NUREG-1815

Environmental Impact Statement for an Early Site Permit (ESP) at the Exelon ESP Site

Draft Report for Comment

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Exelon Generation Company, LLC (Exelon) for an early site permit (ESP). The proposed action requested in Exelon's application is for the NRC to (1) approve a site within the existing Clinton Power Station (CPS) boundaries as suitable for the construction and operation of a new nuclear power generating facility and (2) issue an ESP for the proposed site identified as the Exelon ESP site located adjacent to the CPS. In its application, Exelon proposes a plan for redressing the environmental effects of certain site-preparation and construction activities, i.e., those activities allowed by Title 10 of the Code of Federal Regulations (CFR) 50.10(e)(1), performed by an ESP holder under 10 CFR 52.25. In accordance with the plan, the site would be redressed if the NRC issues the requested ESP (containing the site redress plan), the ESP holder performs these site-preparation and construction activities, the ESP is not referenced in an application for a construction permit or combined operating license, and no alternative use is found for the site. This EIS includes the NRC staff's analysis that considers and weighs the environmental impacts of constructing and operating a new nuclear unit at the Exelon ESP site or at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation to the Commission regarding the proposed action.

The staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued. The staff's evaluation of the site safety and emergency preparedness aspects of the proposed action have been addressed in the staff's draft safety evaluation report dated February 10, 2005.

This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by Exelon; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. In addition, in making its recommendation, the staff determined that there are no environmentally preferable or obviously superior sites. Finally, the staff has concluded that the site-preparation and construction activities allowed by 10 CFR 50.10(e)(1) requested by Exelon in its application would not result in any significant adverse environmental impact that cannot be redressed.

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Executive Summary

On September 25, 2003, the U.S. Nuclear Regulatory Commission (NRC) received an application from Exelon Generation Company, LLC (Exelon) for an early site permit (ESP) for a location identified as the Exelon ESP site, adjacent to the Clinton Power Station (CPS), Unit 1. The Exelon ESP site is located in DeWitt County, Illinois, approximately 10 km (6 mi) east of the City of Clinton. An ESP is a Commission approval of a location for siting one or more nuclear power facilities and is a separate action from the filing of an application for a construction permit (CP) or combined CP and operating license (combined license or COL) for such a facility. An ESP application may refer to a reactor's or reactors' characteristics or plant parameter envelope (PPE), which is a set of postulated design parameters that bound the characteristics of a reactor or reactors that might be built at a selected site; alternatively, an ESP may refer to a detailed reactor design. The ESP is not a license to build a nuclear power plant; rather, the application for an ESP initiates a process undertaken to assess whether a proposed site is suitable should Exelon decide to pursue a CP or COL.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) be prepared for major Federal actions that significantly affect the quality of the human environment. Subpart A of Title 10 of the Code of Federal Regulations (CFR) Part 52 contains the NRC regulations related to ESPs. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. As set forth in 10 CFR 52.18, the Commission has determined that an EIS will be prepared during the review of an application for an ESP. The purpose of Exelon's requested action, issuance of the ESP, is for the NRC to determine whether the Exelon ESP site is suitable for a new nuclear unit by resolving certain safety and environmental issues before Exelon incurs the substantial additional time and expense of designing and seeking approval to construct such a facility at the site. Part 52 of Title 10 describes the ESP as a "partial construction permit." An applicant for a CP or COL for a nuclear power plant or plants to be located at the site for which an ESP was issued can reference the ESP, thus reducing the review of siting issues at that stage of the licensing process. However, a CP or COL to construct and operate a nuclear power plant is a major Federal action and will require an EIS be issued in accordance with 10 CFR Part 51.

Three primary issues – site safety, environmental impacts, and emergency planning – must be addressed in the ESP application. Likewise, in its review of the application, the NRC assesses Exelon's proposal in relation to these issues and determines if the application meets the requirements of the Atomic Energy Act and the NRC regulations. This EIS addresses the potential environmental impacts resulting from the construction and operation of a new nuclear unit at the Exelon ESP site.

In its application, Exelon requested authorization to perform certain site-preparation activities after the ESP is issued. The application, therefore, includes a site redress plan that specifies how Exelon would stabilize and restore the site to its pre-construction condition (or conditions consistent with an alternative use) in the event a nuclear power plant is not constructed on the approved site. Pursuant to 10 CFR 52.17(a)(2), Exelon did not address the benefits of the proposed action (e.g., the need for power). In accordance with 10 CFR 52.18, the EIS is focused on the environmental effects of construction and operation of a reactor, or reactors, that have characteristics that fall within the postulated site parameters.

Upon acceptance of the Exelon ESP application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent (68 FR 66130) to prepare an EIS and conduct scoping. The staff held a public scoping meeting in Clinton, Illinois, on December 18, 2003, and visited the Exelon ESP site in March 2004. Subsequent to the scoping meeting and the site visit and in accordance with NEPA and 10 CFR Part 51, the staff determined and evaluated the potential environmental impacts of constructing and operating a new nuclear unit at the Exelon ESP site. Included in this EIS are (1) the results of the NRC staff's analyses, which consider and weigh the environmental effects of the proposed action (issuance of the ESP) and of constructing and operating a new nuclear unit at the ESP site, (2) mitigation measures for reducing or avoiding adverse effects, (3) the environmental impacts of alternatives to the proposed action, and (4) the staff's recommendation regarding the proposed action.

During the course of preparing this EIS, the staff reviewed the application, including the Environmental Report (ER) submitted by Exelon, consulted with Federal, State, Tribal, and local agencies, and followed the guidance set forth in review standard RS-002, *Processing Applications for Early Site Permits*, to conduct an independent review of the issues. The review standard draws from the previously published NUREG-0800, *Standard Review Plans for the Review of Safety Analysis for Nuclear Power Plants*, and NUREG-1555, *Environmental Standard Review Plan (ESRP)*. In addition, the staff considered the public comments related to the environmental review received during the scoping process. These comments are provided in Appendix D of this EIS.

Following the precedent of NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, and supplemental license renewal EISs, environmental issues are evaluated using the three-level standard of significance – SMALL, MODERATE, or LARGE – developed by NRC using guidelines from the Council on Environmental Quality. Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

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.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections.

The staff plans to conduct a public meeting near the Exelon ESP site to describe the results of the NRC environmental review, answer questions, and provide members of the public with information to assist them in formulating comments on this EIS. After the comment period, the staff will consider and disposition all the comments received. These comments will be addressed in Appendix E of the final EIS.

The staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued. The staff's evaluation of the site safety and emergency preparedness aspects of the proposed action have been addressed in the staff's draft safety evaluation report dated February 10, 2005.

This recommendation is based on (1) the application, including the ER submitted by Exelon; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the staff's independent review; and (4) the staff's consideration of public comments related to the environmental review that were received during the scoping process; and (5) the assessments summarized in the EIS, including the potential mitigation measures identified in the ER and this EIS. In addition, in making its recommendation to the Commission, the staff has determined that there are no environmentally preferable or obviously superior sites. Finally, the staff has concluded that the site-preparation and construction activities allowed by 10 CFR 50.10(e)(1) would not result in any significant adverse environmental impact that cannot be redressed.

Abbreviations/Acronyms

ABWR	Advanced Boiling Water Reactor
ac	acre(s)
ACE	U.S. Army Corps of Engineers
ACR-700	Advanced Canada Deuterium Uranium Reactor
AEC	U.S. Atomic Energy Commission
ALARA	as low as is reasonably achievable
AP1000	Advanced Pressurized Water Reactor
APE	area of potential effect
AQCR	Air Quality Control Region
AQI	Air Quality Index
ATWS	anticipated transient without scram
Btu	British thermal unit(s)
C	Celsius
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	curie(s)
cm	centimeter(s)
COL	combined license
CP	construction permit
CPS	Clinton Power Station
CWA	Clean Water Act of 1977 (also known as the Federal Water Pollution Control Act)
d	day
DBA	design basis accident
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EIS	environmental impact statement
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESBWR	Economic Simplified Boiling Water Reactor
ER	Environmental Report
ESP	early site permit

Abbreviations/Acronyms

F	Fahrenheit
FERC	Federal Energy Regulatory Commission
FR	Federal Register
ft	*foot/feet*
FWPCA	Federal Water Pollution Control Act (also known as the Clean Water Act of 1977)
FWS	*U.S. Fish and Wildlife Service*
gal	gallon(s)
GEIS	generic environmental impact statement
GIS	geographic information system
gpm	gallons per minute
GT-MHR	Gas Turbine-Modular Helium Reactor
ha	hectare(s)
hr	hour(s)
I	interstate
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiation Protection
IDNR	*Illinois Department of Natural Resources*
IDOT	Illinois Department of Transportation
IEPA	Illinois Environmental Protection Agency
IHPA	Illinois State Historic Preservation Agency
in.	inch(es)
INEEL	Idaho National Engineering and Environmental Laboratory
INHS	Illinois Natural History Survey
IPC	Illinois Power Company
IRIS	International Reactor Innovative and Secure
kg	kilogram(s)
km	kilometers)
kV	kilovolt(s)
kWh	kilowatt hour(s)
L	liter(s)
lb	pound(s)
LOCA	loss-of-coolant accident
LOS	level-of-service
LWR	light water reactor

m	meter(s)
m/s	meter(s) per second
m^3/d	cubic meter(s) per day
m^3/s	cubic meter(s) per second
mgd	million gallons per day
mi	mile(s)
mL	milliliter(s)
mph	miles per hour
mrad	millirad(s)
mrem	millirem(s)
MSL	mean sea level
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTU	metric ton(s) uranium
MW	megawatt(s)
MWd/MTU	megawatt days per metric ton of uranium
MW(e)	megawatt(s) electric
MW(t)	megawatt(s) thermal
MWh	megawatt hour(s)
NAGPRA	Native Graves Protection and Repatriation Act
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NIEHS	National Institute of Environmental Health Sciences
N	north
NE	northeast
NNE	north northeast
NOx	nitrogen oxide(s)
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PBMR	Pebble Bed Modular Reactor
PPE	plant parameter envelope
PWR	pressurized water reactor

RCIC	reactor core isolation cooling
REMP	radiological environmental monitoring program
rms	root mean square
ROI	region of interest
RSICC	Radiation Safety Information Computational Center
RTO	Regional Transmission Operator
Ryr-1	per reactor year
s	*second(s)*
scf	standard cubic feet
SE	southeast
SEIS	supplemental environmental impact statement
SER	safety evaluation report
SHPO	State Historic Preservation Officer
SOx	sulfur oxide(s)
SPCC	Spill Prevention Control and Countermeasure
SR	State Route
SSAR	site safety analysis report
SW	southwest
SWR	*Service Water Reservoir*
SWU	separative work units
TEDE	total effective dose equivalent
TIF	tax increment financing (districts)
TLD	thermoluminescent dosimeter
UFSAR	Updated Final Safety Analysis Report
UHS	ultimate heat sink
U.S.	United States
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
yr	year(s)

1.0 Introduction

On September 25, 2003, the U.S. Nuclear Regulatory Commission (NRC) received an application from Exelon Generation Company, LLC (Exelon) for an early site permit (ESP) for a location identified as the Exelon ESP site adjacent to the Clinton Power Station (CPS), Unit 1 in Clinton, Illinois. Under the NRC regulations in Title 10 of the Code of Federal Regulations (CFR) Part 52, and in accordance with the applicable provisions of 10 CFR Part 51, which are the NRC regulations implementing the National Environmental Policy Act of 1969 (NEPA), the NRC is required to prepare an environmental impact statement (EIS) as part of its review of an ESP application. As required by 10 CFR 51.26, the NRC has published in the *Federal Register* a Notice of Intent (68 FR 66130) to prepare an EIS, conduct scoping, and publish a draft EIS for public comment. The final EIS will be issued after considering public comments on the draft. A separate safety evaluation report (SER) will also be prepared in accordance with 10 CFR Part 52.

1.1 Background

An ESP is a Commission approval of a site or sites for one or more nuclear power facilities. The filing of an application for an ESP is a process that is separate from the filing of an application for a construction permit (CP) or combined construction and operating license (combined license or COL) for such a facility. The ESP application and review process makes it possible to evaluate and resolve safety and environmental issues related to siting before the applicant makes large commitments of resources. If the ESP is approved, then the applicant can "bank" the site for up to 20 years for future reactor siting. In addition, if the ESP includes a site redress plan, the ESP holder can conduct certain site-preparation activities pursuant to 10 CFR 50.10(e)(1). An ESP does not authorize construction and operation of a nuclear power plant. To construct and operate a nuclear power plant, an ESP holder must obtain a CP and operating license or a COL, which is a separate major Federal action and will require that an EIS be issued in accordance with 10 CFR Part 51.

As part of its evaluation of the environmental impacts of the action proposed in an ESP application, the NRC prepares an EIS in accordance with 10 CFR 52.18. Because the site suitability encompasses construction and operational parameters, the EIS addresses impacts of both construction and operation of reactors and associated facilities. In a review separate from the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These latter two analyses are documented in a SER that presents the conclusions reached by the NRC regarding whether there is reasonable assurance that a reactor or reactors having characteristics that fall within the parameters for the site can be constructed and operated without undue risk to the health and safety of the public, whether there are significant impediments to the development of emergency plans, and whether site characteristics are such that adequate security plans and measures can be developed. In addition, if the applicant proposes major features of emergency plans, or complete and integrated emergency plans, the SER will document whether such major features are acceptable, or whether the complete and integrated emergency plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

1.1.1 Plant Parameter Envelope

The applicant for an ESP need not provide a detailed design of a reactor or reactors and the associated facilities, but should provide sufficient bounding parameters and characteristics of the reactor or reactors and associated facilities so that an assessment of site suitability can be made. Consequently, the ESP application may refer to a plant parameter envelope (PPE) as a surrogate for a nuclear power plant and its associated facilities.

A PPE is a set of values of plant design parameters that an ESP applicant expects will bound the design characteristics of the reactor or reactors that might be constructed at a given site. The PPE values are a surrogate for actual reactor design information. Analysis of environmental impacts based on a PPE approach permits an ESP applicant to defer the selection of a reactor design until the CP or COL stage. The PPE reflects the upper bounds of the values for each parameter it encompasses rather than the characteristics of any specific reactor design. The PPE is discussed in more detail in Section 3.2 of this EIS.

1.1.2 Site-Preparation and Preliminary Construction Activities

The holder of an ESP, or an applicant for a CP (10 CFR Part 50) or a COL (Subpart C of 10 CFR Part 52) that references an ESP with an approved site redress plan, may in accordance with 10 CFR 52.25(a), perform the site-preparation activities and preliminary construction activities allowed by 10 CFR 50.10(e)(1), provided that the final ESP EIS concludes that the activities will not result in any significant adverse environmental impacts which cannot be redressed. Exelon provided a site redress plan as part of its ESP application (Exelon 2003) to obtain authorization to conduct certain site-preparation and preliminary construction activities. Activities permitted under an ESP include preparation of the site for construction of the facility, installation of temporary construction support facilities, excavation for facility structures, construction of service facilities, and construction of certain structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents (10 CFR 50.10(e)(1)). This is discussed in more detail in Section 4.11 of this EIS.

1.1.3 ESP Application and Review

In accordance with 10 CFR 52.17(a)(2), Exelon submitted an Environmental Report (ER) as part of its ESP application (Exelon 2003). The ER focuses on the environmental effects of construction and operation of reactors with characteristics that fall within the PPE. The ER also includes an evaluation of alternative sites to determine whether there is an obviously superior alternative to the proposed site. An ESP ER is not required to include an assessment of energy alternatives or the benefits of the proposed action, e.g., the need for power. Exelon did not include a discussion on need for power; however, there is a discussion of energy alternatives that is evaluated in Chapter 8 of this EIS.

The NRC standards for review of the ESP application are outlined in 10 CFR 52.18. As does the ER, this EIS focuses on the environmental effects of construction and operation of reactors that have characteristics that fall within the PPE developed by Exelon, and includes an evaluation of alternative sites to determine whether there is any obviously superior alternative to the proposed Exelon ESP site. The EIS does not include an assessment of the benefits of the proposed action.

The NRC staff conducts its reviews of ESP applications in accordance with guidance set forth in review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004). The review standard draws from the previously published NUREG-0800, *Standard Review Plans for the Review of Safety Analysis for Nuclear Power Plants* (NRC 1987), and NUREG-1555, *Environmental Standard Review Plan (ESRP)* (NRC 2000). RS-002 provides guidance to NRC staff reviewers to help ensure a thorough, consistent, and disciplined review of any ESP application. As stated in RS-002, an applicant may elect to use a PPE approach instead of supplying specific design information. The staff's June 23, 2003, responses to comments received on draft RS-002 (ML031710698) provide additional insights on the staff's expectations and potential approach to the review of an application employing the PPE approach (NRC 2003). Specifically, the NRC staff tasked to perform the environmental review has been trained on using the guidance in the ESRP and RS-002, and on incorporating the PPE concept into their review. The reviewers understand that the ESRP review guidance needs to be adapted to account for the PPE concept. The findings in this EIS reflect the adaptation of the ESRP guidance to the PPE approach.

During the review of a CP or COL application referencing an ESP, the staff will assess the environmental impacts of the construction and operation of a specific plant design. If the environmental impacts addressed in the EIS written at the ESP stage are found to be bounding by the staff, no additional analysis of these impacts is required, even if the ESP applicant employed the PPE approach. However, environmental impacts not considered or not bounded at the ESP stage will be assessed at the CP or COL stage. In addition, measures and controls to limit adverse impacts should be identified and evaluated for feasibility and adequacy in limiting adverse impacts at the ESP stage, where possible, and at the CP or COL stage. As a result of the staff's environmental review of the ESP application, the staff may determine that conditions or limitations on the ESP may be necessary in specific areas, as set forth in 10 CFR 52.24. Therefore, the staff has identified in this EIS when and how assumptions and bounding values limit its conclusions on the environmental impacts to a particular resource.

Following requirements set forth in 10 CFR Part 51, on November 25, 2003, the NRC published a notice of intent in the *Federal Register* to prepare an EIS and conduct scoping (68 FR 66130). The NRC environmental staff (and its technical experts from the Pacific Northwest National Laboratory retained to assist the staff) held a scoping meeting on December 18, 2003, to obtain public input on the scope of the environmental review and visited the Exelon ESP site and the alternative sites (Dresden, Quad Cities, Braidwood, Byron, LaSalle, and Zion) in March 2004 to gather information and to become familiar with the site and its environs. During these site visits, the staff and its contractors met with Exelon staff, public officials, and the public. The staff reviewed the comments received during scoping and contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A list of the organizations contacted is provided in Appendix B. Other documents related to the Exelon ESP site were reviewed and are listed as references where appropriate.

To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts using Council on Environmental Quality guidance (40 CFR 1508.27). Using this approach, the NRC established three significance levels: SMALL, MODERATE, or LARGE. The definitions of the three significance levels are as follows:

> 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.

This EIS presents the staff's analysis, which considers and weighs the environmental impacts of the proposed action at the Exelon ESP site, including the environmental impacts associated with construction and operation of reactors at the site, the impacts of construction and operation of reactors at alternative sites, the environmental impacts of alternatives to granting the ESP, and the mitigation measures available for reducing or avoiding adverse environmental effects.

This EIS also provides the NRC staff's preliminary recommendation to the Commission regarding the suitability of the Exelon ESP site for the construction and operation of reactors that have characteristics that fall within the PPE.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the draft EIS to allow members of the public to comment on the results of the NRC staff's review. A public meeting will be held near the site during the public comment period. During this public meeting, the staff will describe the results of the NRC environmental review, answer questions related to the review, and provide members of the public with information to assist them in formulating their comments.

