0.15 mSv/year (15 mrem/year) dose limit for the reasonably maximally exposed individual as a result of a human intrusion at or before 10,000 years after disposal, and (4) a groundwater protection standard that states for 10,000 years of undisturbed performance after disposal, radioactivity in a representative volume of ground water will not exceed (a) 0.0002 MBq/L (5 pCi/L) (radium-226 and radium-228), (b) 0.0006 Mbq/L (15 pCi/L) (gross alpha activity), and (c) 0.04 mSv/year (4 mrem/year) to the whole body or any organ (from combined beta and photon emitting radionuclides).

On February 15, 2002, subsequent to the receipt of a recommendation by Secretary Abraham, Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and HLW. On July 23, 2002, the President signed into law House Joint Resolution 87 designating Yucca Mountain as the repository for spent nuclear fuel. This development does not represent new and significant information with respect to the offsite radiological impacts related to spent fuel and HLW disposal during the renewal term.

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

  The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

  > The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

  The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

  > The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

  The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Onsite spent fuel. Based on information in the GEIS, the Commission found that

  > The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

  The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

- Nonradiological waste. Based on information in the GEIS, the Commission found that

  > No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

  The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

- Transportation. Based on information in the GEIS, the Commission found that

  > The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting HLW to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4 — Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in Sec. 51.52.

  Peach Bottom Units 2 and 3 meet the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.2 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 63. Code of Federal Regulations, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

40 CFR Part 197. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 197, "Public Health and Environmental Radiation Protection Standards for Management and Disposal for Yucca Mountain, Nevada."

66 FR 32132. "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV." *Federal Register.* Vol. 66, No.114. June 13, 2001.

66 FR 55792 "Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada." *Federal Register.* Vol. 66, No. 213. November 2, 2001.

Energy Policy Act of 1992. 42 USC 10101, et seq.

Exelon Generation Company, LLC (Exelon). 2001. *Applicant's Environmental Report – Operating License Renewal Stage Peach Bottom Units 2 and 3.* Kennett Square, Pennsylvania.

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards.* Washington, D.C.

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste.* DOE/EIS-0046F, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

7.0 Environmental Impacts of Decommissioning

Environmental issues associated with decommissioning, which result from continued plant operation during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B that are applicable to Peach Bottom Units 2 and 3 decommissioning following the renewal term are listed in Table 7-1. Exelon Generation Company, LLC (Exelon) stated in its Environmental Report (ER; Exelon 2001) that it is aware of no new and significant information regarding the environmental impacts of Peach Bottom Units 2 and 3 license renewal. The staff has not identified any significant new information during its independent review of the Exelon ER (Exelon 2001), the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1 the GEIS. For all of these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of Peach Bottom Units 2 and 3 Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation Doses	7.3.1; 7.4
Waste Management	7.3.2; 7.4
Air Quality	7.3.3; 7.4
Water Quality	7.3.4; 7.4
Ecological Resources	7.3.5; 7.4
Socioeconomic Impacts	7.3.7; 7.4

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of the issues follows:

- <u>Radiation doses</u>. Based on information in the GEIS, the Commission found that

  > Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem [0.01 person-Sv] caused by buildup of long-lived radionuclides during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no radiation doses associated with decommissioning following license renewal beyond those discussed in the GEIS.

- Waste management. Based on information in the GEIS, the Commission found that

> Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality. Based on information in the GEIS, the Commission found that

> Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of license renewal on air quality during decommissioning beyond those discussed in the GEIS.

- Water quality. Based on information in the GEIS, the Commission found that

> The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of the license renewal term on water quality during decommissioning beyond those discussed in the GEIS.

- Ecological resources. Based on information in the GEIS, the Commission found that

  > Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

  The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of the license renewal term on ecological resources during decommissioning beyond those discussed in the GEIS.

- Socioeconomic impacts. Based on information in the GEIS, the Commission found that

  > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

  The staff has not identified any new and significant information during its independent review of the Exelon ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of license renewal on the socioeconomic impacts of decommissioning beyond those discussed in the GEIS.

7.1 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

Exelon Generation Company, LLC (Exelon). 2001. *Applicant's Environmental Report – Operating License Renewal Stage Peach Bottom Units 2 and 3.* Kennett Square, Pennsylvania.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

8.0 Environmental Impacts of Alternatives to Operating License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of the operating licenses (OLs) (i.e., the no-action alternative); the potential environmental impacts from electric generating sources other than Peach Bottom Units 2 and 3; the possibility of purchasing electric power from other sources to replace power generated by Units 2 and 3 and the associated environmental impacts; the potential environmental impacts from a combination of generating and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by Units 2 and 3. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC's) three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines and set forth in a footnote to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.

LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999)[a] with the additional impact category of environmental justice.

8.1 No-Action Alternative

The NRC's regulations implementing the National Environmental Policy Act (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (10 CFR Part 51, Subpart A, Appendix A4). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the Peach Bottom Units 2 and 3 OLs, and the Exelon Generation Company (Exelon) would then decommission Peach Bottom Units 2 and 3 when plant operations cease. Replacement of Peach Bottom Units 2 and 3 electricity

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

generation capacity would be met by (1) demand-side management (DSM) and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than Peach Bottom Units 2 and 3, or (4) some combination of these options.

Exelon will be required to comply with NRC decommissioning requirements whether or not the OLs are renewed. If the Peach Bottom Units 2 and 3 OLs are renewed, decommissioning activities may be postponed for up to an additional 20 years. If the OLs are not renewed, Exelon would conduct decommissioning activities according to the requirements in 10 CFR 50.82.

The environmental impacts associated with decommissioning under both license renewal and the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the GEIS, Chapter 7 of this Supplemental Environmental Impact Statement (SEIS), and the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586 dated August 1988.[a] The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those occurring after 40 years of operation.

The environmental impacts for the socioeconomic, historic and archeological resources, and environmental justice impact categories are summarized in Table 8-1 and discussed in the following paragraphs.

Table 8-1. Summary of Environmental Impacts of the No-Action Alternative

Impact Category	Impact	Comment
Socioeconomic	SMALL to MODERATE	Decrease in Peach Bottom Township employment opportunities SMALL to MODERATE due to the general size and availability of other employment opportunities in the region. Impact on government budgets SMALL.
Historic and Archeological Resources	SMALL	Decommissioning would necessitate cultural resource investigations, determinations, and consultation requirements.
Environmental Justice	SMALL	Very few minority/low income persons in the immediate vicinity of the Peach Bottom site. Economic offset due to the general size and availability of other employment opportunities in the region.

(a) The NRC staff is currently supplementing NUREG-0586 for reactor decommissioning. In October 2001 the staff issued draft Supplement 1 to NUREG-0586 dealing with Decommissioning of Nuclear Power Reactors (NRC 2001a) for public comment. The staff is currently finalizing the draft supplement for publication as a final document.

- Socioeconomic. When Peach Bottom Units 2 and 3 cease operation, there will be a decrease in employment and tax revenues associated with the closure. These impacts would be most concentrated in York County with smaller impacts in Lancaster County and much smaller impacts in other counties. Most secondary employment impacts and impacts on population would also be concentrated in York and Lancaster counties. Approximately 66 percent of employees who work at Peach Bottom Units 2 and 3 live in York County or Lancaster County, and the remainder live in other locations (Exelon 2001). The extent of impacts on York County, particularly Peach Bottom Township, will depend to some degree on the extent to which economic and population growth projected for Peach Bottom Township materializes (see Section 2.2.8.6).

  The tax revenue losses resulting from closure of Peach Bottom Units 2 and 3 would occur in York County. In 2000, Exelon paid a combined $1.44 million in property taxes in York County to three government units for Peach Bottom Units 2 and 3, or about 0.6 percent of the combined operating budgets for these three government units (Table 2-9). The no-action alternative would result in the loss of these taxes, as well as the loss of plant payrolls 20 years earlier than if the OLs were renewed. Given the relatively low percentage of revenue in the three jurisdictions, the property tax revenue would have a SMALL impact on the ability to provide public services.

  There would be some adverse impacts on local housing values, the local economy in Peach Bottom Township, and county employment in York and Lancaster counties if Peach Bottom Units 2 and 3 were to cease operations. Exelon employees working at Peach Bottom Units 2 and 3 currently contribute time and money toward community involvement, including schools, churches, charities, and other civic activities. It is likely that with a reduced presence in the community following decommissioning, Exelon's community involvement efforts in the region would be lessened.

  If normal economic growth continues in York County and Lancaster County, the socioeconomic consequences of nonrenewal of the OLs could be partially or entirely offset by the new jobs created by such growth. What is not known are the types of jobs, pay scale, and location of the future employment increases. If some of the new jobs are skilled, higher-paying jobs, then the impacts of nonrenewal of the Peach Bottom Units 2 and 3 OLs could be significantly mitigated and the socioeconomic consequence of closure would be SMALL. If not offset by normal growth, impacts would be MODERATE.

- Historic and Archeological Resources. The potential for future adverse impacts to known or unrecorded cultural resources at Peach Bottom Units 2 and 3 following decommissioning will depend on the future use of the site land and on an analysis and determinations of the historic status of the plant (including the units for decommissioning). Following decommissioning, the site would likely be retained by Exelon. Eventual sale or transfer of the site could result in adverse impacts to cultural resources if the land-use pattern changes dramatically. However, there are no known historic or archeological resources on the Peach Bottom site proper. The impacts of this alternative on historic and archeological resources are considered SMALL.

- Environmental Justice. Current operations at Peach Bottom Units 2 and 3 have no disproportionate impacts on the minority and low-income populations of the surrounding counties, and no environmental pathways have been identified that would cause disproportionate impacts. Closure of Units 2 and 3 would result in decreased employment opportunities and somewhat reduced tax revenues in York County, with possible SMALL negative and disproportionate impacts on minority or low-income populations. Because the Peach Bottom site is located in a relatively high-population area with extensive employment opportunities, these effects are likely to be offset by projected growth in the local economy, so that the impacts of closure on minority and low-income populations would be mitigated, regardless of whether the created jobs are low- or high-paying jobs. The environmental justice impacts under the no-action alternative are considered SMALL.

Impacts for all other impact categories would be SMALL, as shown in Table 9-1. In some cases, impacts associated with the no-action alternative would be positive. For example, closure of Peach Bottom Units 2 and 3 would eliminate any impingement and entrainment of fish and shellfish and also eliminate any negative impacts resulting from thermal discharges to Conowingo Pond.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by Peach Bottom Units 2 and 3, assuming that the OLs for Units 2 and 3 are not renewed. The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impacts. The following generation alternatives are considered in detail:

- coal-fired generation at the Peach Bottom site and at an alternate site (Section 8.2.1) (the Peach Bottom site is not feasible, as described in Section 8.2.1)

- natural gas-fired generation at the Peach Bottom site and at an alternate site (Section 8.2.2)

- nuclear generation at the Peach Bottom site and at an alternate site (Section 8.2.3)

The alternative of purchasing power from other sources to replace power generated at Peach Bottom Units 2 and 3 is discussed in Section 8.2.4. Other power generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for Peach Bottom Units 2 and 3 are discussed in Section 8.2.5. Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. The *Annual Energy Outlook 2002 With Projections to 2020* was issued in December 2001 (DOE/EIA 2001a). In this report, EIA projects that combined-cycle[a] or combustion turbine technology fueled by natural gas is likely to account for approximately 88 percent of new electric generating capacity through the year 2020 (DOE/EIA 2001a). Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet baseload[b] requirements. Coal-fired plants are projected by EIA to account for approximately 9 percent of new capacity during this period. Coal-fired plants are generally used to meet baseload requirements. Renewable energy sources, primarily wind, geothermal, and municipal solid waste units, are projected by EIA to account for the remaining 3 percent of capacity additions. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest generation cost in 2005 and 2020, followed by coal-fired plants and then wind generation (DOE/EIA 2001a).

EIA projects that oil-fired plants will account for very little new generation capacity in the United States through the year 2020 because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). However, oil as a back-up fuel to natural-gas-fired generation (combined cycle) is considered.

EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States through the year 2020 because natural gas and coal-fired plants are projected to be more economical (DOE/EIA 2001a). In spite of this projection, a new nuclear plant alternative for replacing power generated by Peach Bottom Units 2 and 3 is considered in Section 8.2.3. Since 1997, the NRC has certified three new standard designs for nuclear power plants under the procedures in 10 CFR Part 52 Subpart B. These designs are the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). The submission to the NRC of these three applications for certification indicates continuing interest in the possibility of licensing new nuclear power plants. NRC has established a New

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(a) In the combined-cycle unit, hot combustion gases in a combustion turbine rotates the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

(b) A baseload plant normally operates to supply all or part of the minimum continuous load of a system and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for baseload generation; i.e., these units generally run near full load.

Reactor Licensing Project Office to prepare for and manage future reactor and site licensing applications (NRC 2001).

8.2.1 Coal-Fired Generation

The staff assumes construction of four standard 508-megawatts electric (MW(e)) units[(a)] as potential replacements for Units 2 and 3, which is consistent with Exelon's Environmental Report (ER; Exelon 2001).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the Exelon ER (Exelon 2001). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

The coal-fired alternative is analyzed for an alternate site on Conowingo Pond using once-through cooling. Although NRC pointed out that siting a new coal-fired plant where an existing nuclear plant is located would reduce many construction impacts (NRC 1996), it is unlikely that the coal-fired unit could fit and be operated efficiently on the Peach Bottom site, since the entire Peach Bottom site is only about 250 ha (620 ac). The land available for disposal of emission control waste (fly ash and scrubber sludge) is wooded and elevated substantially above the location of the operating nuclear reactors (about 91 m [300 ft]) (Exelon 2001). There would be associated environmental impacts and disposal would be quite difficult (e.g., pumping or hauling up steep hills).

Exelon did not identify any specific alternate sites, although if another site were chosen, adding units at other sites with existing Exelon generating units probably would be the least costly and have the least environmental impact. However, for purposes of bounding the environmental impacts, The NRC staff generally uses an unspecified "greenfield" (previously undeveloped) site for possible future generation additions to compare with the existing site. In this case, it is unlikely that a truly remote rural site would be chosen.

Construction at an alternate site would necessitate the construction of a transmission line to connect to existing lines to transmit power to Exelon's customers. Because Exelon does not have specific plans for constructing such a site, site-specific information is not available. For purposes of this analysis, Exelon's ER assumes the alternate site would be near the Peach Bottom site and construction would include approximately 24 km (15 mi) of transmission line in

(a) The gas-fired units would have a rating of 528 gross MW and 508 net MW. The coal-fired units would have a rating of 538 gross MW and 508 net MW. The difference between "gross" and "net" is the electricity consumed on site.

a corridor 106 m (350 ft) wide to tie into the existing transmission lines at the Peach Bottom site (259 ha [640 ac] of easement would be required). Also, the project would require constructing or upgrading an assumed 32 km (20 mile) rail spur in a corridor 30 m (100 ft) wide from an adequate existing rail line. The corridor would take 97 ha (240 ac) of land. The upgrade would include an offloading approach and a turnaround loop at the site (Exelon 2001).

Coal and lime (or limestone) would be delivered by rail via a nearby rail line to a new rail spur leading to the alternate site. The new spur would include an onsite access and turnaround system. Barge delivery is potentially feasible for a site on navigable waters, but not on Conowingo Pond. A coal slurry pipeline is another potential alternative for delivering coal. However, such a pipeline would need to cover a great distance to reach a suitable coal-mining area or the coal would need to be transported by alternative means (e.g., rail) to a site closer to Peach Bottom site for introduction into the pipeline. The coal slurry pipeline alternative for delivering coal is not considered a feasible alternative and is not further evaluated.

The coal-fired plant would consume approximately 6.0 million MT (6.6 million tons) per year of pulverized bituminous coal with an ash content of approximately 11.9 percent (Exelon 2001). The ER assumes a heat rate[a] of 3.0 J fuel/J electricity (10,200 Btu/kWh) and a capacity factor[b] of 0.85 (Exelon 2001). After combustion, 99.9 percent of the ash (708,000 MT or 784,000 tons) would be collected and disposed of at the plant site. In addition, approximately 658,000 MT (728,000 tons) of scrubber sludge would be disposed of at the plant site based on annual lime usage of approximately 222,000 MT (246,000 tons). Lime would be used in the scrubbing process for control of sulfur dioxide (SO_2) emissions.[c]

8.2.1.1 Once-Through Cooling System

For purposes of this SEIS, the staff assumed a coal-fired plant could use either a closed-cycle or a once-through cooling system.

The overall impacts of the coal-fired generating system are discussed in the following sections and summarized in Table 8-2. The extent of impacts at an alternate site would depend on the location of the particular site selected.

(a) Heat rate is a measure of generating station thermal efficiency. It is generally expressed in British thermal units (Btu) per net kilowatt-hour (kWh). It is computed by dividing the total Btu content of fuel burned for electric generation by the resulting net kWh generation.
(b) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.
(c) In a typical wet scrubber, lime (calcium hydroxide) or limestone (calcium carbonate) is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime-based scrubbing solution reacts with sulfur dioxide to form calcium sulfite, which precipitates out and is removed in sludge form.

- **Land Use**

The coal-fired generation alternative would necessitate converting roughly an additional 728 ha (1800 ac) of the site to industrial use for the plant, coal storage, and ash and scrubber sludge disposal. Additional land-use changes would occur offsite in an undetermined coal-mining area to supply coal for the plant. In the GEIS, the staff estimated that approximately 8900 ha (22,000 ac) would be affected for mining the coal and disposing of the waste to support a coal plant during its operational life (NRC 1996). Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for Units 2 and 3. In the GEIS, the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000 MW(e) nuclear power plant.

If coal is delivered by rail, an additional approximately 97 ha (240 ac) would be needed for a rail spur, assuming that the alternate site location is within 32 km (20 mi) from the nearest railway connection. Depending particularly on transmission line and rail line routing, this alternative would result in MODERATE to LARGE land-use impacts.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at an Alternate Site Using Once-Through Cooling

Impact Category	Impact	Comments
Land Use	MODERATE to LARGE	Uses approximately 1084 ha (2680 ac), for plant infrastructure and waste disposal, transmission line, and rail spur. Additional land impacts for coal and limestone mining.
Ecology	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality (Surface Water)	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Water Use and Quality (Groundwater)	SMALL to LARGE	Impacts SMALL if only used for potable water; impacts could be MODERATE to LARGE if groundwater is used as make-up water (impacts would be site/aquifer specific).

Table 8-2. (contd)

Impact Category	Impact	Comments
Air Quality	MODERATE	Sulfur oxides • 12,050 MT/yr (13,344 tons/yr) Nitrogen oxides • 11,550 MT/yr (12,794 tons/yr) Particulates • 354 MT/yr (392 tons/yr) of total suspended particulates which would include • 81 MT/yr (90 tons/yr) of PM_{10} Carbon monoxide • 1490 MT/yr (1649 tons/yr) Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials – mainly uranium and thorium.
Waste	MODERATE	Total waste volume would be approximately 708,000 MT/yr (784,000 tons/yr) of ash, spent catalyst, and 658,000 MT/yr (728,000 tons/yr) of scrubber sludge requiring approximately 324 ha (800 ac) for disposal during the 40-year life of the plant.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.
Socioeconomics	SMALL to LARGE	During construction, impacts would be MODERATE to LARGE. Up to 2500 workers during the peak of the 5-year construction period at alternate site followed by reduction from current Peach Bottom Units 2 and 3 work force of about 1000 to 300; tax base (which may be in York County) preserved. Impacts during operation would be SMALL. Tax impacts on receiving county could be SMALL to LARGE.

Table 8-2. (contd)

Impact Category	Impact	Comments
	SMALL to LARGE	Transportation impacts during operation would be SMALL to MODERATE. Transportation impacts associated with construction workers could be MODERATE to LARGE. Construction impacts depend on location, but could be LARGE if plant is located in a rural area. For rail transportation of coal and lime/limestone, the impact is considered MODERATE to LARGE.
Aesthetics	MODERATE	Exhaust stacks will be visible from nearby local parks. Power block and stacks would be visible at a moderate distance. Impact would depend on the site selected and the surrounding land features. If needed, a new transmission line or rail spur would add to the aesthetic impact. Rail transportation of coal and lime/limestone would have a MODERATE aesthetic impact.
Historic and Archeological Resources	SMALL	Alternate location would necessitate cultural resource studies, determinations and consultation requirements. Studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant on undeveloped sites for cultural resources. Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities will vary depending on population distribution and makeup at the site. Some impacts on housing may occur during construction; loss of about 700 operating jobs at Peach Bottom Units 2 and 3 could slightly reduce employment prospects for minority and low-income populations in York and Lancaster counties and could be offset by projected economic growth and the ability of affected workers to commute to other jobs.

- **Ecology**

Locating a coal-fired plant at the alternate site would alter ecological resources because of the need to convert roughly 728 ha (1800 ac) of land at the site to industrial use for plant, coal storage, and ash and scrubber sludge disposal. However, some of this land might have been previously disturbed.

At an alternate site, the coal-fired generation alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity.

Use of cooling makeup water from a nearby surface water body could have adverse aquatic resource impacts. Ecological impacts associated with transporting coal and lime to the alternate would be significant. The rail option was assumed to involve constructing a rail spur with an assumed length of 32 km (20 mi). Construction and maintenance of an additional transmission line and a rail spur would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE.

- **Water Use and Quality**

Exelon has stated a preference for an (unspecified) alternate site on Conowingo Pond, where once-through cooling could be used. An alternate site might use a closed-cycle cooling system with cooling towers. For an alternate site, the impact on the surface water would depend on the volume of water needed, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the Commonwealth of Pennsylvania or another state. The impacts would be SMALL to MODERATE.

No groundwater is currently used for operation of Peach Bottom Units 2 and 3. Use of groundwater for a coal-fired plant sited at an alternate site is a possibility. Any groundwater withdrawal would require a permit from the local permitting authority. The impacts of withdrawal for the coal-fired plant on the aquifer would be site-specific and dependent on aquifer recharge and other withdrawals. The overall impacts would be SMALL to LARGE.

- **Air Quality**

The air-quality impacts of coal-fired generation vary considerably from those of nuclear generation due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

A new coal-fired generating plant located in southern Pennsylvania would likely need a prevention of significant deterioration (PSD) permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60 Subpart Da. The standards establish limits for particulate matter and opacity (40 CFR 60.42a), SO_2 (40 CFR 60.43a), and NO_x (40 CFR 60.44a).

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR Part 51 Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act. All of south-central Pennsylvania, as defined in 40 CFR 81.105, is classified as attainment or unclassified for criteria pollutants, except that Lancaster County and Franklin County are non-attainment areas for ozone, and Lancaster County and the West York Borough and West Manchester Township in York County do not meet secondary standards for TSP (40 CFR 81.339). With prevailing winds from the west, a coal-fired power plant in York County could cause further deterioration in Lancaster County air quality, which is already marginal.

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. In addition, EPA issued a new regional haze rule in 1999 (64 FR 35714). The rule specifies that for each mandatory Class I Federal area located within a state, the state must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a new coal-fired power station were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. However, there are no Federal Class I areas in Pennsylvania or near the Peach Bottom site.

In 1998 EPA issued a rule requiring 22 eastern states, including Pennsylvania, to revise their state implementation plans (SIPs) to reduce nitrogen oxide emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone. The total amount of nitrogen oxides that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 through September 30) is set out at 40 CFR 51.121(e). For Pennsylvania, the amount is 233,547 MT (257,441 tons). Any new coal-fired plant sited in Pennsylvania would be subject to this limitation.