1.2 The Proposed Federal Action

The proposed Federal action is issuance, under the provisions of 10 CFR Part 52, of an ESP for the Exelon site for one additional nuclear unit that has characteristics that fall within the PPE. In addition, Exelon proposes a plan for redressing the environmental effects of certain site-preparation and preliminary construction activities, i.e., those activities allowed by 10 CFR 50.10(e)(1), performed by an ESP holder under 10 CFR 52.25. In accordance with the plan, the site would be redressed if the NRC issues the requested ESP (containing the site redress plan), the ESP holder performs these site-preparation and preliminary construction activities, the ESP is not referenced in an application for a CP or COL, and no alternative use is found for the site. While the applicant is not currently proposing construction and operation of a new nuclear unit, this EIS analyzes the environmental impacts that could result from the construction and operation of a new nuclear unit at the Exelon ESP site or at one of the six alternative sites. These impacts are analyzed to determine if the proposed ESP site is suitable for the addition of the new nuclear unit and whether there is an alternative site that is obviously superior to the proposed site.

The site proposed by Exelon is located in DeWitt County in central Illinois, near the City of Clinton. The site is approximately 35 km (22 mi) south of Bloomington, Illinois, and 35 km (22 mi) north of Decatur, Illinois. The site is completely within the confines of the current CPS site, with the new unit to be adjacent to the existing Unit 1.

No specific plant design has been chosen by Exelon for the new nuclear unit; instead, a set of bounding plant parameters known as a PPE has been specified to envelop the design to be considered for the ESP site. The PPE is based on the addition of power generation of one new nuclear unit composed of one to eight reactors or reactor modules, as described in Section 3.2. These multiple reactors or modules (the number of which may vary depending on the reactor type selected) would be grouped into one facility or unit. In this EIS, the proposed site is evaluated for construction and operation of various numbers of new reactors and/or modules, configured as one operating unit, up to a total of 6800 MW(t). The new unit would use either a wet cooling (natural draft or mechanical draft cooling towers) or a hybrid wet/dry cooling system.[(a)]

1.3 The Purpose and Need for the Proposed Action

The purpose and need for the proposed action (issuance of an ESP) is to provide stability in the licensing process by addressing safety and environmental issues before plants are built, rather than after construction is completed. This process allows for early resolution of many safety and environmental issues that may be identified for the ESP site. In the absence of an ESP, safety and environmental reviews of applications for CPs and operating licenses under 10 CFR Part 50 continue during plant construction. Alternatively, all safety and environmental issues would have to be addressed at the time of the staff's review of a COL submitted under 10 CFR Part 52 if no ESP for the site were referenced. Although actual construction and operation of the facility would not take place until a COL is granted, certain lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COL is granted. As a result, without the ESP review process, there could be a considerable expenditure of funds, commitment of resources, and passage of time before site safety and environmental issues are finally resolved.

1.4 Alternatives to the Proposed Action

Section 102(2)(C)(iii) of NEPA states that EISs will include a detailed statement on alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for inclusion of a chapter in an EIS discussing the environmental impacts of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A). Chapter 8 of this EIS discusses the environmental impacts of four categories of alternatives: (1) the no-action alternative, (2) alternative energy sources, (3) system design alternatives, and (4) alternative sites. The Commission determined that evaluation of energy alternatives is not required for an ESP;

(a) Exelon also states that a third option, use of a dry cooling system, is being proposed. However, the applicant further states that full wet or hybrid wet/dry cooling processes have been assumed for most purposes because out of the options proposed, they have the greatest consumptive water uses. The applicant does not provide information on a dry cooling system to support an environmental analysis nor does the applicant address the adverse environmental impacts of such a system (noise, large footprint, and inefficiency). Therefore, the staff did not evaluate a dry cooling system. Should Exelon choose to use a dry cooling system at the ESP site in a CP or COL application, the staff will evaluate the environmental impacts of construction and operation of the system during that review.

however, Exelon included a discussion of energy alternatives in its ER, and, therefore, the staff conducted an evaluation of energy alternatives.

The six alternative sites that are considered are all Exelon sites located in Illinois: Braidwood, Byron, Dresden, Quad Cities, LaSalle, and Zion. The environmental analysis was performed using reconnaissance-level information. Chapter 8 also includes sections discussing (1) Exelon's region of interest for identification of alternative plant sites, (2) the methodology used by Exelon to select alternative sites and the proposed Exelon ESP site, and (3) generic issues consistent among alternative sites. Chapter 9 compares the environmental impacts at the Exelon ESP site to the alternative sites and to the no-action alternative and qualitatively determines whether an obviously superior alternative site to the proposed site exists.

1.5 Compliance and Consultations

Prior to construction and operation of a new reactor, Exelon is required to hold certain Federal, State, and local environmental permits, as well as meet applicable Federal and State statutory requirements. In its ER, Exelon provides a list of environmental approvals and consultations associated with the Exelon ESP. Because an ESP is limited to establishing the acceptability of the proposed site for future development, the authorizations Exelon will need from Federal, State, and local authorities for construction and operation are not yet required; therefore, they have not been obtained. However, Exelon will need to obtain the necessary authorizations to conduct the site-preparation activities specified in the site redress plan. Potential authorizations and consultations relevant to the proposed ESP are included in Appendix I. The information provided in Appendix I is based on guidance from NUREG-1555, *Environmental Standard Review Plan (ESRP)* (NRC 2000).

The staff reviewed the list and has contacted the appropriate Federal, State, and local agencies to identify any compliance, permit, or significant environmental issues of concern to the reviewing agencies that may impact the suitability of the Exelon ESP site for the construction and operation of the reactors that fall within the PPE.

1.6 Report Contents

The subsequent chapters of this EIS are organized as follows. Chapter 2 describes the proposed site and discusses the environment that would be affected by the addition of a new nuclear unit. Chapter 3 examines the power plant characteristics to be used as the basis for evaluation of the environmental impacts. The evaluations described in Chapter 3 are based on the PPE as well as site characteristics for which information is currently available. Chapters 4 and 5 examine site suitability by analyzing the environmental impacts of construction (Chapter 4) and operation (Chapter 5) of the proposed new nuclear unit. Chapter 6 analyzes the environmental impacts of the fuel cycle, transportation of radioactive materials, and decommissioning, while Chapter 7 discusses the cumulative impacts of the proposed action as defined in 40 CFR Part 1508. Chapter 8 explains how the alternative sites were selected and analyzes the alternative sites and systems. Chapter 9 compares the proposed action with the alternatives, and Chapter 10 summarizes the findings of the preceding chapters and presents the staff's preliminary recommendation with respect to (1) the Commission's approval of the proposed site for an ESP based on the staff's evaluation of environmental impacts and (2) the conclusions regarding the site redress plan.

The appendixes to the EIS provide the following additional information.

- Appendix A – Contributors to the EIS
- Appendix B – Organizations Contacted
- Appendix C – Chronology of NRC Staff Environmental Review Correspondence Related to Exelon Generation Company, LLC's Application for Early Site Permit at the Exelon ESP Site
- Appendix D – Scoping Meeting Comments and Responses
- Appendix E – Draft Environmental Impact Statement Comments and Responses (Reserved)
- Appendix F – Key Correspondence
- Appendix G – Data and Information to Support Transportation Discussion
- Appendix H – Supporting Documentation on Radiological Dose Assessment
- Appendix I – Required Authorizations and Consultations
- Appendix J – Plant Parameter Envelope Values
- Appendix K – Key Statements from the Exelon Environmental Report Considered in the NRC Staff's Environmental Analysis.

1.7 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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 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 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

68 FR 66130. "Exelon Generation Company, LLC, Clinton Early Site Permit; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." U.S. Nuclear Regulatory Commission, Washington, D.C. *Federal Register.* Docket No. 52-007. November 25, 2003.

Exelon Generation Company, LLC (Exelon). 2003. *Exelon Generation Company LLC, Early Site Permit Application: Environmental Report.* Exelon Nuclear, Kennett Square, Pennsylvania.

National Environmental Policy Act of 1969 (NEPA). 42 USC 4321, et seq.

U.S. Nuclear Regulatory Commission (NRC). 1987. *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants.* NUREG-0800, NRC, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan.* NUREG-1555, Vol. 1, NRC, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2003. Letter from J.L. Lyons, Office of Nuclear Reactor Regulation, NRC, to R.L. Simard, Nuclear Energy Institute, dated June 23, 2–3, "U.S. Nuclear Regulatory Commission Responses to Nuclear Energy Institute (NEI) Comments on Draft RS-002, Processing Applications for Early Site Permits (ML031710698).

U.S. Nuclear Regulatory Commission (NRC). 2004. *Processing Applications for Early Site Permits.* RS-002, NRC, Washington, D.C. (May 3, 2004).

2.0 Affected Environment

The site proposed by Exelon Generation Company, LLC (Exelon) for an early site permit (ESP) is located in DeWitt County, Illinois, within the existing boundaries of the current Clinton Power Station (CPS). The CPS property is owned by AmerGen Energy Company, LLC (AmerGen). The site is located on the shore of Clinton Lake approximately 10 km (6 mi) east of the City of Clinton. One generating unit (Unit 1) is currently located on the CPS site. The station location is described in Section 2.1, with the land, meteorology and air quality, geology, radiological environment, water, ecology, socioeconomics, historic and cultural resources, and environmental justice of the site presented in Sections 2.2 through 2.10, respectively. Section 2.11 examines related Federal projects, and references are presented in Section 2.12.

2.1 Site Location

Exelon's proposed ESP location is within the CPS site (see Figure 2-1). The ESP facility would be located 210 m (700 ft) south of the current CPS facility.

The ESP site is located in rural DeWitt County, which had a population of approximately 17,000 in 2000. Figure 2-2 shows the location of the CPS in relationship to the counties and important cities and towns within an 80-km (50-mi) radius of the site. The site is located between the Cities of Bloomington and Decatur, which are 35 km (22 mi) to the north and 35 km (22 mi) to the south, respectively. In addition, the site is located between the Cities of Lincoln and Urbana-Champaign, 45 km (28 mi) to the west and 48 km (30 mi) to the east, respectively. Illinois State Route (SR) 54 passes approximately 1.6 km (1 mi) north of the ESP site; Illinois SR 10 passes approximately 5 km (3 mi) south; and Illinois SR 48 is approximately 8 km (5 mi) east of the ESP site (see Figure 2-3). There is one active railroad line within the vicinity: the Canadian National Railroad runs parallel to Illinois SR 54 and traverses the vicinity approximately 1.6 km (1 mi) north of the site. There are three active private airports nearby: the Martin Airport is located approximately 6 km (4 mi) south of the site; the Thorp Airport is located approximately 8 km (5 mi) northwest of the site; and the Baker Strip is located approximately 8 km (5 mi) southeast of the site. The nearest community is the City of Clinton, approximately 10 km (6 mi) west of the CPS site. The ESP site is situated on Clinton Lake, which was formed by the construction of an earthen dam across Salt Creek, 370 m (1200 ft) downstream from the confluence of Salt Creek with the North Fork of Salt Creek. The ESP site is approximately 5 km (3 mi) northeast of the dam, located on a peninsula between the two arms of the lake, at an approximate grade elevation of 224 m (736 ft). The normal lake pool elevation is 210 m (690 ft), with a surface area of 1981 ha (4895 ac). The station occupies approximately 187 ha (461 ac) of land. All site land, subsurface lands, and mineral rights are owned by AmerGen. In its Environmental Report (ER),

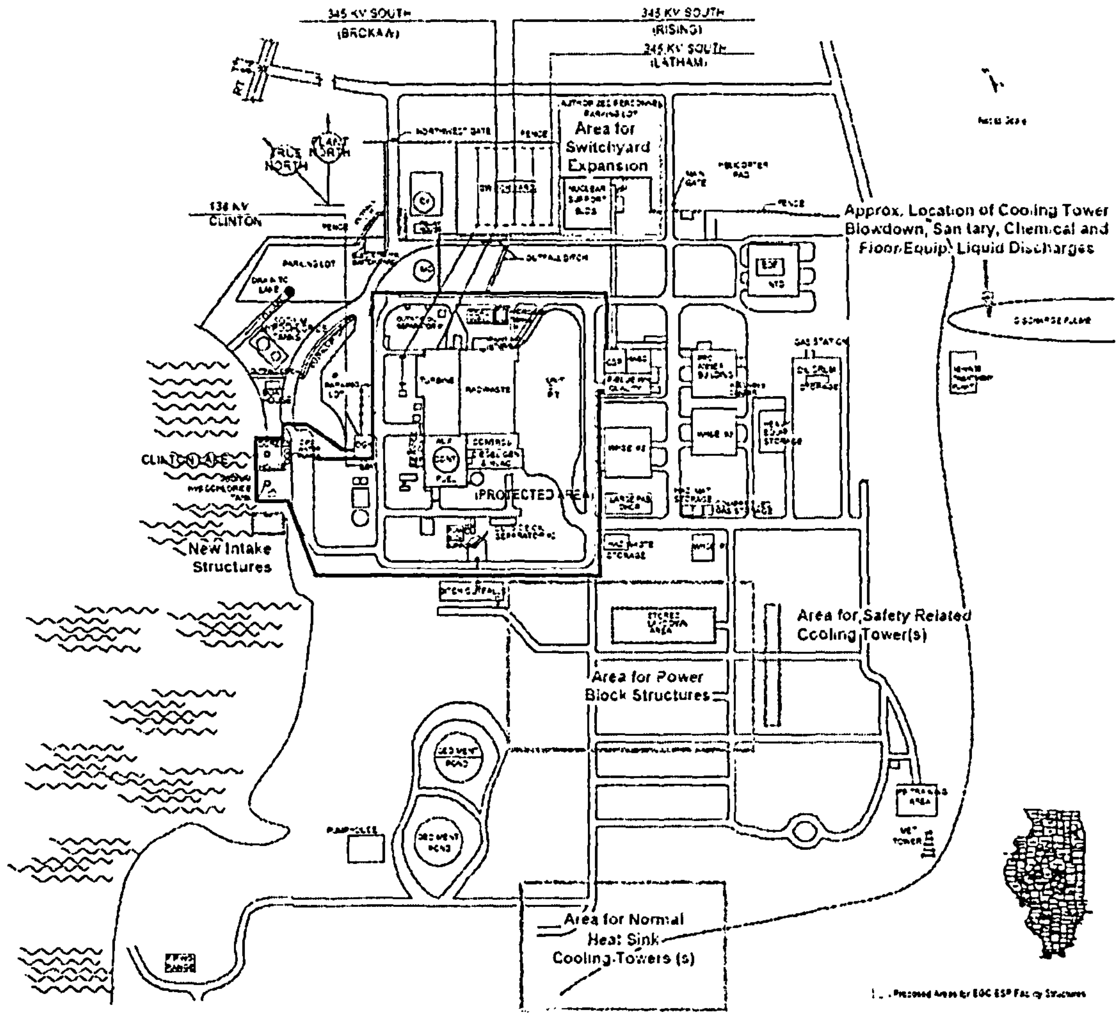

Figure 2-1. Location of ESP Structures Relative to CPS Facilities

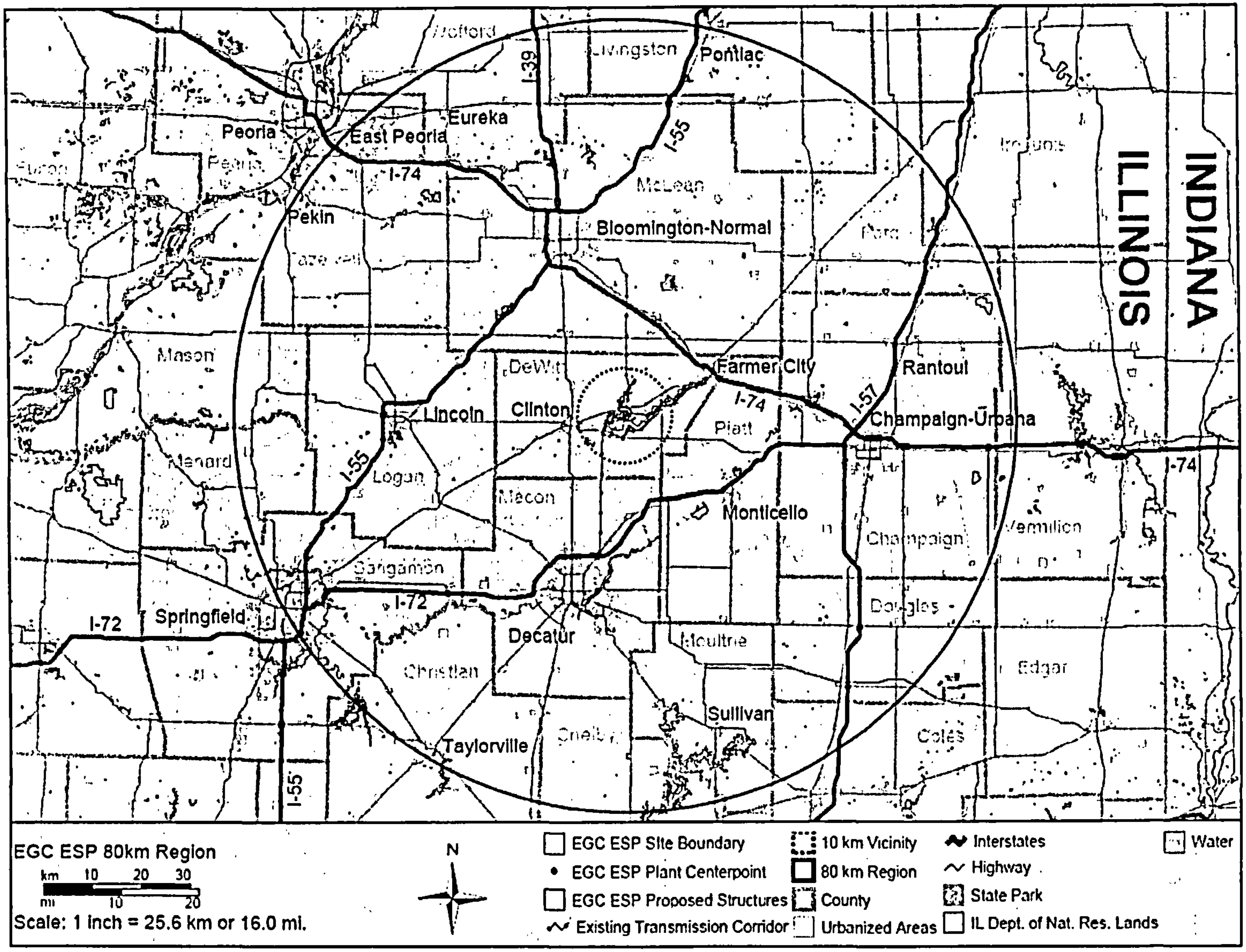

Figure 2-2. Exelon ESP 80-km (50-mi) Region

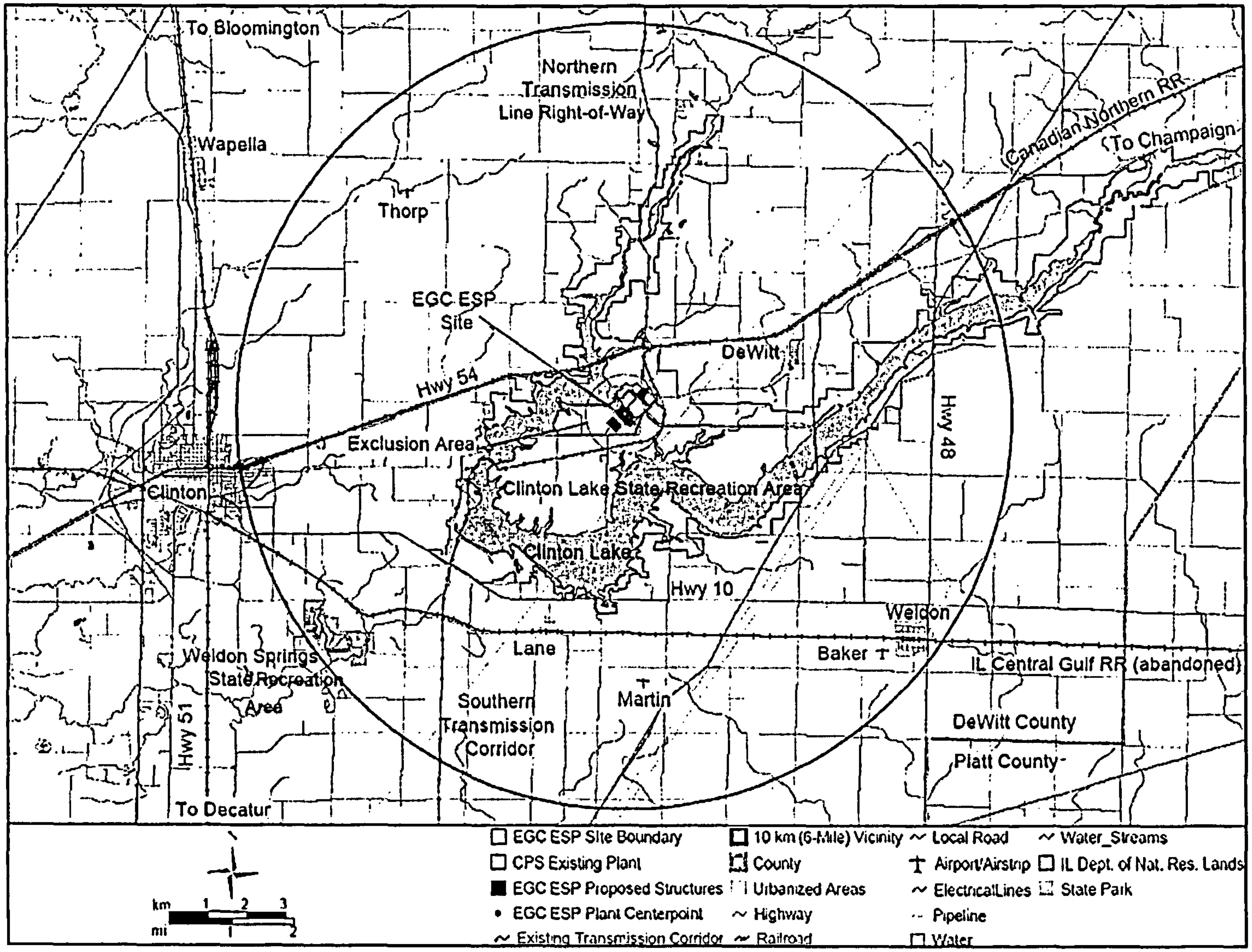

Figure 2-3. Exelon ESP 10-km (6-mi) Region

Exelon states that agreements between Exelon and AmerGen will be in place to ensure that Exelon has the necessary authority, control, and rights related to the proposed ESP site (Exelon 2003a).