Effective September 20, 2001, EPA approved a SIP revision for the control of NO_x in Pennsylvania (66 FR 43795). Under the revised SIP, Pennsylvania will implement NO_x Budget Trading Program rules under EPA's NO_x Budget Trading Program (40 CFR Part 96). The revised plan establishes and requires a NO_x allowance and trading program for large electric generation and industrial units beginning in 2003. The rules establish a fixed statewide electric generating unit emissions budget of 42,840 MT (47,224 tons) of NO_x per ozone season. New units do not receive allowances, but are required to have allowances to cover their NO_x emissions. Owners of new units over 25MW(e) capacity must therefore acquire allowances from owners of other power plants by purchase or reduce NO_x emissions at other power plants they own. Thus, a new coal-fired power plant would not add to net statewide NO_x emissions, although it might do so locally. Regardless, NO_x emissions would be greater for the coal alternative than the OL renewal alternative.

Impacts for particular pollutants are as follows:

Sulfur oxides. Exelon states in its ER that an alternative coal-fired plant located at the Peach Bottom site would use a wet scrubber (Exelon 2001). Lime/limestone would be used for flue gas desulfurization (Exelon 2001).

A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative.

Exelon estimates that by using the best technology to minimize SO_2 emissions, the total annual stack emissions would be approximately 12,050 MT (13,344 tons) of SO_2 (Exelon 2001).

Nitrogen oxides. Section 407 of the Clean Air Act establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453 [EPA 1998]), limits the discharge of any gases that contain nitrogen oxides (expressed as NO_2) in excess of 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

Exelon estimates that using the best available control technology, the total annual NO_x emissions for a new coal-fired power plant would be approximately 11,550 MT (12,744 tons)

(Exelon 2001). This level of NO_x emissions would be greater than the OL renewal alternative.

Particulates. Exelon estimates that the total annual stack emissions would include 354 MT (392 tons) of filterable total suspended particulates (particulates that range in size from less than 0.1 micrometer [μm] up to approximately 45 μm). The 354 MT (392 tons) would include 81 MT (90 tons) of particulate matter having an aerodynamic diameter less than or equal to 10 μm (PM_{10}). Fabric filters or electrostatic precipitators would be used for control. In addition, coal-handling equipment would introduce fugitive particulate emissions (Exelon 2001). Particulate emissions would be greater under the coal alternative than the OL renewal alternative.

During the construction of a coal-fired plant, fugitive dust would be generated. In addition, exhaust emissions would come from vehicles and motorized equipment used during the construction process.

Carbon monoxide. Exelon estimates that the total carbon monoxide emissions would be approximately 1490 MT (1649 tons) per year (Exelon 2001). This level of emissions is greater than the OL renewal alternative.

Hazardous air pollutants including mercury. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000b). EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000b). EPA concluded that mercury is the hazardous air pollutant of greatest concern. EPA found that (1) there is a link between coal consumption and mercury emissions; (2) electric utility steam-generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (EPA 2000b). Accordingly, EPA added coal- and oil-fired electric utility steam-generating units to the list of source categories under Section 112(c) of the Clean Air Act for which emission standards for hazardous air pollutants will be issued (EPA 2000b).

Uranium and thorium. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that a typical coal-fired plant released roughly 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium in 1982 (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

Carbon dioxide. A coal-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air impacts would be substantial. The GEIS also mentioned global warming from unregulated carbon dioxide emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health effects from coal combustion such as cancer and emphysema have been associated with the products of coal combustion. The appropriate characterization of air impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction catalyst, and scrubber sludge. Four 508-MW(e) coal-fired units would generate approximately 708,000 MT (784,000 tons) of this waste annually. The waste would be disposed of onsite, accounting for approximately 324 ha (800 ac) of land area over the 40-year plant life (Exelon 2001). Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels" (EPA 2000a). The EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could present danger to human health and the environment under certain conditions; (2) EPA has identified eleven documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (3) present disposal practices are such that, in 1995, these wastes were being managed in 40 percent to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and (4) EPA identified gaps in state oversight of coal combustion wastes. Accordingly, EPA announced its intention to issue regulations for disposal of coal combustion waste under subtitle D of the Resource Conservation and Recovery Act.

For all of the preceding reasons, the appropriate characterization of impacts from waste generated from burning coal is MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

- **Human Health**

Coal-fired power generation introduces worker risks from coal and limestone mining, worker and public risks from coal and lime/limestone transportation, worker and public risks from disposal of coal combustion wastes, and public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

The staff stated in the GEIS that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from coal-fired plants, but did not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including EPA and State agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. As discussed previously, EPA has recently concluded that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal are characterized as SMALL.

- **Socioeconomics**

Construction of the coal-fired alternative would take approximately 5 years. The staff assumed that construction would take place while Peach Bottom Units 2 and 3 continued operation and would be completed by the time Units 2 and 3 permanently cease operations. The work force would be expected to vary between 1200 and 2500 workers during the 5-year construction period (NRC 1996). If the alternate site were near the Peach Bottom site, then these workers would be in addition to the approximately 1000 workers employed at Units 2 and 3. During construction of the new coal-fired plant, surrounding communities would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other parts of York County, Lancaster County, Baltimore, Philadelphia, and other nearby areas. After construction, the nearby communities would be impacted by the loss of the construction jobs.

During the 5-year construction period for the replacement coal-fired units, 2500 construction workers could place significant traffic loads on existing highways near the Peach Bottom site. Such impacts would be MODERATE to LARGE.

Construction of a replacement power plant at an alternate site not near the Peach Bottom site would mean that the communities around the Peach Bottom site would still experience the impact of Peach Bottom Units 2 and 3 operational job loss as in the no-action alternative (although potentially tempered by projected economic growth), and the communities around the new site would have to absorb the impacts of a large, temporary work force (up to 2500 workers at the peak of construction) and a permanent work force of approximately 300 workers. In the GEIS, the staff stated that socioeconomic impacts at a rural site would be larger than at an urban site, because more of the peak construction work force would need to move to the area to work. The Peach Bottom site is within commuting distance of the Philadelphia and Baltimore metropolitan areas and is therefore not considered a rural site. Alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at an isolated rural site could be LARGE.

Transportation-related impacts associated with commuting construction workers at an alternate site would be site dependent, but could be MODERATE to LARGE.

Transportation impacts related to commuting of plant operating personnel would also be site dependent, but can be characterized as SMALL to MODERATE.

At most alternate sites, coal and lime would likely be delivered by rail, although barge delivery is feasible for a location on navigable waters. Transportation impacts would depend upon the site location. Approximately 600 trains per year would be needed to deliver the coal and lime/limestone for the four coal-fired units; because for each full train delivery there would be an empty return train. On several days per week, there could be four trains per day using the rail spur to the alternate site. Socioeconomic impacts associated with rail transportation would likely be MODERATE to LARGE. Barge delivery of coal and lime/limestone would likely have SMALL socioeconomic impacts.

- **Aesthetics**

The four coal-fired power plant units could be as much as 60 m (200 ft) tall and could be visible in daylight hours offsite. The four exhaust stacks would be 120 to 185 m (400 to 600 ft) high. Given the low elevation at the site and of the surrounding land, the stacks would be highly visible in daylight hours for distances up to 16 km (10 mi). If the coal-fired plant were near the Peach Bottom site, the stacks would be visible from Conowingo Pond and Susqehannock State Park. The plant units and associated stacks would also be visible at night because of outside lighting. The Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 61 m (200 ft) above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). Visual impacts of a new coal-fired plant could be mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting, provided the lighting meets FAA requirements, and appropriate use of shielding. Overall, the addition of the coal-fired units and the associated exhaust stacks would likely have a MODERATE aesthetic impact.

Coal-fired generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. The incremental noise impacts of a coal-fired plant compared to existing Peach Bottom Units 2 and 3 operations are considered to be MODERATE.

At an alternate site, there would be an aesthetic impact from the buildings and exhaust stacks. There would be an aesthetic impact associated with construction of an assumed new 32-km (20-mi) rail spur and 25-km (15-mi) transmission line to connect to other lines and enable delivery of electricity to the grid. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the fact that many people are likely to be within hearing distance of the rail route, the impacts of noise on residents in the vicinity of the facility and the rail line is considered MODERATE. Noise associated with barge transportation of coal and lime/limestone would be SMALL. Noise and light from the plant would be detectable offsite. Aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with locating at an alternate site can be categorized as MODERATE.

- **Historic and Archeological Resources**

At an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the Peach Bottom site. Other impacts, such as impacts on housing availability and prices during construction, might occur, and this could disproportionately affect minority and low-income populations. If the replacement plant is in the vicinity of the Peach Bottom site, closure of Peach Bottom Units 2 and 3 would result in a decrease in employment of approximately 1000 operating employees (same as in the No-Action case), offset by other economic growth related to construction and operation of the replacement power plant. Overall, impacts would be SMALL to MODERATE, and would depend on the extent to which projected economic growth is realized and the ability of minority or low-income populations to commute to other jobs outside the area.

Impacts at the alternate site would depend upon the site chosen and the nearby population distribution but are likely to also be SMALL to MODERATE.

8.2.1.2 Closed-Cycle Cooling System

The environmental impacts of constructing a coal-fired generation system at an alternate site using closed-cycle cooling with cooling towers are essentially the same as the impacts for a coal-fired plant using the once-through system. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

Table 8-3. Summary of Environmental Impacts of Coal-Fired Generation at an Alternate Site with Closed-Cycle Cooling System Using Cooling Towers

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial ecology from cooling tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling tower blowdown containing dissolved solids. Discharge would be regulated by the State. Decreased water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation from cooling towers.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Introduction of cooling towers and associated plume. Natural draft towers could be up to 158 m (520 ft) high. Mechanical draft towers could be up to 30 m (100 ft) high and also have an associated noise impact.
Historic and Archeological Resources	No change
Environmental Justice	No change

8.2.2 Natural-Gas-Fired Generation

The environmental impacts of the natural-gas-fired alternative are examined in this section for both the Peach Bottom site and an alternate site. For the Peach Bottom site, the staff assumed that the plant would use the existing once-through cooling canal system.

Exelon concluded in its ER that the Peach Bottom site would be a reasonable site for location of a natural-gas-fired generating unit. Based on the PECO *Gas Fired Power Plant Guide* (PECO Energy 1999), Exelon chose to evaluate gas-fired generation, using combined-cycle turbines. Exelon determined that the technology is mature, economical, and feasible. The *Gas Fired Power Plant Guide* indicates that standard-sized gas-fired units of 508 MW(e) are readily available and economical. Therefore, Exelon analyzed 2032 MW of net power, consisting of four 508-MW(e) gas-fired units located on Peach Bottom property (Exelon 2001). Exelon realized that gas availability would be questionable.[a]. It would require a new, dedicated high-pressure 61-cm (24-inch) pipeline to tie into the nearby (about 5 km [3 mi] distant) Transco gas pipelines. In the winter, when demand for natural gas is high, it might become necessary for Exelon to operate on fuel oil, which would have higher costs and more emissions than gas.

The staff assumed that a replacement natural-gas-fired plant would use combined-cycle technology (Exelon 2001). In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity. The following additional assumptions are made for the natural-gas-fired plant (Exelon 2001):

- four 508-MW(e) units, each consisting of two 168-MW combustion turbines and a 172-MW heat recovery boiler
- natural gas with an average heating value of 38.6 MJ/m^3 (1035 Btu/ft^3) as the primary fuel
- use of low-sulfur No. 2 fuel oil as backup fuel
- heat rate of 2 J fuel/J electricity (6928 Btu/kWh)
- capacity factor of 0.85

Unless otherwise indicated, the assumptions and numerical values used throughout this section are from the Exelon ER (Exelon 2001). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the natural-gas-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a natural-gas-fired plant).