Clinton Lake, an artificial reservoir, was created in 1977. The lake was filled by early 1978. The lake has a storage capacity of 9.15×10^7 m^3 (74,200 acre-ft) at normal pool elevation. Clinton Lake was created primarily as a source of cooling water for the CPS although it has become a popular recreation area, and the dam provides downstream flood control. The lake is used as a source of potable water for the CPS. AmerGen owns the land, above and below the surface, around the lake up to the expected 212-m (697-ft) high-water mark. Clinton Lake is managed by the Illinois Department of Natural Resources (IDNR). There were 972,616 visitors to the lake in 2000 (Exelon 2003a).

2.2 Land

This section discusses land-related issues for the Exelon ESP site. Section 2.2.1 describes the site and the vicinity around the site. Section 2.2.2 discusses the existing transmission line rights-of-way and offsite areas. Section 2.2.3 discusses the region, defined as the area within 80 km (50 mi) of the ESP site.

2.2.1 The Site and Vicinity

For purposes of this environmental impact statement (EIS), the Exelon ESP site refers to the area that will be directly affected by construction and operation of the new nuclear unit and includes all the land area within the ESP site boundary, or approximately 187 ha (461 ac). The vicinity includes all land within a 10-km (6-mi) radius of the proposed ESP site.

The Exelon ESP site is located in DeWitt County in central Illinois, just over 10 km (6 mi) east of the City of Clinton, the county seat of DeWitt County. The proposed site lies within the existing boundaries of the current CPS site. The new nuclear unit would be sited adjacent to the existing nuclear power station.

The Exelon ESP site is situated on a peninsula of Clinton Lake, between the Salt Creek North Fork arm and the Salt Creek arm. Clinton Lake was created when the Illinois Power Company erected a dam on the main stem of Salt Creek, just northwest of the community of Lane in 1977, and filled the lake in 1978. The earthen dam lies about 370 m (1200 ft) downstream from the confluence of Salt Creek and the Salt Creek North Fork, approximately 5 km (3 mi) to the southwest of the ESP site. Salt Creek flows southwesterly, joining the Sangamon River at a point about 85 km (53 mi) west of the site. At normal pool elevation of 210 m (690 ft), the lake covers 1981 ha (4895 ac) and extends up Salt Creek to about 19 km (12 mi) from the dam and up the Salt Creek North Fork about 11 km (7 mi) from the dam. Most of Clinton Lake's immediate shoreline is owned by AmerGen and managed by the IDNR as the Clinton Lake State Recreation Area. Figure 2-3 illustrates the geography of the site and vicinity.

Within the ESP site, 100 percent (187 ha [461 ac]) has been graded or otherwise developed for the operation of the existing nuclear power plant. Except for the CPS plant structures, there are no industrial, commercial, or institutional structures on the site. The ESP site in its entirety is zoned for transportation and industrial use. Except for the dam that was built across Salt Creek to create Clinton Lake, no structures have been built in the preconstruction 100-year floodplain of the ESP site. Several structures were built along the edges of the flood-prone area of the ESP site, including the intake and discharge structures, modified highway bridges, a marina, and seven boat ramps.

The closest communities to the ESP site include DeWitt, Lane, Weldon, and Clinton. DeWitt has a population of about 188 and is located nearly 5 km (3 mi) east of the ESP site. Lane has a population of 126 and is located just over 4.8 km (3 mi) south of the site. Weldon has a population of 440 and is located more than 8 km (5 mi) southeast of the site. The City of Clinton has a population of 7485, and is located more than 10 km (6 mi) west of the site. The nearest resident to the site is 1.2 km (0.73 mi) to the southwest. The nearest school is 7.7 km (4.8 mi) west of the site, the nearest church is 6.1 km (3.8 mi) south of the site, and the nearest campground is approximately 1.6 km (1 mi) west of the site (Exelon 2003a).

The ESP site vicinity is 84 percent agricultural land (24,622 ha [60,842 ac]). Industrial land use within the vicinity is less than 1 percent and is limited to areas near Clinton and Weldon. Less than 1 percent of land within the site vicinity is residential and consists primarily of residential areas in Clinton and Weldon (Exelon 2003a). There are no known significant mineral resources (e.g., sand and gravel, coal, oil, natural gas, and ores) in the vicinity of the ESP site (Exelon 2003a). Table 2-1 illustrates the land-use and land-cover characteristics of the site and vicinity.

Recreational areas are the only special land uses within the vicinity. They include the Clinton Lake State Recreation Area, the Moscoutin Recreation Site, and the Weldon Springs State Recreation Area. Clinton Lake State Recreation Area is 3760 ha (9300 ac), including the 1981-ha (4895-ac) Clinton Lake, and offers snowmobiling, ice fishing, ice skating, boating, fishing, water skiing, picnicking, camping, swimming, hiking, and hunting. Weldon Springs State Recreation Area encompasses approximately 150 ha (370 ac) and contains an 11-ha (28-ac) lake. Weldon Springs State Recreation Area offers facilities for fishing, picnicking, boating, and hiking during the summer, and sledding, tobogganing, ice fishing, and cross-country skiing during the winter.

Table 2-1. Land-Use Classification of the Exelon ESP Site and Vicinity, Region, and Potentially Affected Transmission Line Rights-of-Way[(a)]

	80-km (50-mi) Region		10-km (6-mi) Vicinity		Transmission Line Rights-of-Way	
Land-Use Class	Area, ha (ac)	Percent of Total	Area, ha (ac)	Percent of Total	Area, ha (ac)	Percent of Total
Agricultural	1,894,801 (4,682,136)	93.1	24,622 (60,842)	84.0	46.5 (1149)	87.8
Developed Nonresidential	10,524 (26,006)	0.5	63.9 (158)	0.2	2 (5)	0.4
Residential	27,470 (67,873)	1.3	66.8 (165)	0.2	0 (0)	0.0
Undeveloped	67,090 (165,782)	3.3	2433 (6012)	8.3	49.4 (122)	9.3
Water or Wetlands	35,117 (86,775)	1.7	2119 (5236)	7.2	13.4 (33)	2.5
Total Acreage	2,034,999 (5,028,571)		29,304 (72,411)		530 (1309)	

(a) U.S. Geological Survey land-cover classes have been aggregated for presentation purposes. Rounding may affect totals. The ESP site is 187 ha (461 ac) in size and is zoned for transportation and industrial use. Land covers vary within the site. Recreation areas are not a designated land-cover class and are not separated in this table (Vogelmann et al. 2001).

The topography of the vicinity is generally flat, even to the exclusion of hedgerows and forested tracts. Along the major drainage courses, however, the land is gently rolling to steeply sloped and usually forested. Elevations range from approximately 240 m (800 ft) above mean sea level (MSL) in the north-central portion of the vicinity to 210 m (690 ft) above MSL and 212 m (697 ft) above MSL along Clinton Lake (Exelon 2003a).

Figure 2-3 shows the transportation and utility networks, comprised of highways, rail lines, and utility rights-of-way, which cross the site and vicinity. Illinois Route 54 is approximately 1.6 km (1 mi) north of the ESP site. Illinois Route 10 is approximately 5 km (3 mi) south, and Illinois Route 48 is approximately 8 km (5 mi) east of the ESP site. As shown, access to the site is limited primarily by Illinois Route 54. The Canadian National Railroad runs parallel to Illinois Route 54 and traverses the vicinity approximately 1.6 km (1 mi) north of the ESP site. There are three private airports within the vicinity of the site: the Martin Airport is located approximately 6 km (4 mi) south of the site; the Thorp Airport is located approximately 8 km (5 mi) northwest of the site; the Baker Strip is located approximately 8 km (5 mi) southeast of the site.

The waterways within the vicinity include Clinton Lake, Salt Creek, the North Fork of Salt Creek, which branches off Clinton Lake, and Weldon Springs Lake. There is one canoe access area north of the site. In addition, there is one marina with boat access south of the site, and four boat access areas, one in each cardinal direction from the site. There are no known significant mineral resources (e.g., sand and gravel, coal, oil, natural gas, and ores) in the vicinity of the ESP site (Exelon 2003a).

In 1992, DeWitt County published a comprehensive plan to guide overall development in the area. Use of the ESP site for a new nuclear unit will not conflict with proposed zoning because the facility will be constructed within the existing CPS site, which is already designated for transportation and utilities. The plan states that DeWitt County should encourage new spin-off development or related expansion at the CPS site (University of Illinois 1992).

2.2.2 Transmission Line Rights-of-Way and Offsite Areas

The anticipated transmission line rights-of-way for the Exelon ESP facility are the existing rights-of-way used to transmit power generated from the CPS. The transmission line rights-of-way are comprised of two sections. Based on geographic information system (GIS) analysis, the northern section is approximately 37 km (23 mi) long with a width of 76 m (250 ft) (an area of 280 ha [700 ac]). The southern section is approximately 30 km (20 mi) long with a width of 76 m (250 ft) (an area of 246 ha [610 ac]). The northern section runs north of the ESP site, and then turns west and terminates at the Brokaw substation just west of Bloomington. The southern section runs southwest of the ESP site past Clinton Lake, and then turns south and terminates at the Oreana substation, just north of Decatur. Figures 2-2 and 2-3 show the transmission line rights-of-way that are anticipated to be upgraded. Table 2-1 describes the percentage and actual area devoted to the major land-use and land-cover classifications that were confirmed with a review of aerial photographs and onsite inspection. Section 3.3 describes the specific upgrades anticipated for the transmission line rights-of-way.

Recreation areas, including the Clinton Lake State Recreation Area, are the only special land uses along the transmission line rights-of-way. Clinton Lake State Recreation Area is 3760 ha (9300 ac), which includes the 1981-ha (4895-ac) Clinton Lake. The topography of the transmission line rights-of-way are generally flat. Along the major drainage courses, however, the land is gently rolling to steeply sloped and usually forested. Elevation ranges from approximately 270 m (900 ft) above MSL in the north-central portion of the transmission rights-of-way to 210 m (700 ft) above MSL near Clinton Lake.

Figure 2-2 shows the transportation network, including highways and rail lines that cross the transmission line rights-of-way. The highways that traverse the transmission line rights-of-way are U.S. Highway 150, Interstate 74, U.S. Highway 136, Illinois SR 54, and Illinois SR 10. The Norfolk Southern Railroad traverses the northern portion of the transmission line right-of-way.

The railroad also has a line that runs parallel to Interstate 74 and traverses the north-central portion of the transmission line rights-of-way. The Canadian National Railroad runs parallel to Illinois SR 54 and traverses the transmission line right-of-way approximately 1.6 km (1 mi) north of the ESP site. There are three private airports and one public airport within 2.4 km (1.5 mi) of the transmission line rights-of-way. The public airport is Bloomington-Normal Airport, located approximately 1.6 km (1 mi) west of the northern tip of the transmission line right-of-way. The private airports include the Martin Airport, and Thorp Airport, discussed previously in Section 2.1.

The waterways that the transmission line rights-of-way cross include Clinton Lake, Salt Creek, and North Fork Salt Creek. There is one canoe access area near the northern section of the transmission line right-of-way that crosses Salt Creek. The southern section of the transmission line right-of-way crosses Salt Creek below Clinton Lake Dam, near a recreation site on the creek. There are no known significant mineral resources (sand and gravel, coal oil, natural gas, or ores) within the transmission line rights-of-way (Exelon 2003a).

The comprehensive plan published in DeWitt County in 1992 (University of Illinois 1992) indicates that the transmission line rights-of-way do not conflict with any proposed zoning for the county. DeWitt County has designated an area approximately 1.6 km (1 mi) southwest of the CPS and Clinton Lake as a possible area for a new restaurant and a golf course. Bicycle and hiking trails are planned along the Canadian National Railroad. The transmission line rights-of-way would not interfere with the county's land-use plan because only existing rights-of-way are anticipated to be used for a new nuclear unit at the Clinton ESP site.

McLean County published a regional comprehensive plan in August 1999 (McLean County 1999). The transmission line rights-of-way would not conflict with any proposed zoning for the county. McLean County plans to make some improvements to the roads that either cross or are adjacent to the transmission line rights-of-way. The transmission line right-of-way would not interfere with the county's land-use plan because only an existing right-of-way is anticipated to be used for a new nuclear unit at the Clinton ESP site.

2.2.3 The Region

The region, defined as 80 km (50 mi) beyond the ESP site boundary, includes all or portions of the following counties in Illinois: Champaign, Christian, Coles, DeWitt, Douglas, Ford, Iroquois, Livingston, Logan, Macon, Mason, McLean, Menard, Moultrie, Piatt, Sangamon, Shelby, Tazewell, Vermilion, and Woodford. Major land-use classifications, waterways, recreation areas, highways, roads, railroads, and other transportation routes in the region are shown in Figure 2-2.

Regionally, the Exelon ESP site is approximately 82 km (51 mi) northeast of Springfield, Illinois, 48 km (30 mi) west of Champaign, Illinois, 35 km (22 mi) southeast of Bloomington, Illinois, and about 200 km (125 mi) south of Chicago, Illinois. The site is near the center of a triangle formed by the large Cities of Bloomington, Urbana, Champaign, and Springfield, Illinois. Interstates 74 and 72 pass within 18 km (11 mi) to the northwest and 19 km (12 mi) to the southwest of the site, respectively. Illinois SR 51 passes about 11 km (7 mi) west of the site. Figure 2-2 illustrates the extent of the region considered in this EIS.

Land use within the region varies with distance from major population centers and high-use transportation corridors. The metropolitan areas of Springfield, Bloomington-Normal, and Urbana-Champaign contain the highest density of residential, commercial, and industrial land use. Land use in the immediate vicinity of the ESP site and the areas outside the noted metropolitan areas and transportation corridors is primarily agricultural, with several small towns and communities. The region, comprising about 14.2 percent of the total area of Illinois, encompasses four main land-use classes (Exelon 2003a). Cropland covers the vast majority of the land area in the region, followed by urbanized areas, forested riparian areas, and park and recreation area reserves.

There are four airports with scheduled passenger air service within the region: Springfield Capital Airport, Decatur Airport, Central Illinois Regional Airport in Bloomington, and the University of Illinois-Willard Airport in Champaign. The Rantoul National Aviation Center - Frank Elliot Field, formerly the Chanute Air Force Base, lies about 61 km (38 mi) northwest of the ESP site.

Much of the region comes under the Illinois Governor's Office regional plan for the North-Central Region of the State, which covers DeWitt, Fulton, Livingston, Marshall, Mason, McLean, Peoria, Stark, Tazewell, and Woodford Counties. The Governor's "Opportunity Returns" plan for North Central Illinois (State of Illinois 2003) consists of five primary goals to address the economic and workforce development needs of the region: investing in entrepreneurship and innovation, improving transportation infrastructure, strengthening education and job training, investing in renewable energy and the environment, and encouraging investment and opening markets.

2.3 Meteorology and Air Quality

The following three sections describe the climate and air quality of the Exelon ESP site. Section 2.3.1 describes the climate of the region and area in the immediate vicinity of the ESP site. Section 2.3.2 describes the air quality in the region. Section 2.3.3 describes the meteorological monitoring program at the site.

2.3.1 Climate

The Exelon ESP site has a typical continental climate with moderately cold winters and warm summers. Air masses may approach the region from the south, west, or north. The closest first-order weather stations with long periods of record are Peoria, about 88 km (55 mi) northwest of the site, and Springfield, about 79 km (49 mi) west-southwest of the site. These stations provide a good indication of the general climate at the ESP site because of their proximity and similarities in topography and vegetation. The ESP site is relatively flat with no topographic features that would cause the local climate to deviate significantly from the regional climate.

The following climatological statistics are derived from local climatological data for Peoria and Springfield (NCDC 2004a, b). Temperatures are more variable in the winter than in the summer because of the differences in air mass source regions. Day time maximum temperatures range from about 0°C (32°F) in January to about 30°C (86°F) in July, while night time minimum temperatures range from about -9°C (16°F) in January to about 19°C (65°F) in July. Monthly average wind speeds range from about 3.5 m/s (8 mph) in the summer to about 5 m/s (12 mph) in the winter and early spring. Precipitation is rather uniformly distributed throughout the year with an average of 7.5 cm (3 in.) or more of rain falling each month from March through September. Snow generally occurs between November and March with the month of January having an average snowfall of about 20 cm (7.8 in.).

Relative humidity generally varies diurnally with a maximum in the early morning hours and a minimum in the afternoon. Regionally, the noon relative humidity ranges from about 70 percent in the winter to about 55 percent in the early spring and fall. During the summer, the noon relative humidity is about 60 percent. On about 20 days per year, the air becomes saturated and fog forms, which limits the visibility to less than 400 m (0.25 mi).

2.3.1.1 Wind

Regionally, the prevailing wind direction in all months is from the south, with wind speeds ranging from about 3.5 m/s (8 mph) during the summer to about 5 m/s (11 mph) in the winter and early spring (NCDC 2004a, b). Winds measured onsite by the CPS meteorological system from April 1972 through April 1977 and January 2000 through August 2002, indicate that the dominant wind directions at the site are from the south-southeast through northwest. During the winter months, the prevailing wind directions are west through northwest; during the remainder of the year, the predominant wind directions are south-southeast through southwest. Annual average wind speed for the site is about 4 m/s (9 mph) (Exelon 2003a).

Wind persistence at the site was evaluated using the 1972 through 1977 data. The maximum persistence period of 33 hours occurred twice. During one period, the wind was from the south-southwest, and during the other it was from the northeast (Exelon 2003a).

2.3.1.2 Atmospheric Stability

Atmospheric stability is a meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined by the difference in temperature between two heights. A seven-category atmospheric stability classification scheme based on temperature differences is set forth in Safety Guide 23 (AEC 1972). When the temperature decreases rapidly with increasing height, the atmosphere is unstable and atmospheric dispersion is good. In contrast, when the temperature increases with height, the atmosphere is stable and dispersion is limited.

Temperature difference measurements made on the CPS meteorological tower indicate that unstable atmospheric conditions exist at the site approximately 18 percent of the time, and stable conditions exist about 44 percent of the time (Exelon 2003a). During the remaining 34 percent of the time, the atmospheric stability is neutral, and atmospheric dispersion is moderate.

Comparison of the atmospheric stability distributions for the two measurement periods indicates that there may have been a shift in the distribution toward unstable conditions between the earlier period and the later period. It is unlikely that such a shift would be a natural occurrence. It is more likely that the lower level of the temperature difference measurement system may be affected by Clinton Lake, which is heated by the cooling water from the CPS. Clinton Lake was not created until 1977, and it was not heated until 1987.

2.3.1.3 Temperature

The temperature measured at the 10-m (33 ft) level of the CPS meteorological tower is considered to be representative of the ESP site. Temperature data from the tower for the 1972 through 1977 time period show the daily average temperature ranges from a low of -5.1°C (23°F) in January to a high of 23.6°C (74.5°F) in July. During this 5-year period, the absolute minimum temperature was -28.8°C (-19.8°F), and the absolute maximum temperature was 35.2°C (95.4°F). These temperatures are consistent with long-term values for Peoria and Springfield.

2.3.1.4 Atmospheric Moisture

The moisture content of the atmosphere can be represented in a variety of ways. The most common are relative humidity, precipitation, and fog. Precipitation is measured at the CPS site, but relative humidity and fog are not.

During the 1972 through 1977 period, the annual average precipitation at the CPS was about 65 cm (25.5 in.), with monthly averages ranging from about 3.0 cm (1.2 in.) in February to about 10.7 cm (4.2 in.) in June. These values are consistent with averages for Springfield. Precipitation was recorded for about 4 percent of the hours. The maximum number of consecutive hours with precipitation was 14, and the maximum number of consecutive hours without precipitation was 807.

The CPS meteorological system does not measure relative humidity, but it does measure the dew point temperature. The dew point temperature is the temperature at which air becomes saturated when it is cooled, i.e., the relative humidity becomes 100 percent when air is cooled to the dew point. The ambient temperature and dew point temperature can be used in the design of wet cooling systems, and the difference between the temperature and dew point can be used to predict the occurrence of fog.

Climatological records at Peoria and Springfield indicate that fog occurs on an average of two to three times per month from November through March and on an average of about one day per month for the remainder of the year. These records are representative of the conditions in Dewitt County. However, they may not be representative of conditions in the immediate vicinity of the site. The site is surrounded by Clinton Lake, which is heated by the existing CPS. The potential effects on fog from the heated water in the lake and in the flume leading from the CPS to the lake have been analytically estimated (AmerGen 2001c). Based on the analytical model, several hundred hours of fog are expected on roads in the vicinity of the site, but this fog is not expected to extend beyond about 1.6 km (1 mi) from the lake, and icing on roads is not expected to extend more than 150 m (500 ft) from the lake.

2.3.1.5 Severe Weather

The site can experience severe weather in the form of thunderstorms, hail, tornadoes, and snow and ice. Thunderstorms occur on about 47 days per year with an average of more than five thunderstorm days per month from April through August. Over the last 10 years, DeWitt County, which includes the Exelon ESP site as well as Macon and McLean Counties, has averaged more than one hail storm with hail size of at least 1.9 cm (0.75 in.) per year (NCDC 2004c).

From 1950 through 2003, 18 tornadoes were reported in DeWitt County (NCDC 2004c), including one magnitude F4 tornado (wind speed between 92 and 116 m/s [207 and 260 mph]). Using tornado data for the period from January 1, 1950, through August 31, 2003, the best estimate tornado strike probability and 10^{-7} probability design wind speed for the Exelon ESP site are 1.2×10^{-3} per year and 134 m/s (300 mph), respectively (Ramsdell 2004).

The average snowfall in the area is about 64 cm (25 in.) with most of the snow falling in December, January, and February. About twice each winter, there is a heavy snow storm, ice storm, or other winter storm of note (NCDC 2004c). These storms generally cover much of central Illinois.

2.3.2 Air Quality

The Exelon ESP site is in DeWitt County, Illinois, which is on the western edge of the East Central Illinois Intrastate Air Quality Control Region (AQCR). The West Central Illinois Intrastate AQCR lies to the south and west of DeWitt County, and the Burlington-Keokuk Interstate AQCR lies northwest of DeWitt County. All of the counties in these AQCRs near the ESP site are in compliance with the National Ambient Air Quality Standards (40 CFR 81.314). In attainment areas, the ambient air quality levels are better than designated by the Environmental Protection Agency (EPA). There are no mandatory Class 1 Federal Areas where visibility is an important value in Illinois or Indiana within 160 km (100 mi) of the ESP site.

The Illinois Environmental Protection Agency (IEPA) operates a statewide air-monitoring network comprising 41 sites. However, none of the monitoring stations is in DeWitt County. The closest monitoring stations are in Normal and Decatur, and slightly more distant stations are located in the Peoria, Springfield, and Champaign-Urbana areas. Results of monitoring at these locations show that there were no days on which the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, and particulate matter were exceeded (IEPA 2003). Similarly, there were no days on which the new 1-hour ozone standard was exceeded. However, the 8-hour ozone standard was exceeded on 4 days each at the Normal and Decatur monitoring locations, on 1 day in the Champaign-Urbana area, and on 2 days in the Peoria area.

Statewide monitoring data for the last 10 years indicate that the air quality in 2002 was generally consistent with air quality in recent years (IEPA 2003). Where air quality trends appear to exist, they indicate that air quality in Illinois is improving.

The Air Quality Index (AQI) is a national standard method for reporting air-pollution levels for the general public. The AQI is based on comparison of the concentrations of six pollutants with National Ambient Air Quality Standards. The six pollutants are ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter smaller than 10 micrometers (PM_{10}), and particulate matter smaller than 2.5 micrometers ($PM_{2.5}$). The air-pollution level for each day is placed in one of six categories based on the AQI. In order of decreasing air quality, the categories are Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, Very Unhealthy, and Hazardous.

According to the IEPA (IEPA 2003), there were no days in 2002 in which the air quality was classified as Unhealthy in the vicinity of DeWitt County. The air quality was classified as Unhealthy for Sensitive Groups on 5 days in the Bloomington-Normal area, 4 days in Decatur, 3 days in Peoria, and 1 day in the Urbana-Champaign area. For the remainder of the time, the air quality was classified as Good or Moderate, with Good days far outnumbering Moderate days.

All of the areas for which there are monitoring data and AQIs are more densely populated than DeWitt County and the area around the ESP site. Consequently, air quality at the site should be better than indicated by the monitoring data and AQIs.

2.3.3 Meteorological Monitoring

There has been a meteorological monitoring program at the Exelon ESP site since April 1972. The initial instrumentation was installed to provide the onsite meteorological information required for licensing of the CPS. It has continued in operation in support of the CPS. The instrumentation is described briefly in the CPS Final Environmental Statement (AEC 1974), in more detail in the CPS Updated Safety Analysis Report (AmerGen 2001c), and in the ER for the ESP site (Exelon 2003a).

The meteorological monitoring system consists of a 60-m (199-ft) tower located approximately 550 m (1800 ft) south-southeast of the center of the ESP power block footprint, meteorological instrumentation located on and near the tower, and signal conditioning and recording equipment. Wind, temperature (or temperature difference), and dew point are measured at the 10- and 60-m (33- and 199-ft) levels of the tower. Precipitation is measured at ground level near the base of the tower. Data from the instruments were initially recorded on strip charts and then manually transferred to punch cards. Data are now recorded on strip charts in the control room and fed to a microprocessor that records the data electronically. Backup wind instruments are located at the 10-m (33-ft) level of a microwave tower about 1160 m (3800 ft) north of the center of the ESP power block footprint.

Instruments and other components of the meteorological system have been replaced periodically over the years, but the basic meteorological system has remained essentially the same as the system installed in 1972. A major upgrade of the system is planned for the near future.

Atmospheric dispersion factors (χ/Q values) are used to evaluate the potential consequences of routine and accidental releases at the ESP site. Meteorological data of the period from January 2000 through August 2002 were used to develop atmospheric dispersion factors for comparison with the atmospheric data Exelon presented in its ER. Exelon (Exelon 2003a) provided the staff with meteorological data for the full 3-year period from January 2000 through December 2003. The staff used these data to estimate the atmospheric dispersion factor for comparison with those presented in the ER.

The staff viewed the meteorological site and instrumentation, reviewed the available information on the meteorological measurement program, and evaluated data collected by the program. Based on this information, the staff concludes that the program provides data that represent the onsite meteorological conditions as required by 10 CFR 100.20. The data also provide an acceptable basis for making estimates of atmospheric dispersion for the evaluation of the consequences of routine and accidental releases required by 10 CFR 50.34 and 10 CFR Part 50, Appendix I.

2.4 Geology

A detailed description of the geological, seismological, and geotechnical conditions at the proposed site is provided in the Site Safety Analysis Report (SSAR) (Exelon 2003b). A brief summary of the geology of the proposed ESP site is provided in Section 2.6 of the ER submitted by Exelon (Exelon 2003a). This description was based in part on earlier reports prepared for the existing units at the site. Additionally, results of subsurface investigations performed recently as part of the ESP application provided further basis for this description. The staff's description of the site and vicinity geological features and the detailed analyses and evaluation of geological, seismological, and geotechnical data as required for an assessment of the site-safety issues related to the specific proposed ESP site will be included in the staff's safety evaluation report.

The Exelon ESP site lies within the Central Lowlands Physiographic Province (Lloyd and Lyke 1995), which is characterized by a low-relief surface formed by glacial till, outwash plains, and glacial lake plains. The glacial materials overlay consolidated Paleozoic-age materials throughout most of the Province.

Groundwater aquifers in the region of the ESP site are described by Exelon in Section 2.3.1.2 of its ER (Exelon 2003a). Aquifers in the Central Lowlands Province occur in unconsolidated sand and gravel of the Quaternary age and consolidated sandstone, limestone, and dolomite of the Paleozoic age. At the ESP site, alluvium along the floodplains overlays glacial drift deposits. Based on Exelon's borings at the site location, the glacial drift is generally more than 61 m (200 ft) thick beneath the site.

The Illinois State Geologic Survey identified the Parnell and Wapella E. oil fields in the vicinity of the proposed site but none beneath it. No known mining activities would likely be precluded from the granting of an ESP.

Geotechnical properties of the glacial material beneath the site would be unsuitable for use as a fill material for plant construction. Therefore, fill material would need to be imported to the ESP site during construction and excavated material would have to be removed to another location, either on or off the site. Assuming best management construction practices would be employed, the low-relief terrain and geotechnical properties of the surficial materials make significant landslides in the region of the site unlikely.

2.5 Radiological Environment

A radiological environmental monitoring program (REMP) has been conducted around the CPS site since 1980 (AmerGen 2000a). The REMP includes the following pathways: direct radiation, atmospheric, aquatic, and terrestrial environments, and ground and surface water. A pre-operational environmental operating program was conducted from 1980 to 1987 to establish a baseline to observe fluctuations of radioactivity in the environment after operations began. After routine operation of Unit 1 started in 1987, the monitoring program continued to assess the radiological impacts to workers, the public, and the environment. The results of this monitoring are documented in an annual environmental operating report for CPS. The U.S. Nuclear Regulatory Commission (NRC) staff reviewed historical data from the REMP reports for the past 4 years and found that environmental measurements of this time period were similar to those during the preoperational monitoring phase (AmerGen 2000a, 2001b, 2002b, 2003).

Each year, AmerGen issues a report entitled *Annual Radioactive Effluent Release Report for the Clinton Power Station*, which documents gaseous and liquid releases and resulting doses from the CPS. The NRC staff reviewed annual radioactive effluent release reports for calendar years 1999, 2000, and 2001 (AmerGen 2000b, 2001a, 2002a). Maximum doses to a member of the public were calculated using effluent concentration and historical meteorological data for the site. For the 3 years reviewed, the maximum annual dose to a member of the public was less than 3×10^{-5} mSv (less than 0.003 mrem). The data showed that doses to the maximally exposed individuals around CPS were a small fraction of the limits specified in Federal environmental radiation standards, 10 CFR Part 20; 10 CFR Part 50, Appendix I; and 40 CFR Part 190.

2.6 Water

This section describes the hydrologic features and processes governing movement and distribution of water in the existing environment at the Exelon ESP site. Two circumstances were considered: (1) the existing unit in operation and (2) the existing unit not in operation. The most limiting of circumstances is the existing environment with the current unit in operation, and, unless mentioned otherwise, it is this scenario that is used throughout this analysis.

2.6.1 Hydrology

This section describes site-specific and regional hydrological features of the existing environment that could be altered by construction, operation, or decommissioning of a new nuclear unit at the ESP site. A description of the site's hydrological features is presented in Section 2.3.1 of the ER (Exelon 2003a). Hydrological features of the site related to site safety (e.g., probable maximum flood) are described in the SSAR portion of the application.

2.6.1.1 Surface-Water Hydrology

The dominant hydrological feature of the Exelon ESP site is Clinton Lake. The site is located between the two main arms of Clinton Lake, which was created by impounding Salt Creek and the North Fork of Salt Creek behind a dam 370 m (1200 ft) downstream from the historical confluence of the two streams. The pool formed behind Clinton Lake Dam has a volume of 9.15×10^7 m^3 (74,200 acre-ft) at the normal pool level elevation of 210 m (690 ft) above MSL. The normal pool level is the height of the crest of the service spillway. An additional 7.29×10^7 m^3 (59,100 acre-ft) are available for flood-control storage up to the crest of the auxiliary spillway at elevation 213 m (700 ft) above MSL. Two small gates near the service spillway are able to provide small releases to maintain minimum downstream flows.

The lake has two arms with the dam at the western end of the lake. The Salt Creek arm is larger than the North Fork of the Salt Creek arm. The existing CPS and the ESP site are located on the peninsula between the two arms. The CPS plant withdraws cooling water from the North Fork arm and returns it to Salt Creek arm. This results in a circulation between the two locations whenever the inflow into the North Fork arm is less than the intake demands for the CPS unit's once-through cooling system. The surface area of the lake is 1981 ha (4895 ac) at normal pool elevation.

The watershed above Clinton Lake drains 476 km^2 (296 mi^2) of predominately agricultural fields with very little relief. Water released from Clinton Lake Dam continues to flow down Salt Creek until it joins the Sagamon River. Pursuant to the CPS National Pollutant Discharge Elimination System (NPDES) permit, IEPA currently requires a minimum release of 0.14 m^3/s (5 cfs) from the Clinton Lake Dam.

Evaporation from the large surface area of Clinton Lake reduces the total amount of water available to flow downstream of the dam. The average annual evaporation reported by Roberts and Stall (1967) for reservoirs in nearby Peoria and Springfield is 90.68 and 90.623 cm (35.70 and 35.68 in.), respectively. The maximum monthly average evaporation for these two locations occurs in July with monthly evaporation values of 16.28 and 16.13 cm (6.41 and 6.35 in.), respectively. The minimum monthly average evaporation for these two locations occurs in January with monthly evaporation values of 1.12 cm and 1.22 cm (0.44 and 0.48 in.), respectively. In addition to this natural evaporation, induced evaporation results from heat added to the waters of Clinton Lake from the once-through heat dissipation system of the existing CPS unit. These two components (presence of the lake plus reject reactor heat) combine to produce evaporation rates that likely exceed the historical pre-impoundment evapotranspiration rates that would have occurred in the area that the lake has inundated. Therefore, the presence of the lake and the discharge of heat to the lake from the existing CPS unit have increased evaporation and reduced the total quantity of water available for release downstream of the dam. It should be noted, however, that the dam provides a beneficial flow stabilization impact, and historical pre-dam minimum flows were less than the current post-dam minimum discharges released from the dam, frequently less than 0.14 m^3/s (5 cfs) during dry summer months.

In an average year at the site, precipitation approximately equals natural evaporation. Mean annual precipitation for Peoria, Illinois, is reported as 89 cm (35 in.) (van der Leeden et al. 1990). However, in drought years, the decrease in precipitation is often paired with an increase in evaporation resulting in significant water deficits.

Seasonal patterns of precipitation and evaporation also impact water availability. While July is the month of maximum precipitation, 10.13 cm (3.99 in.), the natural evaporation in July is significantly greater, 16.28 cm (6.41 in.). On a monthly average basis, natural evaporation exceeds precipitation in May through August.

2.6.1.2 Groundwater Hydrology

The groundwater aquifers in the region of the ESP site are described in Section 2.3.1.2 of the ER (Exelon 2003a). The ESP site lies within the Central Lowlands Physiographic Province. Aquifers in the Central Lowlands occur in unconsolidated sand and gravel of the Quaternary age and consolidated sandstone, limestone, and dolomite of the Paleozoic age. At the ESP site, alluvium along the floodplains overlays glacial drift deposits. Based on Exelon's borings at the site location, the glacial drift is generally more than 61 m (200 ft) thick beneath the site. Exelon reports that a test well completed during the planning stage for the existing plant had high methane levels dissolved in the gas. Based on the methane issue and the availability of surface water from Clinton Lake, it was decided not to use groundwater for the existing plant.

The hydraulic connection between Clinton Lake and nearby aquifers results in a rise of the water table for those aquifers in proximity to the lake. Given the relatively small fluctuations of lake water surface elevation, it is not expected that the water table in these aquifers would vary significantly. No aquifers in Illinois have been designated as sole-source aquifers (EPA 2004).

2.6.1.3 Hydrological Monitoring

This section describes the pre-application hydrological monitoring programs. Thermal and chemical monitoring programs are discussed in Sections 2.6.3.3 and 2.6.3.4, respectively.

As a result of ongoing monitoring associated with the existing CPS unit, Exelon was able to consider the information from this existing monitoring program as part of the pre-application monitoring program for the ESP site. Many of these same monitoring activities would likely be continued if the ESP unit was constructed and would become part of the construction and operational monitoring for a new nuclear unit. Exelon collects flow measurements directly associated with current site operation that are required under the terms of the Exelon's existing NPDES permit. Exelon proposes to: (1) augment its groundwater and aquifer characterization program performed before construction of the CPS unit, (2) continue its ongoing groundwater monitoring program related to the CPS Operating License, and (3) continue its recent subsurface investigations conducted in 2002 with additional piezometers and test wells to more accurately assess the impact of plant construction and operation on local groundwater users.

Since 1942, the U.S. Geological Survey has maintained a streamflow gauge downstream of Clinton Lake at Rowell, Illinois. There are no streamflow gauges upstream of Clinton Lake. Because of the absence of inflow data, it is not possible to create a reliable water budget for Clinton Lake directly from inflow and discharge measurements.

No water velocity measurements within Clinton Lake have been reported by Exelon. Velocity measurements are important both for understanding the hydrodynamics of the lake and calibrating numerical models of fluid and heat transport process in the lake. The lack of these measurements limits detailed process modeling of lake temperature and elevation levels. Exelon has committed to collecting current velocity measurements concurrently with monthly thermal and chemical monitoring. These measurements would become part of the Exelon's pre-application (referring to the construction permit [CP] or combined operating license [COL] application) monitoring program (Exelon 2003a). Exelon has also committed to collect bathymetric transects of the lake and record daily lake pool elevation and discharge data at the dam as part of this pre-application monitoring program.

2.6.2 Water Use

Consideration of water use requires estimating the magnitude and timing of consumptive and non-consumptive water use. Non-consumptive water use does not result in a reduction in the water supply available. For instance, water used to rinse fish impinged on intake screens off the screens would result in no change in the water supply, as the same volume of water pumped from the lake would eventually be returned to the lake. However, consumptive water use results in a reduction of the water supply available. For instance, lake evaporation results in a transfer of water from the lake to the atmosphere, thereby reducing the lake volume. The following two sections describe existing consumptive and non-consumptive uses of surface water and groundwater.