(a) In November, 2000, Conectiv Energy announced that representatives from York County Economic Development Corporation and Conectiv had been in discussion regarding the company's preliminary interest in locating a state-of-the-art $600 million, 1100 megawatt combustion turbine combined cycle power plant in the southern part of the county near Delta. If built, this plant would be about half of the size of the possible Peach Bottom Units 2 and 3 replacement and would add to any demand for gas and environmental impacts, but would offset negative socioeconomic impacts associated with the no-action alternative.

8.2.2.1 Once-Through Cooling System

The overall impacts of the natural-gas-fired generating system are discussed in the following sections and summarized in Table 8-4. The extent of impacts at an alternate site will depend on the location of the particular site selected.

- **Land Use**

Natural-gas-fired generation at the Peach Bottom site and at an alternate location would require converting approximately 45 ha (110 ac) for power block, offices, roads, and parking areas. At the Peach Bottom site, this much previously disturbed land is available. For the Peach Bottom site, there would be an additional land use impact of up to approximately 22 ha (54 ac) for construction of a 3-mile branch gas pipeline to the plant site.

For construction at an alternate site, the staff assumed that 45 ha (110 ac) would be needed for the plant and associated infrastructure (NRC 1996). Approximately 259 ha (640 ac) of additional land could be impacted for construction of a transmission line, assuming a 25-km (15-mi) line. Additional land could be required for natural gas wells and collection stations. In the GEIS, the staff estimated that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). Proportionately more land would be needed for a natural-gas-fired plant replacing the 2032 MW(e) from Peach Bottom Units 2 and 3. Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for Units 2 and 3. In the GEIS (NRC 1996), the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant. Overall, land-use impacts at both the Peach Bottom site and the alternate site would be SMALL to MODERATE.

Table 8-4. Summary of Environmental Impacts of Natural Gas-Fired Generation at the Peach Bottom Site and an Alternate Site Using Once-Through Cooling

	Peach Bottom Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	45 ha (110 ac) for power block, offices, roads, and parking areas. Additional impact of up to approximately 22 ha (54 ac) for construction of a 3-mile branch underground gas pipeline.	SMALL to MODERATE	45 ha (110 ac) for power-block, offices, roads, and parking areas. Additional impact for construction and/or upgrade of an underground gas pipeline, if required. Transmission line likely could be placed in existing corridors.
Ecology	SMALL	Uses previously-disturbed areas at current Peach Bottom site. Some effects from 3 miles of gas pipeline construction.	SMALL to MODERATE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity. Likely plant sites already have power generation facilities.
Water Use and Quality (Surface Water)	SMALL	Uses existing once-through cooling system.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface water body.
Water Use and Quality (Groundwater)	SMALL	Use of groundwater very unlikely.	SMALL to LARGE	Groundwater may be used. Impacts SMALL if only used for potable water; impacts could be MODERATE to LARGE if groundwater is used as make-up cooling water (impacts would be site/aquifer specific)
Air Quality	MODERATE	Sulfur oxides • 111 MT/yr (123 tons/yr) Nitrogen oxides • 417 MT/yr (462 tons/yr) Carbon monoxide • 548 MT/yr (607 tons/yr) PM_{10} particulates • 62 MT/yr (67 tons/yr) Some hazardous air pollutants	MODERATE	Same emissions as Peach Bottom site.

Table 8-4. (contd)

	Peach Bottom Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Waste	SMALL	Minimal waste product from fuel combination.	SMALL	Minimal waste product from fuel combination.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 1200 additional workers during the peak of the 3-year construction period, followed by reduction from current Peach Bottom Units 2 and 3 work force of about 1000 to 150; tax base preserved. Impacts during operation would be SMALL.	SMALL to MODERATE	During construction, impacts would be MODERATE. Up to 1200 additional workers during the peak of the 3-year construction period. York County would experience loss of tax base and employment, potentially offset by projected economic growth.
		Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.		Transportation impacts associated with construction workers would be SMALL to MODERATE.
Aesthetics	SMALL	SMALL aesthetic impact due to impact of plant units and stacks. Visual impact would be similar to current Peach Bottom Units 2 and 3.	MODERATE	Impact would depend on location. Greatest impact likely would be from the new 25-km (15-mi) transmission line that would be needed.
Historic and Archeological Resources	SMALL	Any potential impacts can likely be effectively managed.	SMALL	Any alternate location would necessitate cultural resource studies, determinations and consultation requirements. Potential impacts can likely be effectively managed.

Table 8-4. (contd)

	Peach Bottom Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of about 850 operating jobs at Peach Bottom Units 2 and 3 could reduce employment prospects for minority and low-income populations. Impacts would be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impacts vary depending on population distribution and characteristics at site.

- **Ecology**

At the Peach Bottom site, there would be ecological land-related impacts from siting of a gas-fired plant and branch pipeline. Ecological impacts at an alternate site would depend on the nature of the land converted for the plant and the possible need for a new transmission line and/or gas pipeline. If a natural-gas-fired plant were located at an alternate site there is a reasonable likelihood that the plant would be located adjacent to an existing power plant on previously disturbed land, which would tend to mitigate impacts. Construction of a transmission line and construction and/or upgrading of the gas pipeline to serve the plant would be expected to have temporary ecological impacts. Ecological impacts to the site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. At an alternate site, cooling water intake and discharge could have aquatic resource impacts. Overall, the ecological impacts are considered SMALL at the Peach Bottom site and SMALL to MODERATE at an alternative site.

- **Water Use and Quality**

Surface Water. Each of the gas-fired units would include a heat-recovery boiler from which steam would turn an electric generator. Steam would be condensed and circulated back to the boiler for reuse. A natural-gas-fired plant sited at Peach Bottom is assumed to use the existing cooling canal system. Surface-water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

A natural-gas-fired plant at an alternate site might use a closed-cycle cooling system with mechanical draft cooling towers. The staff assumed that for alternate sites, the impact on the surface water would depend on the discharge volume and the characteristics of the receiving body of water to be used for cooling makeup water and discharge. Intake and discharge would involve relatively small quantities of water compared to the coal alternative. Intake from and discharge to any surface body of water would be regulated by the Commonwealth of Pennsylvania.

Some erosion and sedimentation probably would occur during construction (NRC 1996). The overall impacts to surface water quality are characterized as SMALL to MODERATE.

Groundwater. No groundwater is currently used for operation of Peach Bottom Units 2 and 3. It is unlikely that groundwater would be used for an alternative natural-gas-fired plant sited at Peach Bottom. The overall impacts would be SMALL.

A natural-gas-fired plant sited at an alternate site may use groundwater. Any groundwater withdrawal may require a permit from the local permitting authority. The impacts of such a withdrawal at an alternate site would be site-specific and dependent on the recharge rate and other withdrawal rates from the aquifer; however, it is unlikely that groundwater would be used for cooling water with once-through cooling. The overall impacts could be considered SMALL.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Hence, it would be subject to the same type of air quality regulations as a coal-fired plant.

A new gas-fired generating plant located in south-central Pennsylvania would likely need a PSD permit and an operating permit under the Clean Air Act. A new combined-cycle natural-gas-fired generating plant would also be subject to the new source performance standards for such units at 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x.

Exelon projects the following emissions for the natural-gas-fired alternative (Exelon 2001):

Sulfur oxides - 111 MT/yr (123 tons/yr)
Nitrogen oxides - 417 MT/yr (462 tons/yr)
Carbon monoxide - 548 MT/yr (607 tons/yr)
PM_{10} particulates - 62 MT/yr (69 tons/yr)

A natural-gas-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000b). Natural-gas-fired power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000b). Unlike coal and oil-fired plants, EPA did not determine that emissions of hazardous air pollutants from natural-gas-fired power plants should be regulated under Section 112 of the Clean Air Act.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

The preceding emissions would likely be the same at the Peach Bottom site or at an alternate site. Impacts from the above emissions would be clearly noticeable, but would not be sufficient to destabilize air resources as a whole. The overall air-quality impact for a new natural-gas-generating plant sited at Peach Bottom or at an alternate site is considered MODERATE.

- **Waste**

There will be small amounts of solid-waste products (i.e., ash) from burning natural gas fuel. In the GEIS, the staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Gas firing results in very few combustion by-products because of the clean nature of the fuel. Waste generation at an operating gas-fired plant would be largely limited to typical office wastes. Construction-related debris would be generated during construction activities. Overall, the waste impacts would be SMALL for a natural-gas-fired plant sited at Peach Bottom or at an alternate site.

- **Human Health**

In the GEIS, the staff identifies cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risks. NO_x emissions from the plant would be regulated. For a plant sited in Pennsylvania, NO_x emissions would be regulated by the Pennsylvania Department of Environmental Protection (PDEP). Human health effects are not expected to be detectable or would be sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Overall, the impacts on human health of the natural-gas-fired alternative sited at Peach Bottom or at an alternate site are considered SMALL.

- **Socioeconomics**

Construction of a natural-gas-fired plant would take approximately 3 years. Peak employment would be approximately 1200 workers (NRC 1996). The staff assumed that construction would take place while Peach Bottom Units 2 and 3 continue operation and would be completed by the time Peach Bottom Units 2 and 3 permanently ceases operations. During construction, the communities surrounding the Peach Bottom site would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other parts of York County or from other counties. After construction, the communities would be impacted by the loss of jobs. The current Peach Bottom Units 2 and 3 work force (about 1000 workers) would decline through a decommissioning period to a minimal maintenance size. The new gas-fired plant would provide a replacement tax base at the Peach Bottom site or an alternate site and approximately 150 new permanent jobs. For siting at an alternate site, impacts in York County resulting from loss of Peach Bottom Units 2 and 3 may be offset by economic growth projected to occur in the county.

In the GEIS (NRC 1996), the staff concluded that socioeconomic impacts from constructing a natural gas-fired plant would not be very noticeable and that the small operational work force would have the lowest socioeconomic impacts of any nonrenewable technology (NRC 1996). Compared to the coal-fired and nuclear alternatives, the smaller size of the construction work force, the shorter construction time frame, and the smaller size of the operations work force would mitigate socioeconomic impacts.

Overall, gas-fired generation socioeconomic impacts associated with construction and operation of a natural gas-fired power plant would be SMALL to MODERATE for siting at Peach Bottom or SMALL to MODERATE at an alternate site. Depending on other growth in the area, socioeconomic effects could be noticed, but they would not destabilize any important socioeconomic attribute.

Transportation impacts associated with construction personnel commuting to the plant site would depend on the population density and transportation infrastructure in the vicinity of the site. Transportation impacts can be classified as SMALL to MODERATE for siting at Peach Bottom. The impacts can be classified as SMALL to MODERATE for siting at an alternate site, depending on the characteristics of the site.

- **Aesthetics**

The turbine buildings (approximately 30 m [100 ft] tall) and exhaust stacks (approximately 38 m [125 ft] tall) would be visible during daylight hours from Conowingo Pond, but depending on placement of the units, might not be visible otherwise offsite because of topography. The gas pipeline compressors would be visible. Noise and light from the plant would be detectable offsite. At the Peach Bottom site, these impacts would result in SMALL aesthetic impacts.

At an alternate site, the buildings, stacks, and the associated transmission line and gas pipeline compressors would be visible offsite. The impact of noise and light visual impact of a new 25-km (15-mi) transmission line would be MODERATE. Aesthetic impacts would be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with locating at an alternate site can be categorized as MODERATE. The likely greatest contributor to this categorization is the aesthetic impact of the new transmission line needed to connect the plant to the power grid.

- **Historic and Archeological Resources**

At both the Peach Bottom site and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at the Peach Bottom site or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement natural-gas-fired plant were built at the Peach Bottom site. Other impacts, such as impacts on housing availability and prices during construction, might occur, and this could disproportionately affect minority and low-income populations. Closure of Peach Bottom Units 2 and 3 would result in a decrease in employment of approximately 850 operating employees, possibly offset by general growth in the York County area. Following construction, it is possible that the ability of the local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations in York County. Overall, however, impacts are expected to be SMALL. Projected economic growth in York and Lancaster counties and the ability of minority and low-income populations to commute to other jobs outside the area could mitigate any adverse effects.