2.6.2.1 Surface-Water Use

The existing CPS plant is the only significant consumptive and non-consumptive water user of Clinton Lake. When the CPS unit is operating, pumps draw water from Clinton Lake at a rate of 35,700 L/s (566,000 gpm). However, most of the CPS water usage is non-consumptive. The large volume of water withdrawn from Clinton Lake for condenser cooling is entirely returned to the lake. While there is no consumptive use of water between intake and discharge, the elevated temperature of the discharged water does result in some additional induced evaporative losses from Clinton Lake.

In Section 2.3 of its ER, Exelon identified no domestic surface-water users either upstream or downstream from Clinton Lake other than the CPS unit. Clinton Lake was constructed as a cooling water source for the original two proposed CPS units.

Increases in urban development generally result in increased areas of impervious surface. Impervious surface results in less groundwater recharge and higher fractions of surface water runoff. Due to the limited projected development in the upstream drainage and policies promoting the use of storm water management practices that limit the impact of impervious surfaces, upstream land-use changes are not expected to appreciably alter the patterns of inflow to Clinton Lake.

2.6.2.2 Groundwater Use

Exelon describes groundwater use in the vicinity of the ESP site in Section 2.3.2.3 of the ER (Exelon 2003a). Groundwater is used for public water supplies and agricultural demands throughout the vicinity. Exelon reports that 65 percent of the total public groundwater supplies within a 24-km (15-mi) radius of the ESP site are pumped from the Mahomet Bedrock Valley aquifer. The remaining wells, except for wells at Heyworth, which pumps from alluvial deposits, are pumped from glacial deposits.

2.6.3 Water Quality

The following sections describe the water quality of surface-water and groundwater resources in the vicinity of the ESP site. Pre-application monitoring programs for thermal and chemical water quality are also described.

2.6.3.1 Surface-Water Quality

This section describes the surface-water quality of Clinton Lake, the tributaries draining into Clinton Lake, and Salt Creek downstream of the lake. Exelon presents a discussion of the water quality conditions in Sections 2.3.3.1 and 2.3.3.2 of the ER (Exelon 2003a). The thermal load discharged into the lake from the existing CPS unit results in localized elevated temperatures in the lake. These elevated temperatures are the most significant water quality concern associated with the existing unit. Operational impacts of a new nuclear unit on Clinton Lake water quality are discussed in Section 5.2.2 of this EIS. Monitoring programs for thermal and chemical water quality are discussed in Sections 2.6.3.3 and 2.6.3.4, respectively.

Clinton Lake, a stream reach upstream of Clinton Lake, and several downstream reaches are on the Draft Illinois 2004 Section 303(d) List as impaired for one or more of the following attributes: excess algal growth, metals, fecal coliform, dissolved oxygen, organics, and loss of habitat. The only upstream impairment was a loss of habitat with no listed source of the impairment. Fecal coliform is noted at several downstream reaches with no listed source of impairment. Excess algal growth and metals impairments were listed for Clinton Lake. The existing CPS unit has a NPDES permit from the IEPA. Before a new nuclear unit could begin to operate, Exelon would be required to obtain a NPDES permit for the discharge.

2.6.3.2 Groundwater Quality

Groundwater quality is discussed in Section 2.3.3.3 of the ER (Exelon 2003a); however, there are no site-specific data available for the chemistry of groundwater underlying the ESP site. Groundwater samples from the Mahomet Aquifer collected in 1974 at the CPS test well were similar to groundwater samples taken by the Illinois State Water Survey in 2000 from five locations within the Mahomet Aquifer. Pursuant to 10 CFR 100.20(c)(3), site-specific groundwater chemistry data would be required in a CP or COL application.

2.6.3.3 Thermal Monitoring

This section describes pre-application and pre-operational thermal monitoring programs. As a result of ongoing monitoring associated with the existing CPS unit, Exelon is able to consider this existing monitoring program as part of the pre-application and pre-operational monitoring program at the ESP site. Many of these same monitoring activities would be continued if the ESP unit were completed and would become part of the operational monitoring for the ESP unit. In Section 6.1 of its ER, Exelon describes the lake temperature measurements directly associated with the current site operation that are required under the terms of its existing NPDES permit (Exelon 2003a). Clinton Lake is also part of the IEPA Bureau of Water's ambient lake program. Additionally, thermal lake data is collected as part of the environmental monitoring program for the CPS (BOW 2004).

Baseline data were collected at the Rowell gauge before construction of the dam and after its completion. The Illinois State Geologic Survey has continued to monitor temperatures at the Rowell gauge downstream of Clinton Lake after the CPS Unit 1 went online. The IEPA monitors temperatures as part of its ambient lake program. Additionally, the operator of the existing CPS unit is required to sample temperatures within the discharge plume and approximately 30 m (100 ft) downstream of the dam. In addition to the existing CPS monitoring locations, Exelon proposes two new sampling locations to better understand the temperature of the inflow coming into the lake and the temperature of flow before being discharged from the dam.

2.6.3.4 Chemical Monitoring

This section describes the pre-application and operational chemical monitoring programs. As a result of ongoing monitoring associated with the existing CPS Unit 1, Exelon is able to consider this operational monitoring program as part of the pre-application and pre-operational monitoring program for the ESP site. Many of these same monitoring activities would be continued if the ESP unit was completed and would likely become part of the operational monitoring. In Section 6.6 of its ER, Exelon describes the chemical monitoring that is required under the terms of the existing NPDES permit (Exelon 2003a).

The CPS NPDES permit establishes chemical discharge limits at a variety of locations internal to the CPS facility and at the discharge flume. Chemical monitoring of a variety of constituents is required, including pH, chloride, mercury, nitrate, suspended solids, and dissolved oxygen.

2.7 Ecology

All of the Exelon ESP site has been graded or otherwise developed for operation of the existing CPS. Consequently, most of the area proposed for construction of a new nuclear unit at the ESP site (including permanent structures and laydown areas) consists of weedy habitats, cleared areas, impervious surfaces, existing structures, dirt roads, etc. A small amount of forest habitat is located within the footprint of the power block, and the area designated for the new intake structure is forested. There are four minor herbaceous wetlands (less than 0.4 ha [1 ac]) within the ESP site boundary, but none of these would be located within the footprint of a new nuclear unit. Generally, wildlife species found on the ESP site are representative of those commonly found in the central Illinois region.

Sections 2.7.1 through 2.7.6 provide general descriptions of terrestrial and aquatic environments near the ESP site. They provide detailed descriptions, where needed, to support the analysis of potential environmental impacts of construction, operation, and decommissioning of a new nuclear unit. The descriptions are provided to support mitigation activities identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts. Descriptions are also provided to facilitate comparison of the alternatives to the ESP site. Also included are descriptions of monitoring programs for terrestrial and aquatic environments.

2.7.1 Terrestrial Ecology

The ESP site is located in the Central Cornbelt Plains ecoregion (Omernik 1987). This ecoregion consists of glaciated plains that were once dominated by extensive prairie communities intermixed with oak-hickory forests. Farms are now extensive over the ecoregion where native prairie remains. Land use surrounding the ESP site consists primarily of a patchwork of agricultural fields and pasture.

2.7.1.1 Terrestrial Communities of the Exelon ESP Site

Vegetation

A variety of vegetation communities in various stages of ecological succession can be found near the vicinity of the ESP site (Figure 2-4) and along the transmission line rights-of-way. Agriculture (including hay, row crops, and small grains) is the predominant land use within 10 km (6 mi) of the site. Open lands that are not used for active agricultural purposes are commonly used as pasture. Herbaceous plant species commonly found in upland pasture and open field habitats include common ragweed (*Ambrosia artemisiifolia*), Kentucky bluegrass (*Poa pratensis*), red sorrel (*Rumex acetosella*), Japanese brome (*Bromus japonicus*), timothy (*Phleum pratense*), and common yarrow (*Achillea millefolium*). Shrub species include multiflora rose (*Rosa multiflora*), blackberry (*Rubus* spp.), and hawthorn (*Crataegus* spp.). Open field habitats dominate the landscape at and adjacent to the ESP site (Exelon 2003a).

Upland forest communities in the vicinity of the ESP site harbor overstory and herbaceous species that are common and typical of the region. Herbaceous species include multiflora rose, may apple (*Podophyllum peltatum*), trillium (*Trillium* spp.), goldenrod (Solidago spp.), aster (members of the family asteraceae), and Jack-in-the-pulpit (*Arisaema triphyllum*). Overstory species include several species of oak (*Quercus* spp.) and elm (*Ulmus* spp.), black cherry (*Prunus serotina*), shagbark hickory (*Carya ovata*), black walnut (*Juglans nigra*), hackberry (*Celtis* spp.), honeylocust (*Gleditsia triacanthos*), and red mulberry (*Morus rubra*) (Exelon 2003a).

Herbaceous wetlands are located within 10 km (6 mi) of the Exelon ESP site. Three 100-year floodplain areas containing forest, emergent, and scrub-shrub communities are also located within 10 km (6 mi) of the site and along the transmission line rights-of-way. These generally are associated with small tributaries of Salt Creek and the North Fork of Salt Creek. Tree

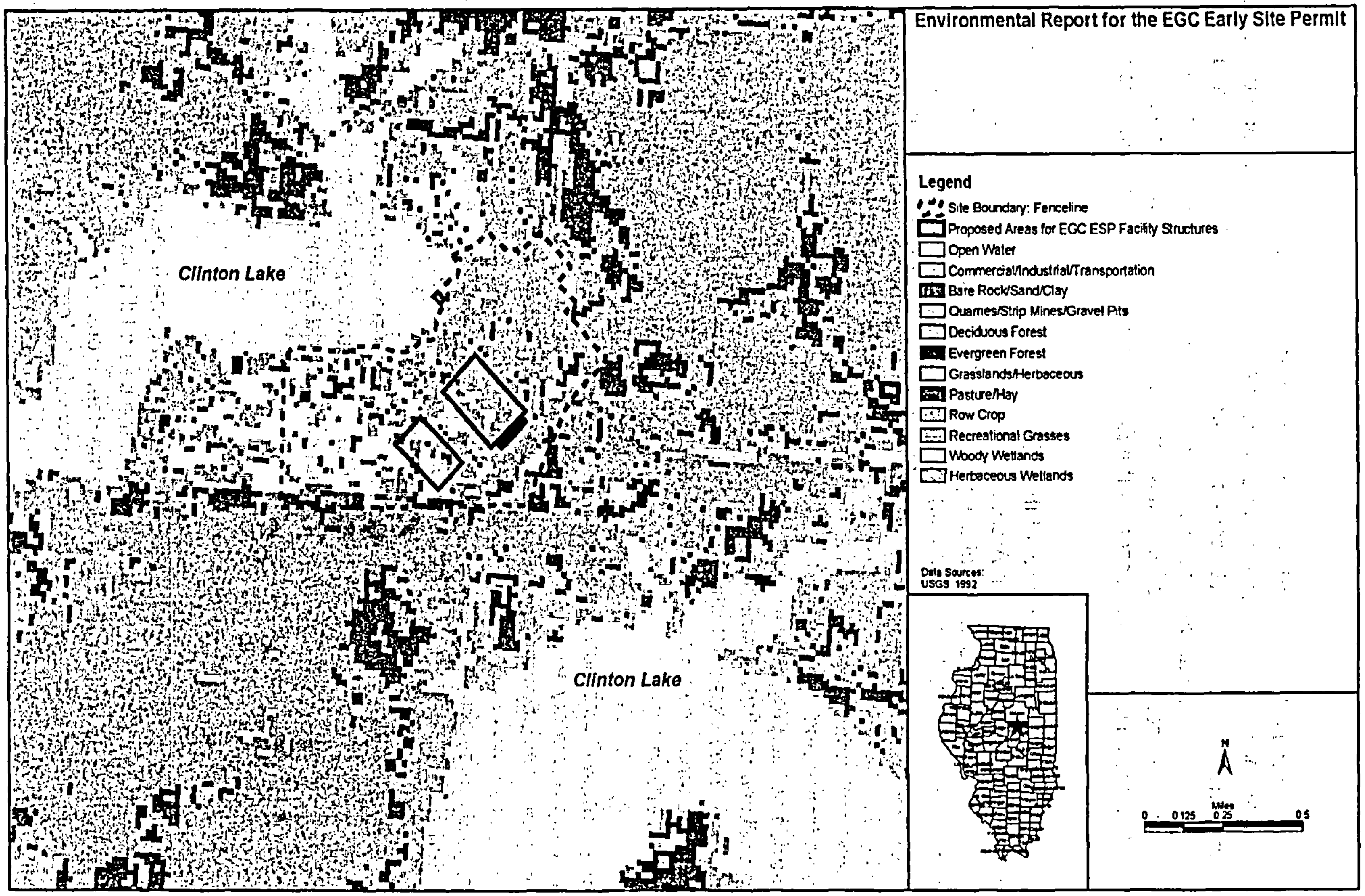

Figure 2-4. Land Use/Land Cover in the Vicinity of the Exelon ESP Site (Exelon 2003a)

species commonly found within wetland and floodplain forests include hackberry, elm, black walnut, silver maple (*Acer saccharinum*), and box elder (*Acer negundo*). Common understory species include Canadian woodnettle (*Laportea canadensis*), avens (*Geum* spp.), and beggarticks (*Bidens* spp.). Invasive perennial weeds, including purple loosestrife (*Lythrum salicaria*) and cutleaf teasel (*Dipsacus laciniatus*), are becoming increasingly more common in wet areas. Cutleaf teasel is known to occur on the ESP site near the existing facilities (Exelon 2003a).

Important terrestrial habitats in the vicinity of the ESP site include Clinton Lake State Recreation Area, Weldon Springs State Recreation Area, and wetlands recognized in the National Wetlands Inventory database. Clinton Lake is part of the Clinton Lake State Recreation Area, consisting of approximately 3760 ha (9300 ac), operated by the IDNR since 1978 via a long-term lease with AmerGen. Major habitat types of the Clinton Lake State Recreation Area include forest (38 percent of the area), grassland (32 percent), shrubs (21 percent), cropland (6 percent), and wetlands (3 percent). In addition, there are several habitats, including wet meadows, pine forest, and a marsh, that are important for a variety of birds (Exelon 2003a). The IDNR carries out its programs to improve wildlife habitat (e.g., planting warm season grasses and cool season brood habitat for northern bobwhite [*Colinus virginianus*] and ring-necked pheasant [*Phasianus colchicus*], planting food plots, tree planting, mowing, chemical brush control, maintenance of wood duck nest boxes, etc.) within the recreation area with the permission of AmerGen.

Weldon Springs State Recreation Area is a 150-ha (370-ac) park located southeast of the City of Clinton and approximately 10 km (6 mi) from the ESP site. Woodlands in the recreation area are vegetated predominantly with a variety of oak, hickory (*Carya* spp.), maple (*Acer* spp.), ash (*Fraxinus* spp.), black walnut, sweetgum (*Liquidambar styraciflua*), sycamore (*Platanus occidentalis*), and honeylocust. Wetlands include lake, pond, and stream habitats, in addition to marsh, forested wetland, and riparian areas (Exelon 2003a).

According to the National Wetland Inventory database, there are four minor herbaceous wetlands (less than 0.4 ha [1 ac]) within the Exelon ESP site boundary (see Figure 2-4). These generally consist of open water in association with constructed sediment basins and have palustrine unconsolidated bottoms (Exelon 2003a).

Wildlife

Wildlife species found in the vicinity of the ESP site and along the transmission line rights-of-way are representative of those commonly found in the central Illinois region. A number of mammal species have been identified, including the deer mouse (*Peromyscus maniculatus*), white-footed mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), various shrew species (including shorttail and least shrews [*Blarina brevicauda* and *Cryptotis parva*, respectively]), white-tailed deer (*Odocoileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), beaver (*Castor canadensis*), coyote (*Canis latrans*), fox (*Vulpes fulva* or *Urocyon cinereoargenteus*), muskrat (*Ondatra zibethica*), opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), mink (*Mustela vison*), and thirteen-lined ground squirrel (*Citellus tridecemlineatus*). Wildlife diversity is highest in the forest communities (Exelon 2003a).

Habitats located in the vicinity of the ESP site and along the transmission line rights-of-way are suitable for a variety of migrating songbirds, shorebirds, waterfowl, and raptors. Ninety-six avian species have been identified in the vicinity during spring and fall. Of the 96 species, 36 are summer residents, 29 are migratory, 28 are permanent residents, and 3 are winter residents (Exelon 2003a).

Common terrestrial bird species include red-winged blackbird (*Agelaius phoeniceus*), common grackle (*Quiscalus quiscula*), northern cardinal (*Cardinalis cardinalis*), redheaded woodpecker (*Melanerpes erythrocephalus*), various species of sparrows, dark-eyed junco (*Junco hyemalis*), black-capped chickadee (*Poecile atricapilla*), blue jay (*Cyanocitta cristata*), mourning dove (*Zenaida macroura*), northern flicker (*Colaptes auratus*), downy woodpecker (*Picoides pubescens*), American crow (*Corvus brachyrhynchos*), and starling (*Sturnus vulgaris*). The most common game birds include ring-necked pheasant (*Phasianus colchicus*), northern bobwhite (*Colinus virginianus*), and wild turkey (*Meleagris gallopavo*). A variety of rare terrestrial bird species have been documented in the vicinity, including the gyrfalcon (*Falco rusticolus*) and prairie falcon (*Falco mexicanus*) near Clinton Lake (Exelon 2003a).

Clinton Lake and other water bodies located within the vicinity provide suitable habitat for waterfowl, including American widgeon (*Anas americana*), American black duck (*Anas rubripes*), blue-winged teal (*Anas discors*), coot (*Fulica americana*), lesser scaup (*Aythya affinis*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), redhead (*Aythya americana*), wood duck (*Aix sponsa*), and Canada goose (*Branta canadensis*). Common migratory shorebirds include a variety of sandpipers and herons. Clinton Lake also supports loons, grebes, and wintering gulls (Exelon 2003a).

Reptiles and amphibians that commonly occur in the vicinity of the ESP site include various species of frogs, salamanders, snakes, and turtles, most of which are commonly found throughout the region (Exelon 2003a).

State-Listed Species

State-listed threatened and endangered terrestrial species that may occur in the vicinity of the Exelon ESP site are listed in Table 2-2. Location information for State-listed species within 3.2 km (2 mi) and 16 km (10 mi) of the ESP site was obtained from the IDNR (IDNR 2004a).

The IDNR Natural Heritage Program maintains current lists of State-listed threatened or endangered species at its website (IDNR 2004b).

The bald eagle and Indiana bat (Table 2-2), both Federally listed species, are further described in Section 2.7.1.2, are also State-listed but are not known to occur within 16 km (10 mi) of the Exelon ESP site (IDNR 2004a). There are no other State-listed threatened or endangered animal species known to occur on or in the vicinity of the Exelon ESP site (IDNR 2004a). However, according to the local Audubon Society and other sources of birding in Illinois, there have been documented sightings of State-listed threatened or endangered bird species in the vicinity. These include the snowy egret (*Egretta thula* [endangered]), Henslow's sparrow (*Ammodramus henslowii* [endangered]), northern harrier (*Circus cyaneus* [endangered]), peregrine falcon (*Falco peregrinus* [endangered]), black-crowned night heron (*Nycticorax nycticorax* [endangered]), short-eared owl (*Asio flammeus* [endangered]), sandhill crane (*Grus canadensis* [threatened]), pied-billed grebe (*Podilymbus podiceps* [threatened]), bald eagle (threatened), brown creeper (*Certhia americana* [threatened]), and red-shouldered hawk (*Buteo lineatus* [threatened]) (Exelon 2003a).

There are no State-listed threatened or endangered plant species known to occur within a 16-km (10-mi) radius of the site (IDNR 2004a; Exelon 2003a).

2.7.1.2 Threatened or Endangered Terrestrial Species

This section describes Federally listed and proposed threatened or endangered terrestrial species and designated and proposed critical habitat that may occur in the vicinity of the Exelon ESP site and transmission line corridors. The U.S. Fish and Wildlife Service (FWS) maintains current lists of Federally listed threatened or endangered species at its website (FWS 2004a). General information on the distribution and habitat use of Federally listed species in the region, including their presence or absence in DeWitt County, was obtained from the FWS (FWS 2004b). Location information for Federally listed species within 3.2 km (2 mi) and 16 km (10 mi) of the ESP site was obtained from the IDNR (IDNR 2004b).

Table 2-2. Federal and State-Listed Terrestrial Species that May Occur in the Vicinity of the Exelon ESP Site and Transmission Line Corridors

Scientific Name	Common Name	Status[a]	Source
Haliaeetus leucocephalus	Bald eagle	FT/ST	FWS 2004a, IDNR 2004a
Myotis sodalis	Indiana bat	FE/SE	FWS 2004a, IDNR 2004a

(a) Federal status rankings developed by the U.S. Fish and Wildlife Service under the Endangered Species Act, FE = Federal endangered, FT = Federal threatened. State status rankings developed by the Illinois Department of Natural Resources, SE = State endangered, ST = State threatened.

The staff is preparing a biological assessment of the Federally listed threatened and endangered terrestrial animal species documented in the FWS correspondence (listed in Table 2-2) (FWS 2004b). Life history attributes of these species that are pertinent to the staff's review of Exelon's ESP application, as well information on the occurrence of these species in the project area, are provided in the biological assessment and in this section.

There are two Federally listed animal species, the threatened bald eagle (*Haliaeetus leucocephalus*) and the endangered Indiana bat (*Myotis sodalis*), which may occur in the vicinity of the ESP site and transmission line corridors (FWS 2004b). There are no Federally proposed threatened or endangered animal species or designated or proposed critical habitat known to occur on or in the vicinity of the ESP site (IDNR 2004b; Exelon 2003a; FWS 2004b).

Bald Eagle - Threatened

The bald eagle is known to winter along large rivers, lakes, and reservoirs in DeWitt County (FWS 2004b) and has been observed in the vicinity of the ESP site (Exelon 2003a), although there are no documented records of its occurrence within 16 km (10 mi) of the site (IDNR 2004b). During the winter, this species feeds on fish in open water areas created by dam tailwaters, by warm water effluents of power plants and municipal and industrial discharges, or by power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. Bald eagles roost at night in groups in large trees adjacent to associated bodies of water in areas that are protected from harsh winter weather. During the day, they perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species (FWS 2004b).

Indiana Bat - Endangered

The Indiana bat potentially occurs throughout Illinois (FWS 2004b) and, thus, may occur on or in the vicinity of the ESP site. However, there are no records of its occurrence within 16 km (10 mi) of the site (IDNR 2004b). Critical habitat has been designated for this species (FWS 2004b); however, the only critical habitat in Illinois is the Blackball Mine in LaSalle County (41 FR 41914).

During the summer, the Indiana bat frequents the corridors of small streams with well-developed riparian woods as well as mature upland forests. It forages for insects along stream corridors, within the canopy of floodplains and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, over farm ponds, and in pastures. The foraging range for the species may be as large as 33 ha (81 ac) and varies by season, age, and sex. It roosts and rears its young beneath the loose bark of large dead or dying trees, and the species tends to be philopatric, i.e., returning to the same roosting area year after year. Indiana bats winter in caves and abandoned mines (FWS 2004b).

Suitable summer habitat in Illinois is considered to have the following characteristics within a 0.8-km (0.5-mi) radius of any project site

- forest cover of 15 percent or greater

- permanent water

- one or more of the following tree species: shagbark and shellbark hickory that may be dead or alive, dead bitternut hickory (*Carya cordiformis*), American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), eastern cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), white oak (*Quercus alba*), red oak (*Quercus rubra*), post oak (*Quercus stellata*), and shingle oak (*Quercus imbricaria*) with slabs or plates of loose bark

- at least one potential roost tree per 1 ha (2.5 ac)

- potential roost trees with greater than 10 percent coverage of loose bark (FWS 2004b).

Federally Listed or Proposed Plants

There are no Federally listed or proposed threatened or endangered plant species, or associated designated or proposed critical habitat, known to occur on or in the vicinity of the ESP site and transmission line corridors (IDNR 2004b; Exelon 2003a; FWS 2004b).

2.7.1.3 Terrestrial Ecology Monitoring

Terrestrial ecological monitoring primarily consists of collecting data used to describe the distribution and abundance of important species and habitats, and environmental changes that may contribute to the existing patterns of plant and animal communities (NRC 2000). Although terrestrial ecological monitoring may be performed in support of an application for an ESP, Exelon did not provide any information on terrestrial ecological monitoring in its application.

All of the ESP site has been graded or otherwise developed for operation of the existing CPS (Exelon 2004b). The site does not currently support any important species or habitats (as defined in NUREG-1555, *Environmental Standard Review Plan (ESRP)*, [NRC 2000]), except for four minor (less than 0.4 ha [1 ac]) herbaceous wetlands that consist of open water in association with constructed sediment basins. In addition, there have been no substantive changes to the terrestrial ecological environment since construction of the CPS that contribute significantly to existing patterns of plant and animal communities onsite. Consequently, Exelon currently performs no terrestrial ecological monitoring on the site.

2.7.2 Aquatic Ecology

This section describes the aquatic ecological resources existing at and within the vicinity of the ESP site. This description focuses on the habitats and species that could be affected by the construction or operation of a new nuclear unit at the ESP site.

2.7.2.1 Aquatic Communities of the Exelon ESP Site

Clinton Lake is the largest and most important aquatic resource in the vicinity of the ESP site. The 1981-ha (4895-ac) reservoir was filled in 1978, creating a lake environment where there once were two free-flowing streams. The earthen dam constructed across Salt Creek created the reservoir. The reservoir has no fish passage facilities, restricting upstream movement of fish past the dam.

The deepest region of the lake is near the dam (approximately 13 m [40 ft]), but the average water depth is approximately 5 m (15 ft). The ESP site is located approximately 5 km (3 mi) northeast of the dam between the North Fork of Salt Creek and Salt Creek arms of the lake. The lake is the main attraction for the Clinton Lake State Recreation Area, a 3760-ha (9300-ac) facility located 5 km (3 mi) east of Clinton, Illinois. The park land is owned by AmerGen Energy Company, LLC, the owner and operator of the CPS. Since 1978, the State of Illinois has operated the park through a lease agreement with the utility company (IDNR 2003b). People use the park's lake, marsh, and riverine habitats for boating, swimming, and recreational fishing.

Besides the lake, other important aquatic habitats near the ESP site include portions of Tenmile Creek and Salt Creek, Weldon Springs State Recreation Area, and several small wetland areas. Illinois designates some environmentally sensitive areas, such as Illinois Natural Areas, and provides varying degrees of protection under the jurisdiction of the Illinois Nature Preserves Commission. There are two of these environmentally sensitive areas near the ESP site. The first includes a portion of Tenmile Creek west of the City of Clinton and approximately 8 km (5 mi) from the site. It is designated as critical habitat (i.e., medium gradient creek) by the IDNR and as a unique aquatic resource by the IEPA (Exelon 2003a). The second environmentally sensitive area is along Salt Creek, approximately 5 km (3 mi) from the ESP site. Weldon Springs State Recreation Area is located southeast of the City of Clinton, approximately 10 km (6 mi) from the proposed ESP site. The area includes a 11-ha (28-ac) spring-fed lake, as well as pond, stream, marsh, forested wetland, and riparian areas. Several small wetland areas, generally associated with small tributaries to Salt Creek and the North Fork of Salt Creek, are present within 10 km (6 mi) of the ESP site and along the proposed transmission line rights-of-way. These wetland areas include forested, shrub-scrub, and emergent vegetation communities. Additionally, four small wetland areas, each less than 0.4 ha (1 ac), are present on the site. These are open water resources, such as constructed sediment basins (Exelon 2003a), some of which are used by IDNR as fish-rearing ponds.

There are no Federally or State-listed fish species found in DeWitt County (FWS 2003b, 2003c; IDNR 1999a; Illinois Natural History Survey (INHS) 2004; see Section 2.7.2.2). There are also no commercial fisheries in the vicinity of the ESP site (Exelon 2003a). However, Clinton Lake does provide sport fishing opportunities, and many of the fish species that inhabit the lake have recreational value and are considered important, as defined in NUREG-1555 (NRC 2000). These include such species as the channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), bullhead (*Ameiurus* spp.), white bass (*Morone chrysops*), striped bass (*Morone saxatilis*), hybrid striped bass (a cross between white and striped bass), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), walleye (*Stizostedion vitreum*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), bluegill (*Lepomis macrochirus*), and other sunfish species (*Lepomis* spp.) (City of Clinton 2004; IDNR 2003b). Tiger muskellunge (an artificial cross between muskellunge [*Esox masquinongy*] and northern pike [*Esox lucius*]), sauger (*Stizostedion canadense*), and common carp (*Cyprinus carpio*) are also present, and sometimes caught by sport fishermen (IDNR 2003c). While much of the fishing activity occurs during the warmer months, ice fishing also attracts people to Clinton Lake in winter (IDNR 2003d).

Some recreational fish species are stocked by the IDNR to provide improved fishing opportunities for the public. In 2004, these were expected to include hybrid striped bass, striped bass, smallmouth bass, walleye, and white crappie (IDNR 2003c). These species either do not reproduce naturally in Clinton Lake, have exhibited poor recruitment (due in part to lack of appropriate spawning and rearing habitat, such as emergent aquatic vegetation), or are still in the process of recovering their population structure as a result of flood events that occurred between 1993 and 1995 (IDNR 1999b). Most of the fish are supplied through an offsite IDNR hatchery program, but there is also a limited number of smallmouth bass, walleye, and white crappie produced by IDNR in small ponds located on the CPS site.

The Clinton Lake fishery is managed by IDNR. To provide balance between fishing opportunity and fish population structure and abundance, IDNR imposes a minimum length and daily creel limit on some species (IDNR 2003d). Periodic creel surveys are conducted at Clinton Lake by the Illinois Natural History Survey, and the results are provided to IDNR. Various portions of the lake are designated as no-wake, electric motor only, or no-boat areas for safety and security reasons. Areas closed to public access in 2004 included the water-intake area for CPS, the spillway and the dam areas east of the spillway, and the water surface of the discharge canal (IDNR 2003a).

Besides the sport fish, many other fish species common to Illinois lakes and reservoirs are present in Clinton Lake. The Clinton Lake fish community is dominated by gizzard shad (*Dorosoma cepedianum*), common carp (*Cyprinus carpio*), quillback (*Carpoides cyprinus*), and bigmouth buffalo (*Ictiobus cyprinellus*). Several shiner species, creek chub (*Semotilus atromaculatus*), and white sucker (*Catostomus commersoni*) are also present.

There is currently a statewide methyl-mercury advisory for pregnant women, nursing women, women of child-bearing age, and children under 15 years of age. These more sensitive populations are advised to consume no more than one meal per week of predator fish, including some species that occur in Clinton Lake: sauger, walleye, all bass species, and flathead catfish (IDNR 2003a).

The section of Salt Creek between Clinton Lake and Kickapoo Creek (Figure 2-5) was cited in 2001 as supporting endangered mussel species and as having high mussel diversity (i.e., more than ten live species or with a Shannon-Weaver Diversity index greater than 2.5), according to data collected post-1976 (IPCB 2001).

There are currently no known nuisance aquatic species in Clinton Lake. However, at least one of four species of exotic Asian carp (i.e., bighead carp [*Hypophthalmichthys nobilis*], black carp [*Mylopharyngodon piceus*], grass carp [*Ctenopharyngodon idella*], or silver carp [*Hypophthalmichthys molitrix*]) has been confirmed by IDNR as present in Salt Creek downstream of the Clinton Lake Dam. The concern from an ecological perspective is that these species, originally imported for use in the aquaculture industry, may become as widely distributed and abundant as the common carp, potentially outcompeting native fish and shellfish for habitat and food (FWS 2004c). To date, another aquatic nuisance species of concern in the region, the zebra mussel (*Dreissena polymorpha*), has not been identified in Clinton Lake (IDNR 2003a). These mussels may unwittingly be transported to new water bodies by boaters and can harm native aquatic species through competition for such food items as phytoplankton and zooplankton. Should the Asian carp or zebra mussel invade Clinton Lake, the current balance of species in the lake ecosystem could be disrupted.

State-Listed Species

The IDNR endangered and threatened species list is revised every 5 years by the Illinois Endangered Species Protection Board. The current list was generated in 2004 (IDNR 2004c). Eighteen fish are State-listed as endangered; eight as threatened. None of the State-listed species found in the INHS fish collection was collected from DeWitt County (INHS 2003a).

Twenty mussel species were State-listed as endangered; seven as threatened. However, only two of the mussels, both threatened, are included on the INHS list, "Mussels of DeWitt County" (INHS 2003b): the slippershell mussel (*Alasmidonta viridis*) and the spike (*Elliptio dilatata*).

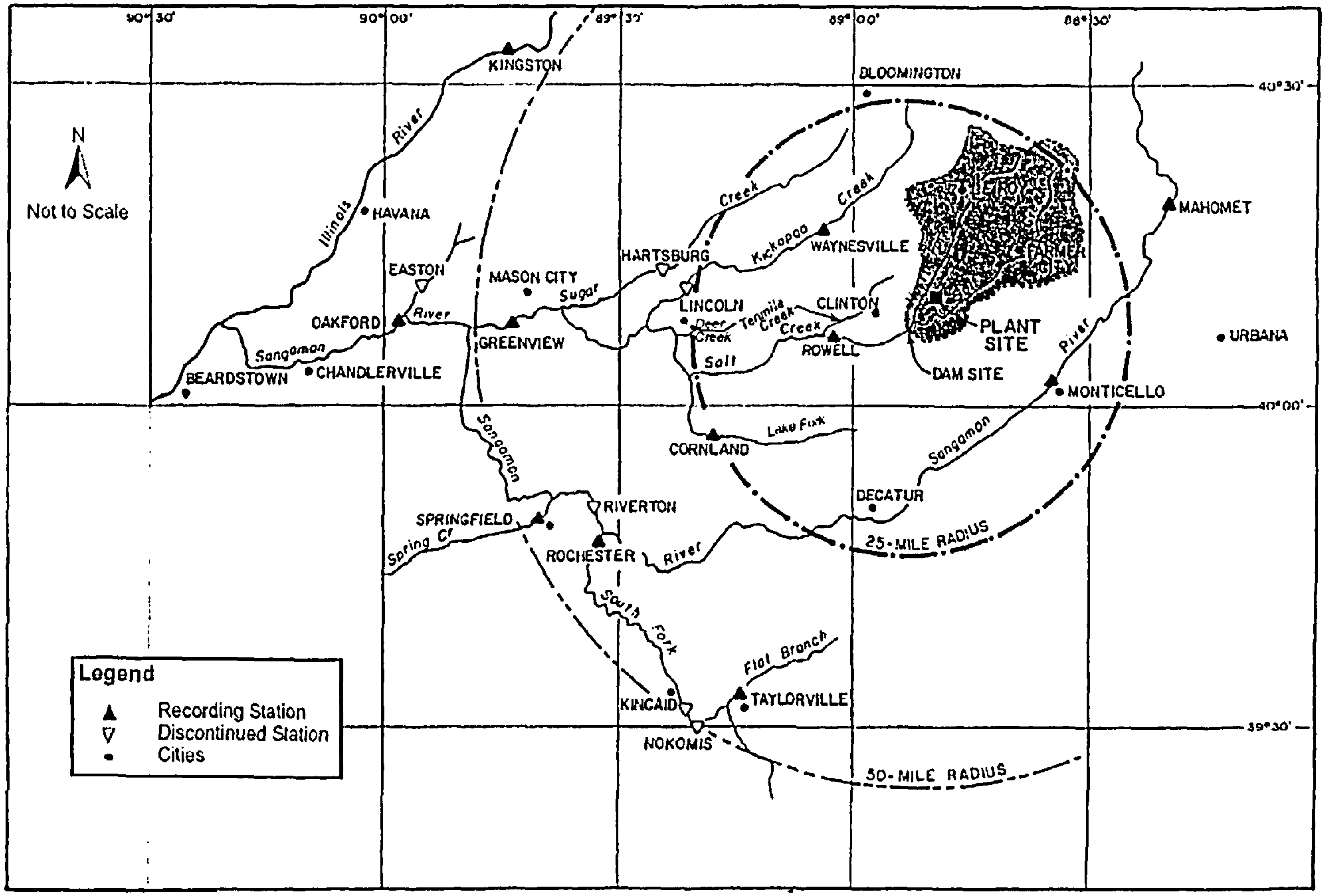

Figure 2-5. Sangamon River Basin (Exelon 2003a)

The slippershell mussel inhabits creeks and the headwaters of large rivers in sand, mud, or fine gravel (Table 2-3). A map of Midwest mussel habitats indicates that the slippershell mussel may be present in DeWitt County and the surrounding region (Cummings and Mayer 1992). Exelon queried a 2002 IDNR GIS database and found no documented occurrences of the slippershell mussel in Clinton Lake, or any other watercourses in the vicinity of the ESP site (Exelon 2003a). The spike inhabits small to large streams and, occasionally, lakes in mud or gravel. It is widespread, but sporadic, in distribution. The INHS range map for this species indicates the spike may be present in DeWitt County and the surrounding region (Cummings and Mayer 1992). Exelon queried the 2002 IDNR GIS database and found documented occurrences of the spike 16 km (10 mi) from the ESP site. There were no documented occurrences of the spike in Clinton Lake, or any other watercourses within a 10-km (6-mi) radius of the site (Exelon 2003a). Database queries for each of the State-listed plant species (263 endangered; 75 threatened) were made of the extensive INHS vascular plant collection (INHS 2003a). No State-listed aquatic plants were found in the INHS database for DeWitt County. The results of the staff's review of the IDNR species list, INHS database, and Exelon's ER indicate that no State-listed threatened or endangered aquatic plant species are known to occur on or in the vicinity of the ESP site (IDNR 2004c; Exelon 2003a).

2.7.2.2 Threatened or Endangered Aquatic Species

This section describes Federally listed threatened, endangered, and proposed aquatic species and designated and proposed critical habitats known to occur on or in the vicinity of the ESP site.

A review of the FWS database of county distributions of Federally listed species in Illinois indicated that eight aquatic animal species are listed as threatened or endangered. However, none is known to be present in DeWitt County or in any of the counties surrounding the ESP site (i.e., Logan, Macon, McLean, or Piatt Counties). The FWS database also indicated that no Federally listed or proposed aquatic plant species or critical habitat are known to be present in DeWitt County or in any of the counties surrounding the ESP site (i.e., Logan, Macon, McLean, or Piatt Counties) (Exelon 2003a; FWS 2003a). For confirmation, the staff requested a list of endangered, threatened, candidate, and proposed species, and designated and proposed

Table 2-3. State-Listed Aquatic Species in Illinois That May Be Present in the Vicinity of the Exelon ESP Site

Scientific Name	Common Name	Status	Comments
Alasmidonta viridis	Slippershell mussel	Threatened	Mussel
Elliptio dilatata	Spike	Threatened	Mussel

critical habitat that might be in the vicinity of the CPS site and its transmission line rights-of-way along with any other information considered appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934 (NRC 2004b). In its response, the FWS indicated that there were no known occurrences of aquatic species or critical habitat in DeWitt or McLean Counties (FWS 2004b).