Impacts at an alternate site would depend upon the site chosen and the nearby population distribution, but are likely to also be SMALL to MODERATE.

8.2.2.2 Closed-Cycle Cooling System

This section discusses the environmental impacts of constructing a natural-gas-fired generation system at an alternate site using closed-cycle cooling with cooling towers. The impacts of this option are essentially the same as the impacts for a natural-gas-fired plant using once-through cooling. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8.5 summarizes the incremental differences.

Table 8-5. Summary of Environmental Impacts of Natural Gas-Fired Generation at an Alternate Site with Closed-Cycle Cooling Towers

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required for cooling towers and associated infrastructure.
Ecology	Impact would depend on ecology at the site. Additional impact to terrestrial ecology from cooling tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling tower blowdown containing dissolved solids. Discharge would be regulated by the State. Decreased water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation from cooling towers.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Introduction of cooling towers and associated plumes. Possible noise impact from operation of cooling towers.
Historic and Archeological Resources	No change
Environmental Justice	No change

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the System 80+ Design (10 CFR Part 52, Appendix B), and the AP600 Design (10 CFR Part 52, Appendix C). All of these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent volatility of natural gas and electricity have made new nuclear power plant construction more attractive from a cost standpoint. Consequently, construction of a new nuclear power plant at the Peach Bottom site using the existing cooling canal system and at an alternate site using both closed- and open-cycle cooling are considered in this section. The staff assumed that the new nuclear plant would have a 40-year lifetime.

The NRC summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs, sited at Peach Bottom or an alternate site. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect replacement of Units 2 and 3, which have a net capacity of 1093 MW(e). The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51 Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using once-through cooling is presented in Section 8.2.3.1 and using closed-cycle cooling in Section 8.2.3.2.

8.2.3.1 Once-Through Cooling System

The overall impacts of the nuclear generating system are discussed in the following sections. The impacts are summarized in Table 8-6. The extent of impacts at an alternate site will depend on the location of the particular site selected.

Table 8-6. Summary of Environmental Impacts of New Nuclear Power Generation at Peach Bottom Site and an Alternate Site Using Once-Through Cooling

Category	Peach Bottom Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Requires approximately 200 to 400 ha (500 to 1000 ac) for the plant and 400 ha (1000 ac) for uranium mining.	MODERATE to LARGE	Same as Peach Bottom site, plus land for transmission line (259 ha [640 ac] assuming a 25 km [15 mi] line)
Ecology	MODERATE	Uses undeveloped areas at current Peach Bottom site.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission line routes; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality (Surface water)	SMALL	Uses existing cooling canal system.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Water Use and Quality (Groundwater)	SMALL	No groundwater used at the Peach Bottom site.	SMALL to LARGE	Groundwater may be used. Impacts SMALL if only used for potable water; impacts could be MODERATE to LARGE if groundwater is used as make-up cooling water (impacts would be site/aquifer specific)
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amount of emissions from diesel generators and possibly other sources during operation. Emissions are similar as current releases at Peach Bottom Units 2 and 3.	SMALL	Same impacts as at Peach Bottom site.

Table 8-6. (contd)

	Peach Bottom Site		Alternate Site	
Category	**Impact**	**Comments**	**Impact**	**Comments**
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Debris would be generated and removed during construction.	SMALL	Same impacts as at Peach Bottom site.
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impacts as at Peach Bottom site.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 2500 workers during peak period of the 5-year construction period. Operating work force assumed to be similar to Peach Bottom Units 2 and 3; tax base preserved. Impacts during operation would be SMALL.	MODERATE to LARGE	Construction impacts depend on location. Impacts at a rural location could be LARGE. York County would experience loss of tax base and employment with MODERATE impacts, potentially offset by projected economic growth.
	SMALL to LARGE	Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts of commuting workers during operations would be SMALL.	SMALL to LARGE	Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts of commuting workers during operations would be SMALL.

Table 8-6. (contd)

Category	Peach Bottom Site Impact	Peach Bottom Site Comments	Alternate Site Impact	Alternate Site Comments
Aesthetics	SMALL to MODERATE	No exhaust stacks or cooling towers would be needed. Daytime visual impact could be mitigated by landscaping and appropriate color selection for buildings. Visual impact at night could be mitigated by reduced use of lighting and appropriate shielding. Noise impacts would be relatively small and could be mitigated.	SMALL to LARGE	Impacts would depend on the characteristics of the alternate site. Impacts would be SMALL if the plant is located adjacent to an industrial area. New transmission lines would add to the impacts and could be MODERATE. If a greenfield site is selected, the impacts could be LARGE.
Historic and Archeological Resources	SMALL	Any potential impacts can likely be effectively managed.	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction.	SMALL to LARGE	Impacts will vary depending on population distribution and makeup at the site. Impacts to minority and low-income residents of south York County associated with closure of Peach Bottom Units 2 and 3 could be MODERATE, but could also be mitigated by projected economic growth for the area. Impacts to receiving county are site-specific and could range from SMALL to LARGE.

- **Land Use**

The existing facilities and infrastructure at the Peach Bottom site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that a replacement nuclear power plant would use the existing cooling canal system, switchyard, offices, and transmission line right-of-way. A replacement nuclear power plant at the Peach Bottom site would require approximately 200 to 400 ha (500 to 1000 ac) of new land, some of which may be previously undeveloped land. It is not clear whether there is enough usable land for replacement units at the Peach Bottom site. Additional land beyond the current Peach Bottom site boundary may be needed to construct a new nuclear power plant while the existing Units 2 and 3 continue to operate.

There would be no net change in land needed for uranium mining because land needed to supply the new nuclear plant would offset land needed to supply uranium for fueling the existing Peach Bottom Units 2 and 3 reactors.

The impact of a replacement nuclear generating plant on land use at the existing Peach Bottom site is best characterized as MODERATE. The impact would be greater than the OL renewal alternative.

Land-use requirements at an alternate site would be 200 to 400 ha (500 to 1000 ac) plus the possible need for land for a new transmission line. Assuming a 25-km (15-mi) transmission line, an additional 259 ha (640 ac) would be needed. In addition, it may be necessary to construct a rail spur to an alternate site to bring in equipment during construction. Depending particularly on transmission line routing, siting a new nuclear plant at an alternate site would result in MODERATE to LARGE land-use impacts, and probably would be LARGE for a greenfield site.

- **Ecology**

Locating a replacement nuclear power plant at the Peach Bottom site would alter ecological resources because of the need to convert additional land to industrial use. Some of this land, however, would have been previously disturbed.

Siting at Peach Bottom would have a MODERATE ecological impact that would be greater than renewal of the Unit 2 and 3 OLs.

At an alternate site, there would be construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling water from a nearby surface water body could have adverse aquatic resource impacts. Construction and maintenance of the transmission line would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE.

- **Water Use and Quality**

Surface water. A replacement nuclear power plant located at the Peach Bottom site is assumed to use the existing once-through cooling system. It would obtain potable, process, and fire-protection water from the Susquehanna River in a manner similar to the current practice for Peach Bottom Units 2 and 3. Thus, the environmental impacts would be similar to the existing Peach Bottom Units 2 and 3 nuclear plant. Surface-water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

For a replacement reactor located at an alternate site, the staff assumed that a closed-cycle cooling system would be employed. New intake structures would need to be constructed to provide water needs for the facility. Impacts would depend on the volume of water withdrawn for makeup, relative to the amount available from the intake source and the characteristics of the surface water. Plant discharges would be regulated by the Commonwealth of Pennsylvania or other jurisdiction. Some erosion and sedimentation would likely occur during construction. The impacts would be SMALL.

Groundwater. No groundwater is currently used for operation of Peach Bottom Units 2 and 3. It is unlikely that groundwater would be used for an alternative nuclear power plant sited at Peach Bottom, so the impacts would be SMALL. A nuclear power plant sited at an alternate site may use groundwater. Groundwater withdrawal would require a permit from the local permitting authority. The impacts of such a withdrawal rate on an aquifer would be site specific and dependent on aquifer recharge and other withdrawal rates from the aquifer; however, it is unlikely that groundwater would be used in a once-through cooling system. The overall impacts likely would be SMALL.

- **Air Quality**

Construction of a new nuclear plant at the Peach Bottom site or an alternate site would result in fugitive emissions during the construction process. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. An operating nuclear plant would have minor air emissions associated with diesel generators. These emissions would be regulated. Emissions for a plant sited in Pennsylvania would be regulated by the Pennsylvania Department of Environmental Protection. Overall, emissions and associated impacts are considered SMALL.

- **Waste**

The waste impacts associated with operation of a nuclear power plant are set out in Table B-1 of 10 CFR Part 51 Subpart A, Appendix B. In addition to the impacts shown in Table B-1, construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts are considered SMALL.

Siting the replacement nuclear power plant at a site other than Peach Bottom would not alter waste generation. Therefore, the impacts would be SMALL.

- **Human Health**

Human health impacts for an operating nuclear power plant are identified in 10 CFR Part 51 Subpart A, Appendix B, Table B-1. Overall, human health impacts are considered SMALL.

Siting the replacement nuclear power plant at a site other than Peach Bottom would not alter human health impacts. Therefore, the impacts would be SMALL.

- **Socioeconomics**

The construction period and the peak work force associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). In the absence of quantified data, the staff assumed a construction period of 5 years and a peak work force of 2500. The staff assumed that construction would take place while the existing nuclear units continue operation and would be completed by the time Peach Bottom Units 2 and 3 permanently cease operations. During construction, the communities surrounding the Peach Bottom site would experience demands on housing and public services that could have SMALL to MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other counties. After construction, the communities would be impacted by the loss of the construction jobs, although this loss could be offset by other growth currently being projected for York and Lancaster counties.

The replacement nuclear units are assumed to have an operating work force comparable to the approximately 1000 workers currently working at Peach Bottom Units 2 and 3. The replacement nuclear units would provide a new tax base to offset the loss of tax base associated with decommissioning of Peach Bottom Units 2 and 3. The appropriate characterization of non-transportation socioeconomic impacts for operating replacement nuclear units constructed at the Peach Bottom site would be SMALL to MODERATE.

During the 5-year construction period, up to 2500 construction workers would be working at the Peach Bottom site in addition to the approximately 1000 workers at Units 2 and 3. The addition of the construction workers could place significant traffic loads on existing highways, particularly those leading to the Peach Bottom site. Such impacts would be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of Units 2 and 3 and are considered SMALL.

Construction of a replacement nuclear power plant at an alternate site would relocate some socioeconomic impacts, but would not eliminate them. The communities around the Peach Bottom site would still experience the impact of Peach Bottom Units 2 and 3 operational job loss (although potentially tempered by projected economic growth), and the communities around the new site would have to absorb the impacts of a large, temporary work force (up to 2500 workers at the peak of construction) and a permanent work force of approximately 1000 workers. In the GEIS (NRC 1996), the staff noted that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction work force would need to move to the area to work. The Peach Bottom site is within commuting distance of the Baltimore and Philadelphia metropolitan areas and is therefore not considered a rural site. Alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at rural sites could be LARGE.

Transportation-related impacts associated with commuting workers at an alternate site are site dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site dependent, but can be characterized as SMALL.

- **Aesthetics**

Depending upon how they were placed on the site (on the river or on the bluff above the river), the containment buildings for a replacement nuclear power plant sited at Peach Bottom and other associated buildings could be visible in daylight hours over many miles. The nuclear units would also likely be visible at night because of outside lighting. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed. No cooling towers would be needed, assuming use of the existing once-through cooling system.

A replacement nuclear plant sited at Peach Bottom would be visible from Conowingo Pond. However, with appropriate mitigation, the visual impact can be kept SMALL to MODERATE.