2.7.2.3 Aquatic Ecology Monitoring

As stated in NUREG-1555 (NRC 2000), aquatic ecological monitoring programs should cover ecosystem elements for which a causal relationship between facility construction and/or operation and adverse change is established or strongly expected. An initial baseline assessment and subsequent monitoring efforts have already been conducted at the ESP site under the Illinois Power Company and Exelon environmental monitoring programs (Exelon 2003a; IPC 1973, 1982). In these studies, aquatic ecology data were gathered to characterize the ecology of the site before and during construction of the CPS and following CPS operation. Data gathered during pre-construction and construction periods included information on water quality, the periphytic algal community, benthic macroinvertebrates (organisms that live on or in the lake substrate), and fish. In general, two effects were noted due to lake and CPS construction activities. There was a temporary increase in turbidity and nonfilterable residue downstream from the Clinton Lake Dam construction site and changes to the algal community resulting from the shift from a variable stream flow prior to dam closure to a stable stream flow after dam closure (IPC 1982). Benthic macroinvertebrate and fish species composition changed somewhat, but the overall abundance and species variety seemed unaffected by construction (IPC 1982).

Post-operational effluent and aquatic ecology monitoring at CPS has been conducted under the direction of the IEPA, through the NPDES (effective permit IL0046919). The NRC relies on this agency for regulation of aquatic issues that involve water quality and aquatic biota. For example, fish impingement studies were conducted over a 1-year period after operation of CPS Unit 1 commenced, as required by the CPS NPDES permit in effect at that time (Pallo 1988). The research indicated that more than 99 percent of fish impinged were young-of-the-year gizzard shad (*Dorosoma cepedianum*), a prolific forage fish species that typically experiences a naturally high young-of-the-year mortality rate and commonly demonstrates mass mortality in winter when water temperatures approach 4°C (39°F).

Under the current NPDES permit, discharge to Clinton Lake must meet specific requirements for flow, pH, total residual chlorine, total residual oxidants, and temperature (IEPA 2000). There are also temperature requirements associated with water discharged from the Clinton Lake Dam to Salt Creek (IPCB 1993). There is currently no specific aquatic ecological monitoring of the algal community, benthic invertebrates, or fish required by this NPDES permit or by the NRC under the CPS Unit 1 Environmental Protection Plan (nonradiological), other than reporting any occurrence of an unusual or important event causally related to plant operation that could result in significant environmental impact (IPC 1987). However, since 1978, the Clinton Lake State Recreation Area, which consists of approximately 3764 ha (9300 ac) including Clinton Lake, has been operated by IDNR through a long-term lease agreement with the owners of CPS (Exelon 2003a). The IDNR conducts its own surveys of aquatic biota primarily to ensure conservation and enhancement of the fishery resource while providing fishing opportunities to the public. In addition to netting, seining, and electroshocking to sample fish species composition, relative abundance, condition, and size distributions, the IDNR Division of Fisheries conducts a number of creel surveys on different lakes and rivers each year to determine the relative success of fisheries management activities and fish stocking efforts (IDNR 2003a). The IDNR also attempts to prevent the introduction and spread of aquatic nuisance species in Illinois waters and tracks the presence of these nuisance species.

Elements of the monitoring program for the ESP site are described below. Data collected under this program would be similar to those collected during monitoring activities in support of construction and operation of the CPS. The purpose of such data is to establish species composition and abundance and characterize naturally occurring annual variation within the communities, so that changes in these communities due to construction or operation of the ESP facility can be detected (Exelon 2003a). The hydrological, water use, water quality, thermal, and chemical monitoring outlined in Section 2.6 will also contribute significantly to the overall understanding of how aquatic species and habitats may be affected by construction and operation of a new nuclear unit at the site.

Site preparation and construction monitoring, pre-operational monitoring, and operational monitoring programs would be provided at the CP or COL phase, in accordance with the schedule provided in NUREG-1555 (NRC 2000). Exelon expects that monitoring would be required by the IEPA (e.g., impingement) and performed in conjunction with construction and operation of a new nuclear unit at the ESP site.

Exelon proposes to reinstate a fisheries monitoring program based on the one established in support of the 1973 CPS ER for the CP stage (IPC 1973). Recommendations for improving on this monitoring program were made by the Illinois Power Company in the 1982 ER for CPS for the operating license stage (IPC 1982), and the NRC intends to revisit these at the CP or COL phase. Because the IDNR currently implements routine fish sampling programs in the vicinity of the proposed ESP facility, Exelon will coordinate with IDNR so that the program will adequately monitor fishery resources and Exelon does not duplicate any IDNR data collection and sampling efforts (Exelon 2003a).

Exelon has not conducted surveys for Federally listed aquatic threatened or endangered or proposed species or of designated or proposed critical habitats, because none is known to occur in the vicinity of the ESP site (Exelon 2003a). Similarly, there will be no monitoring of State-listed aquatic threatened or endangered species because none is known to occur within 10 km (6 mi) of the ESP site.

The requirement for additional pre-application monitoring would be at the discretion of the IEPA. Monitoring of the aquatic ecology during CPS pre-construction and construction phases involved sampling periphyton, benthic macroinvertebrates, and zooplankton. Exelon has not committed to monitoring any of these aquatic ecological resources, unless directed to do so by the IEPA, as these species are not of commercial or recreational importance and are not expected to be adversely affected by construction or operation of a new nuclear unit at the ESP site (Exelon 2003a).

2.8 Socioeconomics

This section presents the socioeconomic resources that could be potentially impacted by the construction, operation, and decommissioning of a new nuclear unit. The section contains two subsections: (1) demography and (2) community characteristics. These subsections include discussions on spatial (e.g., regional, vicinity, and site) and temporal (e.g., 10-year increments of population growth) considerations, where appropriate, as referenced. The area of interest for the socioeconomic analysis that follows is the Counties of Champaign, DeWitt, Logan, Piatt, Macon, and McLean.

2.8.1 Demographics

The resident population distribution around the ESP site out to an 80-km (50-mi) radius is based on the 2000 Census. Table 2-4 presents the population in the concentric rings starting at 16 km (10 mi), 16 km to 40 km (10 to 25 mi), 40 km to 60 km (25 to 37 mi), and 60 km to 80 km (37 to 50 mi), and projected population increases in those rings from 2000 to 2060. Population projections for 2010 and 2020 are based on a methodology developed by Illinois State University (Exelon 2003a). They are based on 1990 populations and fertility, mortality, and migration rates from the early 1990s. The data have not been adjusted for the more recent 2000 Census population. The State of Illinois is preparing population projections based on the 2000 Census, but these are not expected to be released until 2004 to 2006 (Exelon 2003a). A ratio of the population in 2010 and 2020 was used to determine the projected population for the years 2030, 2040, 2050, and 2060. The population annual growth percentage ranges between 0.44 percent (for years 2000 to 2010) and 0.31 percent (for years 2050 to 2060). Total growth in population between 2000 and 2060 is projected at 23 percent.

Table 2-4. Resident Population Distribution from 2000 to 2060 Within 80 km (50 mi) of the Exelon ESP Site

Year	0 to 16 km (0 to 10 mi)	16 to 40 km (10 to 25 mi)	40 to 60 km (25 to 37 mi)	60 to 80 km (37 to 50 mi)	Total	Annual Growth Percent
2000	12,358	222,424	267,376	262,208	764,366	-
2010*	11,767	229,680	283,901	272,986	798,334	0.44
2020*	11,506	237,333	296,856	281,481	827,176	0.35
2030*	11,244	244,987	309,812	289,978	856,021	0.34
2040*	10,983	252,640	322,764	298,476	884,863	0.33
2050*	10,727	260,289	335,723	306,972	913,711	0.32
2060*	10,462	267,946	348,680	315,468	942,556	0.31

*Estimated population. Source: Exelon 2003a.

All or parts of 20 counties and four major cities (Bloomington-Normal, Urbana-Champaign, Decatur, and Springfield) are located within 80 km (50 mi) of the ESP site and are principal economic centers in the region. Decatur (population 81,860), due south of the ESP site, and Bloomington-Normal (population 110,191), due north of the site, lie within 16 to 40 km (10 to 25 mi) (USCB 2000a). Urbana-Champaign (population 103,913), due east of the ESP site, lies within 60 to 80 km (37 to 50 mi) (USCB 2000a). Springfield (the State capitol, population 114,454), southwest of the ESP site, straddles the 80-km (50-mi) radius and is also a principal economic center (USCB 2000a). Other smaller communities within 80 km (50 mi) include Lincoln (population 15,369), due west of the ESP site and within the 40- to-60-km (25-to-37-mi) radius; Monticello (population 5138), southeast of the site and within the 60- to-80-km (37-to-50-mi) radius; and Taylorville (population 11,427), southwest of the site and along the 80-km (50-mi) radius (USCB 2000a). The largest population center within the 16-km (10-mi) area is the City of Clinton (population 7485), due west of the ESP site (USCB 2000a).

Table 2-5 lists the age distribution in DeWitt, Logan, Macon, McLean, and Piatt Counties in 2000 and compares it to the age distribution in the State of Illinois. The counties' age-distributed populations closely track within approximately 4 percent of each other. The exceptions are McLean and Champaign Counties, which for the 18 to 24 age range are at 19 and 23 percent, respectively, of the total population, versus the other counties, which range between 7 and 10 percent, and Illinois at 10 percent. The reason for the difference with the other counties is the presence of the University of Illinois at Urbana-Champaign (enrollment at 38,872 during Fall 2003

Table 2-5. Estimated Age Distribution of Population in 2000 for Counties and State of Illinois

Champaign County			DeWitt County		Logan County		Macon County		McLean County		Platt County		State of Illinois	
Age Group	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%
Under 18	37,819	21	4126	25	6824	22	28,171	25	35,292	23	4115	25	3,245,451	26
18 to 24	41,432	23	1302	8	3617	11	11,214	10	28,000	19	1117	7	1,210,898	10
25 to 44	50,603	28	4760	28	9249	30	30,312	26	43,896	29	4518	28	3,795,544	31
45 to 64	32,345	18	3944	23	6802	22	27,528	24	28,624	19	4086	25	2,667,375	21
65 and over	17,470	10	2666	16	4691	15	17,481	15	14,621	10	2529	15	1,500,025	12
Totals	179,669		16,798	100	31,183	100	114,706	100	150,433	100	16,365	100	12,419,293	100

Source: USCB 2000b.

[University of Illinois 2003]) and Illinois State University (enrollment at 20,705 during Fall 2003 [ISU 2003]) at Bloomington-Normal. In the 65-and-over age group, McLean and Champaign Counties are at 10 percent, versus the other counties which range between 15 and 16 percent and Illinois at 12 percent. McLean and Champaign Counties are also somewhat lower than the other counties for the 45-to-64 age group at 18 and 19 percent, respectively, versus 22 to 25 percent for the remaining counties and 21 percent for Illinois.

Table 2-6 contains data on population, estimated population, and annual growth rates for the area of potential impact (Champaign, DeWitt, Logan, McLean, Piatt, and Macon Counties) from 1970 through 2020. The fastest growing counties in the region over the 50-year period, including projected populations between 2000 and 2020, are McLean and Champaign Counties.

Table 2-6. Population Growth in Champaign, DeWitt, Logan, McLean, Macon, and Piatt Counties, 1970 to 2020[(a)]

	Champaign		DeWitt		Logan		McLean		Macon		Platt	
Year	Population	Annual Growth Percent	Population	Annual Growth Percent	Population	Annual Growth Percent	Population	Annual Growth Percent	Population	Annual Growth Percent	Population	Annual Growth Percent
1970	163,281		16,975		33,538		104,389		125,010		15,509	
1980	168,392	0.3	18,108	0.6	31,802	-0.5	119,149	1.3	131,375	0.5	16,581	0.7
1990	173,025	0.3	16,516	-0.9	30,798	-0.3	129,180	0.8	117,206	-1.1	15,549	-0.6
2000	179,669	0.4	16,798	0.2	31,183	0.1	150,433	1.5	114,706	0.2	16,365	0.5
2010	194,953	0.8	16,018	-0.5	33,449	0.7	156,685	0.4	117,906	0.3	16,636	0.2
2020	206,417	0.6	15,635	-0.2	33,965	0.1	165,592	0.5	118,505	0.1	17,270	0.4

Sources: USCB (for 1970 to 1990) 2000h and IDOCEO 2004.
(a) Projected population for 2010 and 2020; values for 1970 through 2000 are actual census population numbers.

During the 1990s, McLean County grew at an annual rate of 1.5 percent while Champaign County grew at annual rate of 0.4 percent. DeWitt County, the county most impacted economically by CPS, actually lost population during the 1980s and gained a small amount of population during the 1990s. DeWitt County is projected to lose population between 2000 and 2020. Logan, Macon, and Piatt Counties also lost population during the 1990s.

2.8.1.1 Transient Population

The area within the first 16 km (10 mi) of the ESP site is predominately rural and characterized by farmland, which accounts for 82 percent or 24,229 ha (59,870 ac) of the total land area. Industrial land use within the vicinity is less than 1 percent and is limited to areas near Clinton and Weldon. Less that 1 percent of the land within the site vicinity is residential and consists primarily of residential areas near Clinton and Weldon. The land use was confirmed by Exelon with a review of recent aerial photographs taken by the U.S. Geological Survey (Exelon 2003a).

There are approximately 130 small businesses located within the 16-km (10-mi) radius of the ESP site. Exelon considered employees of businesses within the radius as transients and not living within the 16-km (10-mi) radius. Other populations considered transients include the hotel/motel population; special populations such as schools, hospitals, nursing homes, and correctional facilities; and visitors at the annual Apple and Pork Festival, held in Clinton (Exelon 2003a).

2.8.1.2 Migrant Labor

Agribusiness is a major industry in the area surrounding the ESP site. In 1997, DeWitt County had 463 individual farms, Macon County 665, Logan County 739, Piatt County 448, and McLean County had 1475 (USDA 1997).[a] In 2001, approximately 4891 farm workers worked in the five-county area (BEA 2001). Migrant workers are typically members of minority or low-income populations. Because migrant workers travel and can temporarily spend a significant amount of time in an area without being actual residents, they may be unavailable for census takers to count. If this occurs, migrant workers would be under-represented in the census minority and low-income population counts. Based on average statewide statistical data provided by the Illinois Agricultural Statistics Service, 14 percent of the agricultural workforce in the five-county area, or 515 workers, is estimated to be migrant labor. These migrant laborers were considered transients by Exelon (Exelon 2003a).

Table 2-7 presents estimates of the projected transient population distribution from 2000 to 2060 within 80 km (50 mi) of the ESP site. The methods employed in projecting the population

(a) At the time this was written, the *2002 Census of Agriculture* was not available.

Table 2-7. Transient Population Distribution from 2000 to 2060 Within 80 km (50 mi) of the Exelon ESP Site

Year	0 to 16 km (0 to 10 mi)	16 to 40 km (10 to 25 mi)	40 to 60 km (25 to 37 mi)	60 to 80 km (37 to 50 mi)	Total	% Annual Growth
2000	11,834	7354	8677	48,029	75,894	–
2010*	11,542	7616	9100	49,242	77,500	0.21
2020*	11,213	7965	9399	51,616	80,193	0.34
2030*	11,086	8315	9698	53,981	83,080	0.35
2040*	10,946	8666	9996	56,357	85,965	0.34
2050*	10,817	9015	10,295	58,721	88,848	0.33
2060*	10,595	9365	10,594	61,097	91,651	0.31

*Estimated Population.
Source: Exelon 2003a.

estimates for Table 2-4 are also employed for Table 2-7. The estimated annual percentage growth rate for the transient population ranged between 0.21 (2010) and 0.35 (2030).

2.8.2 Community Characteristics

A number of areas are used to define community characteristics. This section addresses the following: (1) local economy around the ESP site, (2) property taxes in the area, (3) transportation in the region, (4) the aesthetics and recreational activities near the ESP site, (5) housing in the area, (6) public services available, and (7) education in the region.

2.8.2.1 Economy

The principal economic centers within 80 km (50 mi) of the proposed ESP site are the Cities of Bloomington-Normal, Urbana-Champaign, Decatur, and Springfield. In addition, East Peoria, Lincoln, Monticello, Morton, Pekin, Pontiac, Rantoul, Taylorville, and Washington are smaller communities within the 80-km (50-mi) radius. These communities collectively support the agricultural industry throughout the region. Other types of industries and major employers include manufacturing, transportation, public utilities, government, retail trade, medical services, and education (including institutions of higher education).

Table 2-8 presents the top employers for the major urban centers and counties located predominately within the 80-km (50-mi) radius of the ESP site (Champaign, DeWitt, Logan, Macon, McLean, and Piatt Counties). DeWitt County is the major beneficiary of the current CPS tax base and has the greatest number of current CPS employees living in the county, approximately 33 percent of the existing workforce. Macon and McLean Counties have approximately 24 and 21 percent, respectively, of the CPS workforce residing in the counties.

Table 2-8. Major Employers by County

Employer	Product	Number of Employees
	Champaign County	
University of Illinois at Urbana-Champaign	Higher education	20,571
Carle Clinic Association	Health care	2918
Carle Foundation Hospital	Health care	2100
Champaign Community Unit School District #4	Public education	1305
Kraft Foods, Inc.	Food processing	1300
Parkland College	Higher education	1200
	DeWitt County	
Wallace Computer Services	Printed forms	240
Action Technology	Plastic extrusion	94
McElroy Metal Mill, Inc.	Metal buildings	75
Miller Container	Corrugated cartons	60
National Environmental	Medical waste	35
	Logan County	
Logan & Lincoln Correctional Centers	Corrections	750
Eaton Cutler Hammer	Circuit breakers	680
Abraham Lincoln Memorial Hospital	Health services	289
Precision Products	Lawn and garden equipment	236
Saint – Gobain Containers	Glass containers	209
	Macon County	
Archer Daniels Midland	Corn and soybean processing	3500
Decatur Memorial Hospital	Health care	2266
Caterpillar	Mining and construction vehicles	2000
Decatur Public School District	Education	1500
St. Mary's Hospital	Health care	1058
Tate and Lyle/A. E. Scaley	Corn processing	720
	McLean County	
State Farm Insurance Companies	Insurance	15,029
Mitsubishi Motor Manufacturing	Automobile	3291
Illinois State University	Higher education	3264
Country Insurance and Investment	Insurance and finance	2183
BroMenn Health Care	Health care	1851
Unit 5 Schools	Education	1636
	Piatt County	
Monticello Schools – Unit #25	Education	174
Piatt County Nursing Home	Health care	150
City of Monticello	Government	150
Kirby Hospital	Health care	105
Neighborcare	Pharmaceutical	87
County of Piatt	Government	70

Sources: BNM 2003; EDCDM 2003; CCCC 2004; IDOCEO 2002, 2003.

Piatt County, which is adjacent to DeWitt County and contains the City of Monticello, is home to 4.5 percent of the CPS workforce (Exelon 2004a).

The economic impacts of the existing nuclear facility at CPS are less noticeable in Macon and McLean Counties, and the economic benefits of plant operation on these larger cities are dispersed over a larger economic base. The main economic benefit to these counties is the tax benefits derived from having CPS employees, who are well paid, living in the counties, and paying sales and use taxes on purchases made in those counties, and property taxes on owned residences. Piatt and Logan Counties, which have 4.5 and 2 percent, respectively, of the existing CPS workforce residing within their boundaries, but none of the property tax benefits of the CPS plant, also receive some of the sales and use and property tax benefits of the CPS workforce.

The two largest cities in the region of interest (counties within or almost wholly within the 80-km [50-mi] radius of the ESP site) are Urbana-Champaign and Bloomington-Normal. Both cities are major centers of economic activity in the region. The largest employer in Urbana-Champaign is the University of Illinois, with 20,571 employees, while State Farm Insurance is the largest employer in Bloomington–Normal at 15,029 employees (IDOCEO 2002, 2003). Bloomington–Normal and Urbana-Champaign are approximately a 2-hour drive south of Chicago.