Noise from operation of a replacement nuclear power plant would potentially be audible by visitors to Conowingo Pond. Mitigation measures, such as reduced or no use of outside loudspeakers, can be employed to reduce noise level and keep the impact SMALL.

At an alternate site, depending on placement, there would be an aesthetic impact from the buildings. There would also be a significant aesthetic impact associated with construction of a new 25-km (15-mi) transmission line to connect to other lines to enable delivery of electricity. Noise and light from the plant would be detectable offsite. The impact of noise and light would be mitigated if the plant is located in an industrial area adjacent to other power plants, in which case the impact could be SMALL. The impact could be MODERATE if a transmission line needs to be built to the alternate site. The impact could be LARGE if a greenfield site is selected.

- **Historic and Archeological Resources**

  At both the Peach Bottom site and an alternate site, a cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

  Before construction at the Peach Bottom site or another site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

  No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement nuclear plant were built at the Peach Bottom site. Other impacts, such as impacts on housing availability and prices during construction, might occur, and this could disproportionately affect the minority and low-income populations. After completion of construction, it is possible that the ability of the local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the minority and low-income populations. Overall, impacts are expected to be SMALL to MODERATE. Projected economic growth in York County and the ability of minority and low-income populations to commute to other jobs outside the York County area could mitigate any adverse effects.

  Impacts at an alternate site would depend upon the site chosen and the nearby population distribution. If a replacement nuclear plant were constructed at an alternate site, York County, Delta, and South Eastern School District could experience a loss of property tax revenue, which could affect their ability to provide services and programs. However, because the tax revenue attributable to Peach Bottom Units 2 and 3 is a relatively small percentage of total tax revenue for each jurisdiction, the impacts to minority and low-income populations are expected to be SMALL to MODERATE. Impacts to minority and low-income residents of York County associated with closure of Peach Bottom Units 2 and 3 could be MODERATE, but could also be mitigated by projected economic growth for the area. Impacts to the receiving county could be SMALL to LARGE, depending on the relative increase to the tax base resulting from the new plant's construction, and its siting.

8.2.3.2 Closed-Cycle Cooling System

This section discusses the environmental impacts of constructing a nuclear power plant at an alternate site using closed-cycle cooling. The impacts of this option are essentially the same as the impacts for a nuclear power plant using once-through cooling. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8.7 summarizes the incremental differences.

Table 8-7. Summary of Environmental Impacts of a New Nuclear Power Plant Sited at an Alternate Site with Closed-Cycle Cooling

Impact Category	Change in Impacts from Once-Through Cooling System
Land Use	10 to 12 additional ha (25 to 30 ac) required for cooling towers and associated infrastructure.
Ecology	Impacts would depend on ecology at the site. Additional impact to terrestrial ecology from cooling tower drift. Reduced impact to aquatic ecology.
Surface Water Use and Quality	Discharge of cooling tower blowdown containing dissolved solids. Discharge would be regulated by the Commonwealth of Pennsylvania. Decreased water withdrawal and less thermal load on receiving body of water. Consumptive use of water due to evaporation from cooling towers.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Introduction of cooling towers and associated plume. Natural draft towers could be up to 158 m (520 ft). Mechanical draft towers could be up to 30 m (100 ft) high and also have an associated noise impact.
Historic and Archeological Resources	No change
Environmental Justice	No change

8.2.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the Peach Bottom Units 2 and 3 OLs. It is unlikely, however, that sufficient baseload power supply would be available to replace the Units 2 and 3 capacity.

Exelon has evaluated conventional and prospective power supply options that could be reasonably implemented before the current Peach Bottom Units 2 and 3 licenses expire (in 2013 for Unit 2 and in 2014 for Unit 3). Because Pennsylvania is a net exporter of power and would be fully deregulated, Exelon assumes that in-state power could be purchased. For example, in 1997 Pennsylvania exported 137 million kilowatt hours (kWh) (DOE/EIA 2000b). This is less than 1 percent of what Peach Bottom Units 2 and 3 generates annually (approximately 16,400 gigawatt hours). It would probably require new construction to provide replacement capacity for Peach Bottom Units 2 and 3 (2186 MW(e) net). Power is exported from Pennsylvania because it has been purchased by consumers and is not excess power available to replace existing capacity. The NRC staff evaluated the environmental impacts of thirteen alternative energy sources in Section 8.3 of the GEIS. Exelon assumed that the generating technology producing purchased power would be one of the alternatives that the NRC staff analyzed. For this reason, Exelon adopted by reference, as representative of the purchased power alternative, the GEIS description of the alternative generating technologies. Of these technologies, simple-cycle combustion turbines or combined-cycle facilities fueled by natural gas were found to be the most cost-effective. There has been a corresponding decreased incentive for boilers fired by coal or residual oil. Although purchased power could provide replacement power for Peach Bottom Units 2 and 3, Exelon identified drawbacks to this alternative. They include the following:

- Utility generators providing power to Exelon would need to increase their capacity with new power units. For the reasons discussed in Sections 8.2.1 - 8.2.3, and 8.2.5, construction of a new generating station is not a preferable alternative to license renewal of Peach Bottom Units 2 and 3.

- Deregulation in Pennsylvania was expected to be fully in place by 2001. Under deregulation, non-utility generators could compete directly with utility companies for the generation market. This is expected to decrease non-utility generators' incentives to provide wholesale power to utility companies.

To replace Peach Bottom Units 2 and 3 capacity with imported power, Exelon might need to construct a new 500 kV transmission line which, assuming a 106 m (350 ft) easement width, the transmission line would impact approximately 10.6 ha per km (16.1 ac/mi).

Imported power from Canada or Mexico is unlikely to be available for replacement of Peach Bottom Units 2 and 3 capacity. In Canada, 62 percent of the country's electricity capacity is derived from renewable energy sources, principally hydropower (DOE/EIA 2001b). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale projects (DOE/EIA 2001b). Canada's nuclear generation is projected to increase by 1.7 percent by 2020, but its share of power generation in Canada is projected to decrease from 14 percent currently to 13 percent by 2020 (DOE/EIA 2001b). EIA projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 47.9 billion kWh in year 2000 to 66.1 billion kWh in year 2005, and then gradually decrease to 47.4 billion kWh in year 2020 (DOE/EIA 2001a). On balance, it is unlikely that electricity imported from Canada or Mexico would be able to replace Peach Bottom Units 2 and 3 capacity.

If power to replace Peach Bottom Units 2 and 3 capacity were to be purchased from sources within the United States or a foreign country, the generating technology likely would be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the purchased electrical power alternative to renewal of the Peach Bottom Units 2 and 3 OLs. Thus, the environmental impacts of imported power would still occur, but would be located elsewhere within the region, nation, or another country.

8.2.5 Other Alternatives

Other generation technologies considered by NRC are discussed in the following subsections.

8.2.5.1 Oil-Fired Generation

EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States through the year 2020 because of higher fuel costs and lower efficiencies (DOE/EIA 2001a). Nevertheless, an oil-fired generating alternative at the Peach Bottom site for replacement of power generated by Peach Bottom Units 2 and 3 is considered in this section.

Exelon has several oil-fired units; however, they produce only about 2 percent of Exelon's power generation. The cost of oil-fired operation is more expensive than nuclear or coal-fired operation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has prompted a steady decline in its use for electricity generation. From 1997 to 1998, production of electricity by oil-fired plants dropped by about 11 percent in Pennsylvania (DOE/EIA 1998). For these reasons, oil-fired generation is not an economically feasible alternative to Peach Bottom Units 2 and 3 license renewal.

Also, construction and operation of an oil-fired plant would have environmental impacts. In Section 8.3.11 of the GEIS, the staff estimated that construction of a 1,000-MWe oil-fired plant would require about 120 ac. Additionally, operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

8.2.5.2 Wind Power

According to the Wind Energy Resource Atlas of the United States (National Renewable Energy Laboratory 2000) areas suitable for wind energy applications must be wind power class 3 or higher. Approximately 50 percent of the land area in Pennsylvania has a wind power classification of 3 or higher and, therefore, may be suitable for wind energy applications. However, many of the wind power class 3 areas are located in the Allegheny and Appalachian Mountains along sharp ridgelines at the highest elevations, which is confirmed by the Pennsylvania Wind Map available from the Pennsylvania Department of Environmental Protection (PDEP 2002). Many of these sites may be unsuitable for wind turbines. Accessing many of the best wind energy ridgelines would require extensive road building, as well as land clearing (for tower and blades) and leveling (for the tower bases and associated facilities) in very steep terrain. While not impossible, this is expected to be very costly. Therefore, many of the ridgelines with good wind resources may not be practical based on likely costs and environmental impacts.

Several ridge top wind farms are in various stages of development for Exelon and others in northeastern and southwestern Pennsylvania and in nearby states. Somerset is 9 MW, Mill Run is 15 MW, Pocono is 60 MW, Moosic Mountain is 50 MW, Backbone (in West Virginia) is 65 MW, and Mountaineer (in West Virginia to open in the spring of 2003) is 66 MW (Exelon Corporation 2002; Community Energy, Inc. 2002). Exelon claims a total wind generation portfolio of 175 MW (Exelon Corporation 2002). These are considered among the best sites in the Eastern United States. The replacement of Peach Bottom Units 2 and 3 capacity of 2186 MW would require an additional 36 wind farms of the size stated for the West Virginia site or replicating the entire existing Exelon wind resource 12 times to produce the necessary generating capacity.

Based on figures available in the NUREG-1437, Chapter 8, the amount of land dedicated to wind facilities would be about 61 ha (134 ac) per MW based on the Altamont Pass, California, facility. It is likely that new wind farms would use larger turbine units of 1 MW to 1.5 MW to generate power, thereby reducing the "footprint" on the ground. Based on the latest Storm Mountain proposal in West Virginia, the total land needed might be only 18 Ha (40 ac) per MW. Even this lower figure results in a need for 153 square miles of land to replace Peach Bottom Units 2 and 3 capacity. This is clearly a large potential impact on land use and ecological resources.

About 1500 to 2200 wind towers would have to be installed to replace Peach Bottom Units 2 and 3 capacity. Wind turbines typically operate at a 30 to 35 percent capacity factor compared to 90 to 95 percent for a baseload plant (NWPPC 2000). This relatively low capacity factor is the result of an intermittent resource, not down time due to maintenance. Because the low capacity factor is the result of an intermittent resource, increasing the number of wind turbines will not compensate for the low capacity factor. For this reason, the staff concluded that wind energy is not, by itself, a suitable replacement for baseload generating capacity of Peach Bottom Units 2 and 3.

8.2.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies, photovoltaic and thermal, cannot currently compete with conventional fossil-fueled technologies in grid-connected applications due to higher capital costs per kilowatt of capacity. The average capacity factor of photovoltaic cells is about 25 percent (NRC 1996), and the capacity factor for solar thermal systems is about 25 percent to 40 percent (NRC 1996). Energy storage requirements limit the use of solar-energy systems as baseload electricity supply.

There are substantial impacts to natural resources (wildlife habitat, land-use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS, land requirements are high—14,000 ha (35,000 ac) per 1000 MW(e) for photovoltaic and approximately 5700 ha (14,000 ac) per 1000 MW(e) for solar thermal systems (NRC 1996). Neither type of solar electric system would fit at the Peach Bottom site, and both would have large environmental impacts at a greenfield site.

Recent staff inquiries to the National Renewable Energy Laboratory yielded a current average commercially available conversion efficiency of perhaps 10 percent today, with 25 percent availability, and a lower overall requirement for land (approximately 8000 ha [20,000 ac] per 1000 MW), which reduces the land requirements by about one half. However, the land requirements (160 km^2 [68 mi^2]) or rooftop space requirements (309 million m^2 [1.9 billion ft^2], which is equivalent to 46 percent of all commercial building rooftops in Pennsylvania, New York, and New Jersey combined) for the necessary solar arrays still would be large. Space requirements would be large even if the efficiency of solar panels increases substantially from today's levels. If the panels were mounted on greenfield sites rather than rooftops, the impact on ecological resources could also be substantial.

Furthermore, Exelon noted that solar power is not a technically feasible alternative in Exelon's service area for large-scale generation. Southeastern Pennsylvania receives about 3.3 kWh of solar radiation per square meter per day, compared with 5 to 7.2 kWh/m^2 per day in areas of the West, such as California, which are most promising for solar technologies (NRC 1996). Because of the area's low rate of solar radiation and high technology costs, solar power in Pennsylvania is limited to niche applications and is not a feasible base-load alternative to Peach Bottom Units 2 and 3 license renewal.

Some solar power may substitute for electric power in rooftop and building applications. Implementation of non-rooftop solar generation on a scale large enough to replace Peach Bottom Units 2 and 3 would likely result in LARGE environmental impacts.

8.2.5.4 Hydropower

Approximately 6 percent (about 2000 MW) of Pennsylvania electric generating capacity (but less than 1 percent of power production) is hydroelectric. As stated in Section 8.3.4 of the GEIS, hydropower's percentage of the country's generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern over flooding, destruction of natural habitat, and alteration of natural river courses. According to the U.S. Hydropower Resource Assessment for Pennsylvania (INEEL 1997), there are no remaining sites in Pennsylvania that would be environmentally suitable for a large hydroelectric facility.

The staff estimated in the GEIS that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac or about 1600 mi^2) per 1000 MW(e). Based on this estimate, replacement of Peach Bottom Units 2 and 3 generating capacity would require flooding about 850,000 ha (3300 mi^2). This would result in a large impact on land use. Further, operation of a hydroelectric facility would alter aquatic habitats above and below the dam, which would impact existing aquatic species. Due to the relatively low amount of undeveloped hydropower resource in Pennsylvania and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace Peach Bottom Units 2 and 3, the staff concludes that local hydropower is not a feasible alternative to Peach Bottom Units 2 and 3 OL renewal. Any attempts to site hydroelectric facilities large enough to replace Peach Bottom Units 2 and 3 would result in LARGE environmental impacts.

8.2.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload generation due to the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated by Figure 8.4 in the GEIS, geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent. There is no feasible eastern location for geothermal capacity to serve as an alternative to Peach Bottom Units 2 and 3. The staff concludes geothermal energy is not a feasible alternative to renewal of the Peach Bottom Units 2 and 3 OLs.

8.2.5.6 Wood Waste

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and high inefficiency, the staff has determined that wood waste is not a feasible alternative to renewing the Peach Bottom Units 2 and 3 OLs.

8.2.5.7 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2001). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001c). Mass burning technologies are most commonly used in the United States. This group of technologies process raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. Because of the need for specialized waste-separation and processing equipment for municipal solid waste, the initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities (NRC 1996).

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills; (2) the 1994 Supreme Court decision (*C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001c).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters and/or scrubbers (DOE/EIA 2001c).

Currently, there are approximately 102 waste-to-energy plants operating in the United States. These plants generate approximately 2800 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2001), much smaller than needed to replace the 2186 MW(e) baseload capacity of Peach Bottom Units 2 and 3. Therefore, the staff concludes that municipal solid waste would not be a feasible alternative to renewal of the Peach Bottom Units 2 and 3 OLs, particularly at the scale required.

8.2.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuels, there are several other concepts for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In the GEIS, the staff stated that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as Peach Bottom Units 2 and 3 (NRC 1996). For these reasons, such fuels do not offer a feasible alternative to renewal of the Peach Bottom Units 2 and 3 OLs.

8.2.5.9 Fuel Cells

Fuel cells work without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Phosphoric acid fuel cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. Phosphoric acid fuel cells are generally considered first-generation technology. These are commercially available today at a cost of approximately $4500 per kW of installed capacity (DOE 2002). Higher-temperature second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

DOE has a performance target that by 2003, two second-generation fuel cell technologies using molten carbonate and solid oxide technology, respectively, will be commercially available in sizes of approximately 3 MW at a cost of $1000 to $1500 per kW of installed capacity (DOE 2002). For comparison, the installed capacity cost for a natural-gas-fired combined-cycle plant is on the order of $500 to $600 per kW (NWPPC 2000). As market acceptance and manufacturing capacity increase, natural-gas-fueled fuel cell plants in the 50- to 100-MW range are projected to become available (DOE 2002). At the present time, however, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Fuels cells are, consequently, not a feasible alternative to renewal of the Peach Bottom Units 2 and 3 OLs.

8.2.5.10 Delayed Retirement

Peach Bottom Units 2 and 3 provide about 23 percent of Exelon's operating group generating capacity and approximately 35 percent of its energy requirements to its mid-Atlantic service area. Even without retiring any generating units, Exelon expects to require additional capacity in the near future. Thus, even if substantial capacity were scheduled for retirement and could be delayed, some of the delayed retirement would be needed just to meet load growth. Peach Bottom Units 2 and 3 will be required, in part, to offset any actual retirements that occur. Delayed retirement of other Exelon generating units could not provide a replacement of the power supplied by Peach Bottom Units 2 and 3 and could not be a feasible alternative to Peach Bottom Units 2 and 3 license renewal.

8.2.5.11 Utility-Sponsored Conservation

In the past, Exelon (formerly PECO) has offered the demand-side management (DSM) programs, which either conserve energy or allow PECO to reduce customers' load requirements during periods of peak demands. The programs, as described by Exelon, are:

Conservation Program

Homeowner agreements to limit peaking power in specific areas

Load Management Programs

- Change status of currently operating units to standby generation
- Curtailable service (e.g., industry agreements)
- Interruptible service (e.g., electric water heaters)

Exelon annually projects both the summer and winter peak power (MW) and annual energy requirements (gigawatt-hours [GWH]) impacts of DSM. Projections for future DSM programs represent substantial decreases in DSM initiatives that were in effect during past years.

Market and regulatory conditions are undergoing dramatic changes that have significantly impacted the cost-effectiveness of utility-sponsored DSM and can be described as follows:

(1) A decline in generation costs, due primarily to technological advances that have reduced the cost of constructing new generating units (e.g., combustion turbines); and

(2) National energy legislation that has encouraged wholesale competition through open access to the transmission grid, as well as state legislation designed to facilitate retail competition.

Consistent with (1) and (2) above, the utility planning environment features lower capacity and lower energy prices than during earlier periods, shorter planning horizons, lower reserve margins, and increased reliance on market prices to direct utility resource planning. These have greatly reduced the number of cost-effective DSM alternatives.

Other significant changes include:

- Rate design programs that enable customers to make energy choices based on their unique needs and energy costs. An example is Exelon's eight percent reduction in electricity rates and caps on future generation and transmission and distribution rates. Such rate designs will increasingly replace incentive-driven direct load-control programs.

- The adoption of increasingly stringent national appliance standards for most major energy-using equipment and the adoption of energy efficiency requirements in state building codes. These mandates have further reduced the potential for cost-effective utility-sponsored measures.

- Third parties are increasingly providing energy services and products in competitive markets at prices that reflect their value to the customer. Market conditions can be expected to continue this shift among providers of cost-effective load management.

For these reasons, Exelon determined that the remaining DSM programs, which are primarily directed toward load management, are not an effective substitute for any of its large base-load units operating at high-capacity factors, including Peach Bottom Units 2 and 3.

Deregulation and Reducing Demand

In November 1996, the General Assembly of Pennsylvania enacted the Electricity Generation Customer Choice and Competition Act. The Act would enable all customers of electric distribution companies in the Commonwealth to purchase electricity from their choice of electric generation suppliers by January 1, 2001 (General Assembly of Pennsylvania 1996). As such, electric generation supply would be based on the customers' needs and preferences, the lowest price, or the best combination of prices, services, and incentives (Pennsylvania Public Utility Commission 2000).

In response, Exelon (as PECO) submitted its restructuring plan and received final approval from the Pennsylvania Public Utility Commission. The restructuring plan allowed all customers to choose among competing power suppliers by January 1, 2000 (PECO 1998). With more than 50 suppliers licensed to sell electricity in Pennsylvania, Exelon will not be able to control demand and offering extensive conservation and load modification incentives would not be effective in a competitive market. As a result, in a deregulated market for generation of electrical power in which the market price of power is a function of supply and demand, Exelon will not be able to offer competitively priced power if it subsidizes demand reduction alternatives. Furthermore, as discussed in this section, there is limited potential to reduce loads using unsubsidized demand reduction alternatives. As a result, demand reduction is not a reasonable alternative to license renewal of Peach Bottom Units 2 and 3. The Public Utility Commission will ensure that the operation of generating units of incumbent utilities will not inhibit the development of competition within the Commonwealth. Therefore, it is not clear whether Exelon or another competitive supplier would construct new generating units to replace Peach Bottom Units 2 and 3, if its licenses were not renewed. However, regardless of the entity that constructed and operated the replacement power sources, certain environmental parameters would be constant among replacement power sources. Therefore, this DSEIS discusses the impacts of reasonable alternatives to Peach Bottom Units 2 and 3, without regard to whether they would be owned by Exelon.

The staff concludes that additional DSM, by itself, would not be sufficient to replace the 2186 MW(e) capacity of Peach Bottom Units 2 and 3 and that it is not a reasonable replacement for the OL renewal alternative.

8.2.6 Combination of Alternatives

Even though individual alternatives to Peach Bottom Units 2 and 3 might not be sufficient on their own to replace Peach Bottom Units 2 and 3 capacity due to the small size of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost-effective.

As discussed in Section 8.2, Peach Bottom Units 2 and 3 have a combined net summer rating of 2186 MW(e). For the coal- and natural-gas-fired alternatives, the Exelon ER assumes four standard units that generate a net 508-MW(e) apiece as potential replacements for Units 2 and 3, leaving 154 MW(e) to be supplied.

There are many possible combinations of alternatives. One combination of alternatives that might be assumed as replacements for Peach Bottom Units 2 and 3 would consist of combined cycle natural-gas-fired generation using closed-cycle cooling and additional DSM measures or purchased power. However, Sections 8.2.4 and 8.2.5.11 show that neither additional purchased power nor DSM programs are very practical large-scale alternatives under current regulatory conditions. In addition, Table 8-8 shows that the associated environmental impacts of the combination option still would be at least as large as those of renewing the Peach Bottom Unit 2 and Unit 3 OLs. The impacts are based on the gas-fired generation impact assumptions discussed in Section 8.2.2, adjusted for the reduced generating capacity. While the DSM measures would have few environmental impacts, operation of the new gas-fired plant would result in increased emissions and environmental impacts. The environmental impacts associated with power purchased from other generators would still occur but would be located elsewhere within the region, nation, or another country as discussed in Section 8.2.4. The impacts of purchased power are not shown in Table 8-8. The staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the Peach Bottom Units 2 and 3 OLs.

Table 8-8. Summary of Environmental Impacts of 1060 MW(e) of Natural Gas-Fired Generation and 1126 MW(e) from Demand-Side Management Measures

Impact Category	Peach Bottom Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land Use	SMALL to MODERATE	23 ha (55 ac) for power block, offices, roads, and parking areas. Additional impact of up to approximately 22 ha (54 ac) for construction and/or upgrade of an underground gas pipeline.	SMALL to MODERATE	23 ha (55 ac) for power-block, offices, roads, and parking areas. Approximately 259 ha (640 ac) for transmission line. Additional impact for construction and/or upgrade of an underground gas pipeline.
Ecology	SMALL	Uses previously disturbed areas at current Peach Bottom site, plus gas pipeline route.	SMALL to MODERATE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity. Impacts to terrestrial ecology from cooling tower drift. Likely plant sites already have power generation facilities.
Water Use and Quality (Surface Water)	SMALL	Uses existing cooling canal system.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface water body.

Table 8-8. (contd)

Impact Category	Peach Bottom Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Water Use and Quality (Groundwater)	SMALL	Use of groundwater very unlikely.	SMALL to LARGE	Impacts SMALL if used only for potable purposes; could be MODERATE to LARGE if groundwater is employed as makeup cooling water. Impacts would be site/aquifer specific.
Air Quality	MODERATE	Sulfur oxides • 56 MT/yr (62 tons/yr) Nitrogen oxides • 209 MT/yr (231 tons/yr) Carbon monoxide • 274 MT/yr (304 tons/yr) PM_{10} particulates • 31 MT/yr (35 tons/yr) Some hazardous air pollutants	MODERATE	Potentially same impacts as at the Peach Bottom site.
Waste	SMALL	Minimal waste products from fuel combustion.	SMALL	Minimal waste products from fuel combustion.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Impacts considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be MODERATE. Up to 750 additional workers during the peak of the 3-year construction period, followed by reduction from current Peach Bottom Units 2 and 3 work force of 975 to 75; tax base preserved. Impacts during operation would be SMALL.	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Tax impacts on receiving county could be small to MODERATE. Up to 750 additional workers during the peak of the 3-year construction period. Impacts significant if location is in a more rural area than the Peach Bottom site. York County would experience loss of tax base and employment, potentially offset by projected economic growth.

Table 8-8. (contd)

Impact Category	Peach Bottom Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
	SMALL to MODERATE	Transportation impacts during operation would be SMALL due to the smaller workforce. Transportation impacts associated with construction workers would be SMALL to MODERATE.	SMALL to MODERATE	Transportation impacts associated with construction workers would be SMALL to MODERATE and would depend on population density and road infrastructure at alternate site. Impacts during operation would be SMALL due to the smaller workforce.
Aesthetics	SMALL	SMALL impact due to plant units and stacks. Visual impact would be similar to current Peach Bottom site.	SMALL to MODERATE	SMALL if previously developed site is used and site disturbance is minimal. MODERATE with construction of a transmission line to a previously developed site. MODERATE if greenfield site is developed.
Historic and Archeological Resources	SMALL	Any potential impacts can likely be effectively managed.	SMALL	Same as at the Peach Bottom site. Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 900 operating jobs at Peach Bottom Units 2 and 3 could reduce employment prospects for minority and low-income populations. Impacts could be offset by projected economic growth and the ability of affected workers to commute to other jobs.	SMALL to MODERATE	Impacts vary depending on population distribution and makeup at site—could be SMALL to MODERATE.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, renewal of the Peach Bottom Units 2 and 3 OLs, are SMALL for all impact categories (except collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal for which single significance level was not assigned). The alternative actions, i.e., no-action alternative (discussed in Section 8.1), new generation alternatives (from coal, natural gas, and nuclear discussed in Sections 8.2.1 through 8.2.3, respectively), purchased electrical power (discussed in Section 8.2.4), alternative technologies (discussed in Section 8.2.5), and the combination of alternatives (discussed in Section 8.2.6) were considered.

The no-action alternative would require replacing electrical generating capacity by (1) demand-side management and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than Peach Bottom Units 2 and 3, or (4) some combination of these options, and would result in decommissioning Peach Bottom Units 2 and 3. For each of the new generation alternatives (coal, natural gas, and nuclear), the environmental impacts would not be less than the impacts of license renewal. For example, the land-disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of Peach Bottom Units 2 and 3. The impacts of purchased electrical power would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the OLs for Peach Bottom Units 2 and 3.

The staff concludes that the alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

8.4 References

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10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 50. Code of Federal Regulations, Title 40, *Protection of Environment,* Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

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9.0 Summary and Conclusions

By letter dated July 2, 2001, the Exelon Generation Company, LLC, (Exelon) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Peach Bottom Units 2 and 3 for an additional 20-year period (Exelon 2001a). If the OLs are renewed, State regulatory agencies and Exelon will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OLs are not renewed, then the plant must be shut down at or before the expiration of the current OLs, which expire on August 8, 2013, for Unit 2, and July 2, 2014, for Unit 3.

Section 102 of the National Environmental Policy Act (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51, which identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[a]

Upon acceptance of the Exelon application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping (67 FR 44832, EPA 2002). The staff visited the Peach Bottom site in November 2001, and held public scoping meetings on November 7, 2001, in Delta, Pennsylvania (NRC 2002). The staff reviewed the Exelon Environmental Report (ER; Exelon 2001b) and compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plan for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff also considered the public comments received during the scoping process for preparation of the Supplemental Environmental Impact Statement (SEIS) for Peach Bottom Units 2 and 3. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part I, of this SEIS.

The staff held two public meetings in Delta, Pennsylvania in July 2002, to describe the preliminary results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating their comments. All of the

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

comments received on the draft SEIS were considered by the staff in developing the final document and are presented in Appendix A.

The SEIS includes the NRC staff's analysis in which the staff considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse effects. It also includes the staff's recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The goal of the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> ... whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b).[a]

(a) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operations-generic determination of no significant environmental impact."

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. In the GEIS, the NRC evaluated 92 environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in a footnote to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 issues considered in the GEIS, the analysis in the GEIS shows the following:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off site radiological impacts from the fuel cycle and from high level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must also be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This SEIS documents the staff's evaluation of all 92 environmental issues considered in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OLs for Peach Bottom Units 2 and 3) and alternative methods of power generation. These alternatives are evaluated assuming that the replacement power generation plant is located at either the Peach Bottom site or some other unspecified location.

9.1 Environmental Impacts of the Proposed Action — License Renewal

Exelon and the NRC staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Exelon nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither Exelon nor the staff has identified any new issue applicable to Peach Bottom Units 2 and 3 that has a significant environmental impact. These determinations include the considerations of public comments. Therefore, the staff relies upon the conclusions of the GEIS for all Category 1 issues that are applicable to Peach Bottom Units 2 and 3.

Exelon's license renewal application presents an analysis of the Category 2 issues that are applicable to Peach Bottom Units 2 and 3 plus environmental justice and chronic effects from electromagnetic fields. The staff has reviewed the Exelon analysis for each issue and has conducted an independent review of each issue. Three Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at Peach Bottom. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. Exelon (Exelon 2001b) has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of Peach Bottom Units 2 and 3 for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the *Final Environmental Statement Related to Operation of Peach Bottom Atomic Power Station Units Nos. 2 and 3* (AEC 1973).

Thirteen Category 2 issues related to operational impacts and one related to postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this SEIS in relation to operation during the renewal term. For all 14 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for Peach Bottom Units 2 and 3, and the plant improvements already made, the staff concludes that none of the candidate SAMAs are cost-beneficial.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance, and none warrants implementation of additional mitigation measures. The adverse impacts of likely alternatives if Peach Bottom Units 2 and 3 ceases operation at or before the expiration of the current OLs will not be smaller than those associated with continued operation of these units, and they may be greater for some impact categories in some locations.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of Peach Bottom Units 2 and 3 during the current license periods was made when the plant was built. The resource commitments to be considered in this SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are the fuel and the permanent storage space. Peach Bottom Units 2 and 3 replace approximately one third of the fuel assemblies in each of the two units during every refueling outage, which occurs on a 24-month cycle.

The likely power generation alternatives if Peach Bottom Units 2 and 3 cease operation on or before the expiration of the current OLs will require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the Peach Bottom site was set when the plants were approved and construction began. That balance is now well established. Renewal of the OLs for Peach Bottom Units 2 and 3 and continued operation of the plant will not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the OLs will lead to shutdown of the plant and will alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the Peach Bottom site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OLs for Peach Bottom Units 2 and 3. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at Peach Bottom Units 2 and 3. Chapters 4 through 7 discuss environmental issues associated with renewal of the OLs. Environmental issues associated with the no-action alternative and alternatives involving power generation and use reduction are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the OLs), the no-action alternative (denial of the application), alternatives involving nuclear or coal- or gas-fired generation of power at the Peach Bottom site and an unspecified "greenfield site," and a combination of alternatives are compared in Table 9-1. Continued use of a once-through cooling system for Peach Bottom Units 2 and 3 is assumed for Table 9-1.

Table 9-1 shows that the significance of the environmental effects of the proposed action are SMALL for all impact categories (except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned [see Chapter 6]). The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation

Option	Impact Category	Land Use	Ecology	Water Use and Quality	Air Quality	Waste
Proposed Action	License Renewal	SMALL	SMALL	SMALL	SMALL	SMALL
No-Action Alternative	Denial of Renewal	SMALL	SMALL	SMALL	SMALL	SMALL
Coal-Fired Generation	Alternate Site	MODERATE to LARGE	MODERATE to LARGE	SMALL to LARGE	MODERATE	MODERATE
	Alternate Site using Closed-Cycle Cooling	MODERATE to LARGE	MODERATE to LARGE	SMALL to LARGE	MODERATE	MODERATE
Natural Gas-Fired Generation	Peach Bottom Site	SMALL to MODERATE	SMALL	SMALL	MODERATE	SMALL
	Alternate Site	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	MODERATE	SMALL
	Alternate Site using Closed-Cycle Cooling	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	MODERATE	SMALL
New Nuclear Generation	Peach Bottom Site	MODERATE	MODERATE	SMALL	SMALL	SMALL
	Alternate Site	MODERATE to LARGE	MODERATE to LARGE	SMALL to LARGE	SMALL	SMALL
	Alternate Site using Closed-Cycle Cooling	MODERATE to LARGE	MODERATE to LARGE	SMALL to LARGE	SMALL	SMALL
Combination of Alternatives	Peach Bottom Site	SMALL to MODERATE	SMALL	SMALL	MODERATE	SMALL
	Alternate Site	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	MODERATE	SMALL

Table 9-1 (contd)

Option	Impact Category	Human Health[(a)]	Socioeconomics	Aesthetics	Historic and Archeological Resources	Environmental Justice
Proposed Action	License Renewal	SMALL	SMALL	SMALL	SMALL	SMALL
No-Action Alternative	Denial of Renewal	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL
Coal-Fired Generation	Alternate Site	SMALL	SMALL to LARGE	MODERATE	SMALL	SMALL to MODERATE
	Alternate Site using Closed-Cycle Cooling	SMALL	SMALL to LARGE	MODERATE	SMALL	SMALL to MODERATE
Natural Gas-Fired Generation	Peach Bottom Site	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL
	Alternate Site	SMALL	SMALL to MODERATE	MODERATE	SMALL	SMALL to MODERATE
	Alternate Site using Closed-Cycle Cooling	SMALL	SMALL to MODERATE	MODERATE	SMALL	SMALL to MODERATE
New Nuclear Generation	Peach Bottom Site	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL	SMALL to MODERATE
	Alternate Site	SMALL	SMALL to LARGE	SMALL to LARGE	SMALL	SMALL to LARGE
	Alternate Site using Closed-Cycle Cooling	SMALL	SMALL to LARGE	SMALL to LARGE	SMALL	SMALL to LARGE
Combination of Alternatives	Peach Bottom Site	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL
	Alternate Site	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE

(a) Except for collective offsite radiological impacts from the fuel cycle and from HLW and spent-fuel disposal, for which single significance levels were not assigned. See Chapter 6 for details.

9.3 Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS (NRC 1996; 1999), (2) the ER submitted by Exelon (Exelon 2001b), (3) consultation with Federal, State, and local agencies, (4) the staff's own independent review, and (5) the staff's consideration of public comments, the staff recommends that the Commission determine that the adverse environmental impacts of license renewal for Peach Bottom Units 2 and 3 are not so great that preserving the option of license renewal for energy planning decision makers would be unreasonable.

9.4 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Exelon Generation Company, LLC (Exelon). 2001a. Application for Renewed Operating Licenses, Peach Bottom Units 2 and 3. Kennett Square, Pennsylvania.

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U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

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U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal.* NUREG-1555, Supplement 1, Washington, D.C.

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