Table 2-9 shows the unemployment rate for November 2003, the percent of individuals below the poverty line for 2000, and the median household income for 2000 for the six counties and the State of Illinois. McLean County has the lowest unemployment (2.6 percent) and the highest median household income ($47,021). Champaign County has the next lowest unemployment (3.0 percent), the highest percentage of individuals below poverty (16.7 percent), and the lowest median household income ($37,780). DeWitt County (home to CPS) had 7.5 percent unemployment rate, 8.2 percent of its individuals below the poverty line, and a median household income at $41,256. This compares to the State of Illinois unemployment

Table 2-9. Percent Unemployment, Individual Poverty, and Median Household Income

	Unemployment (Percent November 2003)	Individuals Below Poverty Level (Percent Estimated 2000)	Median Household Income (2000 $)
Champaign County	3.0	16.1	37,780
DeWitt County	7.5	8.2	41,256
Logan County	6.8	8.1	39,389
Macon County	6.8	12.9	37,859
McLean County	2.6	9.7	47,021
Piatt County	5.3	5.0	45,752
State of Illinois	6.8	10.7	46,590

Sources: BLS 2003; USCB 2000c.

rate of 6.8 percent, individuals below poverty at 10.7 percent, and median household income of $46,590.

DeWitt County is located between Decatur (Macon County), Urbana-Champaign (Champaign County), Bloomington-Normal (McLean County), and Springfield (Sangamon County), the State capital. Regional employment trends are shown in Table 2-10 for the years 1990 and 2000.

McLean County grew the fastest in employment during the decade at 35.7 percent. Macon and Champaign Counties were next at 10.4 and 9.0 percent, respectively. Most of the counties showed a favorable drop in unemployment over the decade: Champaign County dropped from 4.2 percent (1990) to 2.4 percent (2000); Piatt County dropped from 4.4 percent to 3.5 percent; and Macon County declined from 4.0 percent to 2.5 percent. This compares to November 2003 unemployment estimates (Table 2-9), when Champaign, Piatt, and McLean Counties had unemployment rates of 3.0, 5.3, and 2.6 percent, respectively. DeWitt County was the only county showing an increase in unemployment between 1990 and 2000, from 6.6 to 7.3 percent. The reason is that DeWitt County lost several large manufacturing firms during the decade.

Table 2-11 presents employment by proprietorship and industry, by county for 1990 and 2000. Nonfarm proprietorship employment (self-employed individuals) increased for all counties during the decade of the 1990s. Farm proprietorship employment and farm employment fell across all the counties, i.e., farmers were discontinuing farming by either retiring, going into another line of work, or being bought out, among other possibilities. The agricultural services, fishing, and the other-industry category, on the other hand, were mixed, increasing in those counties where data were available for 1990 and 2000, except for Champaign County where it declined. Construction held its own with minor fluctuations, except in Champaign and McLean

Table 2-10. Regional Employment Trends,1990 and 2000

County	Workers Employed Full- and Part-time, 1990	Workers Employed Full- and Part-time, 2000	Percent Change in Workers Employed, 1990 to 2000	Unemployment Rate, 1990	Unemployment Rate, 2000
Champaign	113,390	123,555	9.0	4.2	2.4
DeWitt	8382	8770	4.6	6.6	7.3
Logan	15,609	15,433	-1.1	5.4	3.6
Macon	65,419	72,246	10.4	4.0	2.5
McLean	80,513	109,249	35.7	6.6	5.0
Piatt	5882	6342	7.8	4.4	3.5

Sources: BEA 2001; County and City Data Books 1994a, 2000.

Table 2-11. County Employment by Proprietorship and by Industry, 1990 and 2000

	Champaign County		DeWitt County		Logan County		McLean County		Macon County		Platt County	
Industry	**1990**	**2000**	**1990**	**2000**	**1990**	**2000**	**1990**	**2000**	**1990**	**2000**	**1990**	**2000**
Proprietorships Proprietor employment	15,672	17,928	1951	2404	3386	3595	11,132	15,257	9295	9890	2012	2259
Nonfarm proprietor employment	14,048	16,459	1383	1888	2465	2818	9339	13,650	8466	9163	1439	1781
Farm proprietor employment	1624	1469	568	516	921	777	1793	1607	829	727	573	478
Industry												
Farm employment	1894	1701	675	625	1239	999	2117	1834	1079	962	708	581
Agriculture services, fishing, and other	1421	1207	97	192	178	D	1394	2230	532	615	96	D
Mining	164	88	25	18	D	D	72	46	251	100	25	D
Construction	3976	5367	273	453	D	542	2988	5167	4204	4391	322	294
Manufacturing	10,869	13,297	1084	962	2155	1685	8095	7826	14,730	14,076	515	553
Transportation and public utilities	2957	4213	1616	1332	434	579	3317	3392	4703	5494	282	246
Wholesale trade	3891	3415	313	293	554	550	2961	3024	2092	2365	250	348
Retail trade	17,743	21,814	1312	1497	2800	3119	14,212	18,960	11,012	12,698	1124	1069
Finance, insurance, and real estate	5625	7205	348	553	732	915	13,621	23,217	3530	3912	353	536
Services	27,642	32,689	1544	1564	4223	3951	19,848	29,077	17,075	20,623	1163	1425
Government and government enterprises	37,208	32,559	1095	1281	2537	2684	11,888	14,476	6211	7010	1044	1066

Sources: BEA 2001.
Note: "D" indicates that the data were not reported due to privacy concerns because individual firms in the county could be identified.

Counties, where there was substantial growth of 35 and 73 percent, respectively. Manufacturing either declined or held its own during the decade, except for Champaign County where it increased 22 percent. Other industries seeing increases in employment were transportation, public utilities (although DeWitt and Piatt Counties saw minor declines) and retail trade, which had increases across all counties except Piatt, which showed some minor declines. Another strong growth industry was services, which showed strong growth across most of the counties, except for a 6.4-percent decline in Logan County. Government and government enterprises were stable employers, showing a decline of some significance only in Champaign County.

Table 2-12 is an aggregation of the data presented in Table 2-11 and totals employment by industry or business type for 1990 and 2000 for the same six counties. Between 1990 and 2000, non-farm proprietor employment increased 23 percent while farm proprietor employment declined by 12 percent and farm employment decreased by 23 percent. Based on the proprietorship decline and the fact that the "agricultural services, fishing, and other" category is up by 24 percent, it would appear that the agricultural industry may be going through a consolidation phase of fewer but larger farms.

The growth industries that could be quantified over the decade between 1990 and 2000 include finance, insurance, and real estate (50 percent increase), the services industry (25 percent increase), and retail trade (23 percent increase). Manufacturing held its own in employment through the decade, increasing by approximately 2.5 percent. Generally, the economy across the region can be viewed as being economically diversified.

DeWitt County lost about 1000 jobs over the last 5 to 7 years as manufacturing firms have shifted jobs overseas or to other places in the United States and through businesses consolidating, merging, or going out of business. The general thinking of county and city officials in the Clinton area is that the economy is soft and that they have reached bottom.[a] New firms are moving into the county and creating new jobs. However, the wages paid for these jobs are lower than the wages paid for the lost jobs.

(a) Personal interviews were conducted March 3, 2004, in the City of Clinton with Roger Cyrulik (Mayor of Clinton), Steve Lobb (Director of Public Works, Clinton), and Tim Followell (Administrative Assistant, Clinton). A group interview was conducted March 2, 2004, in Clinton, Illinois, with Duane Harris, (DeWitt County Board Chairman), Terry Ferguson (DeWitt County Board and Land Use Chairman), Sherrie Brown (Administrator, DeWitt County Zoning), Sandy Moody (DeWitt County Supervisor of Assessments), Dee Dee Rentmeister (Administrative Assistant, DeWitt County Board of Supervisors), and Christy Long (DeWitt County Treasurer).

Table 2-12. Aggregated Employment by Industry or Business Type for Champaign, DeWitt, Logan, McLean, Macon, and Piatt Counties, 1990 and 2000

Industry or Business Type	1990 Employment	2000 Employment	Percent Change
Proprietorships Proprietor employment	43,448	51,333	18.1
Nonfarm proprietor employment	37,140	45,759	23.2
Farm proprietor employment	6308	5574	-11.6
Industry			
Farm employment	8674	6702	-22.7
Agricultural services, fishing, and other	3718	6702	Incomplete[(a)]
Mining	537	252	Incomplete[(a)]
Construction	11,763	16,214	Incomplete[(a)]
Manufacturing	37,448	38,399	2.5
Transportation and public utilities	13,309	15,256	14.6
Wholesale trade	10,061	9995	-0.7
Retail trade	48,203	59,157	22.7
Finance, insurance, and real estate	24,209	36,338	50.1
Services	71,495	89,329	24.9
Government and government enterprises	59,983	59,075	-1.5

Source: BEA 2001.
(a) Incomplete, as some county data not available.

Commodity prices are up, helping the agricultural sector. The market value of farmland is increasing, especially for the larger contiguous pieces of land, those from 160 to 320 ha (400 to 800 ac). Farmers in and around the Chicago area are selling their land for development and buying new farms involving non-taxable Starker exchanges. This has increased the price of farmland in and around Clinton to $4000 per acre.[a]

The number of building permits issued by the county is remaining stable, numbering about 170 permits annually from 2000 to 2003, of which new residential permits are holding steady between 42 and 45 annually over the same 4-year period (Brown 2004).

The county infrastructure is fairly new. A new courthouse and jail combination have been built. The county does not have any growth moratoriums in place. The City of Clinton also appears to have a fairly new, modern town hall.

The City of Clinton is going through a transition period economically. Manufacturing outsourcing and downsizing have made some realize that it is possible that Clinton may not return to the economy that characterized it during the decade of the 1990s and before. Clinton's strategic placement, midway between Decatur, Urbana-Champaign, Bloomington-Normal, and Springfield has suggested to some town and county officials that the City of Clinton might begin to promote itself as a bedroom community to these larger communities, instead of a commercial manufacturing hub.[b]

The City of Clinton has had limits placed on its growth for a number of years for two reasons. First, there was an overtaxing of its sewer system in the early 1990s. The problem was caused by an inadequate combined storm water/sewer system, which has been corrected. The city has also expanded its water-treatment plant. Second, until approximately 1996, Clinton was locked into trust lands and could not annex new land into the town. The problem was resolved in 1996, and since then Clinton has annexed 80 ha (200 ac) and plans to extend utilities and other services to the annexed lands within the next 3 to 5 years.[c]

The City of Clinton has also taken advantage of tax increment financing districts (TIFs) to fund infrastructure improvements, such as street improvements (curbs, gutters, and a center turn lane on business U.S. Highway 51, which has greatly alleviated congestion through town).

(a) Personal interview conducted on March 2, 2004, in the City of Clinton, Illinois, with Sandi Thayer, Thayer Real Estate.

(b) Group interview conducted March 2, 2004, in Clinton, Illinois, with Duane Harris, (DeWitt County Board Chairman), Terry Ferguson (DeWitt County Board and Land Use Chairman), Sherrie Brown (Administrator, DeWitt County Zoning), Sandy Moody (DeWitt County Supervisor of Assessments), Dee Dee Rentmeister (Administrative Assistant, DeWitt County Board of Supervisors), and Christy Long (DeWitt County Treasurer), and personal interview conducted March 3, 2004, in the City of Clinton, Illinois, with Stephen Vandiver (Economic Development Director, City of Clinton).

(c) Personal interview conducted March 3, 2004, in the City of Clinton, Illinois, with Stephen Vandiver (Economic Development Director, City of Clinton).

Under a TIF, tax revenues collected in a defined district are capped in the amount that goes to the town. Taxes collected above the cap go into a fund, which the town manages to pay for improvements within the district. Clinton also passed an increase to the local sales tax, which has also been used to fund improvements.[b]

Because of the presence of the CPS in DeWitt County, property taxes in Clinton and the county have been lower than those of neighboring counties. An owner of a house in McLean County (Bloomington-Normal) whose house was assessed at $150,000 would pay $4000 per year in property taxes. The same house in Clinton/DeWitt County would pay property taxes between $2800 per year and $3000 per year.[b]

The real estate market in both agricultural and residential housing is strong. Prices for residential housing are rising about 3 percent per year. The commercial sector is stable. The rental market, as the 2000 Census figures show, is very tight (see more detailed discussion in Section 2.8.2.5). There are not many vacancies, and those that do occur are filled quickly by word of mouth. According to two realtors, Clinton itself is increasingly becoming a bedroom community to the larger cities of Urbana-Champaign, Springfield, Decatur, and Bloomington-Normal.[a]

There is also some building of residential housing in and around the City of Clinton. The average sale price of a used house is in the $75,000 to $80,000 range for three bedrooms, one-and-a-half baths, and a single-car garage on two-tenths of an acre. At the upper end, $285,000 will buy a five-bedroom, five-bath house on a one-and-one-third-acre lot. Houses are on the market an average of 60 to 75 days. Rents for apartments and residential housing range between $385 to $680 per month.[b]

Clinton Lake is heavily used for recreation, but its impact on the economy of Clinton is minimal. In the vicinity of the lake, a 7.6-ha (19-ac) lot can be bought for $150,000.[c] A three-bedroom, two-bath house with unfinished basement, family room and two fireplaces on 0.5 ha (1.3 ac) recently sold for $150,000.[c] No properties around the lake actually abut the lake. CPS owns the lake and 91 m (100 yards) up the shoreline from the lake. There is approximately a

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(a) Personal interviews conducted on March 2, 2004, in the City of Clinton, Illinois, with Sandi Thayer (Thayer Real Estate), and on March 3, 2004, in the City of Clinton, Illinois, with Camill Tedrick, (General Manager, Brady Weaver Real Estate).

(b) Personal interviews conducted on March 2, 2004, in the City of Clinton, Illinois, with Sandi Thayer, (Thayer Real Estate), on March 3, 2004, with Stephen Vandiver (Economic Development Director, City of Clinton), and on March 3, 2004, with Camill Tedrick (General Manager, Brady Weaver Real Estate).

(c) Personal interview conducted March 5, 2004, in the City of Clinton, Illinois, with Sandi Thayer (Thayer Real Estate).

10-percent differential in values between lake properties and properties in Clinton, with the lake properties being higher.[c]

In adjoining Piatt County and the Town of Monticello, the economy is better and more diversified. Monticello is close to neighboring Champaign County and the University of Illinois, as well as to Decatur. Highway I-72 runs past Monticello, and a number of its residents commute to jobs in Urbana-Champaign and Decatur. Like Clinton, it is a bedroom community to these larger cities.

Also like Clinton, Piatt County and Monticello have lost industry and jobs over the past few years, with some new industry being attracted to the area. Those firms coming in are generally paying lower wages than those that left. Agriculture, a large part of the county's economy, is currently strong, with improvements in commodity prices and rising land values.[a]

Four new subdivisions are underway in Monticello with 91 lots available in March 2004 (Monticello 2004). The infrastructure (water and sewer) is in place to support new construction for 5 years, with 25 to 30 new building permits annually. New housing construction ranges in price between $165,000 and $275,000.[a] Older houses with three bedrooms and one-and-a-half baths can be purchased for around $80,000. The price range for all houses sold in 2003 ranged from just under $50,000 to $350,000 (Monticello 2004). There are approximately 80 homes on the market at any given time, which in 2003 were on the market an average of 109 days.[a]

Mt. Pulaski, a small town in Logan County adjacent to and west of DeWitt County, is a bedroom community to Springfield, the State capitol. The economy in Logan County is considered strong. Agriculture, as in Piatt and DeWitt Counties, is a major component of Logan County economy. However, two prisons are the primary employers. Within the City of Mt. Pulaski, there are two industries: Inland Tools and Mt. Pulaski Products, Inc. Generally, the infrastructure (water, sewer, and roads) is sound, but the sewer system is being upgraded.[b] The rental market in Mt. Pulaski is tight, with no apartments available and limited places to build (only six lots are available and no houses are built on speculation – a buyer must enter into a contract before construction starts). If building does take place, it is considered important not to

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(a) Group interview conducted March 5, 2004, in the City of Monticello, Illinois, with Sue Gortner (Executive Director, Monticello Chamber of Commerce and Tourism), Bill Mitze (Mayor, Town of Monticello), Mary Jo Hetrick (Community and Economic Development Director, Monticello), Floyd Allsop (Superintendent of City Services, Monticello), and Lawrence J. McNabb, Ph.D. (Superintendent, Monticello Community Unit School District 25).

(b) Personal interviews conducted March 5, 2004, in the City of Mt. Pulaski, Illinois, with William Glaze (Mayor, City of Mt. Pulaski) and Michael R. Partridge (Director of Public Works, City of Mt. Pulaski).

"overbuild," i.e., building an expensive house with lots of amenities, because it would be difficult to sell.

A three-bedroom house in Mt. Pulaski would generally sell for between $75,000 and $100,000. When houses do become available, they sell rather quickly. Two houses were built in 2003, both by Habitat for Humanity.[b]

2.8.2.2 Taxes

CPS pays annual property taxes to the following jurisdictions: DeWitt County, Clinton Community School District 15, and Harp Township (including Richland Community College District 537, Multi-Township Assessment District 3, Vespasian Warner Public Library District, and Mahomet Valley Water Authority).

Table 2-13 presents information on the total property taxes Exelon pays to all jurisdictions, the total property taxes collected, and the percent of the total property taxes that are paid by Exelon. The preponderance of taxes are paid to DeWitt County and Clinton School District 15. The Exelon annual property tax payments to DeWitt County for the 7-year period 1996 to 2002 averaged approximately 66.5 percent of the total property taxes collected.

Deregulation of the Illinois electric utility industry has had and is continuing to have a major impact on the finances of DeWitt County and other taxable entities receiving property tax

Table 2-13. Total Property Tax Revenues Generated in DeWitt County and Other Taxing Districts, Total Property Taxes Exelon Paid to These Jurisdictions, 1997 to 2002, and Percent of Exelon Property Taxes Paid of Total Property Tax Revenues Collected

Year	Total Property Tax Revenues ($)	Property Tax Paid by Exelon ($)	Percent of Total Property Taxes Paid to the Jurisdiction
1996	22,818,230	17,883,087	78
1997	23,120,605	17,801,100	77
1998	22,086,537	16,412,640	74
1999	21,071,703	15,398,610	73
2000	18,289,345	10,128,580	55
2001	17,524,729	9,558,990	54
2002	17,344,778	9,165,355	53

Source: Personal communication March 2, 2004, from Christy Long (DeWitt County Treasurer).

revenue from Exelon. For the period 2000 to 2002, the Exelon property taxes paid to DeWitt County averaged 54.2 percent of the total property taxes received, or a drop of 21.5 percent from the average of the four previous years. This drop represents a transition period of declining property tax collections due to deregulation. Whereas in pre-deregulation years the property taxes paid were based on the depreciated assessed value of the CPS, post-deregulation the amount of property taxes paid will be based on the market value of power produced from the plant. As reflected in Table 2-14, the assessed value of the plant has dropped from $708 million, county-assessed valuation in 1999, to $411 million (tentative) for 2003. The CPS, owned by AmerGen (a subsidiary of Exelon Generation Company), has valued the CPS at $470 million (1999) to a projected $165 million by 2003. The county currently is in a transition period from pre-deregulation to deregulation and does not know how CPS will be valued after 2005 (Moody 2004).[a]

2.8.2.3 Transportation

In Urbana-Champaign, four interstate highways cut through or end at the metropolitan area. Interstate-57 runs north-south through Urbana-Champaign and connects with Chicago to the north. Interstate-74 connects with the cities from the east and then runs northwest through Bloomington-Normal and Peoria and eventually connects with I-80 just east of Davenport, Iowa. Interstate-72 crosses I-57 and then runs southwest, connecting Decatur with Urbana-Champaign to the northeast and Springfield to the west, where it terminates at I-55 coming from St. Louis to Springfield.

Table 2-14. Real Estate Assessment of CPS Compared to Total Real Estate Assessment of DeWitt County

Year	DeWitt County Total Assessed Evaluation ($)	CPS Assessed Valuation ($)	Percent of CPS Assessed Valuation to County Total
1996	760,669,126	558,689,373	73
1997	751,432,800	540,000,000	72
1998	704,173,862	480,000,000	68
1999	707,995,785	470,000,000	66
2000	466,246,810	220,000,000	47
2001	453,754,329	210,000,000	46
2002	440,622,585	195,000,000	44
2003[a]	410,928,943	165,000,000	40

Source: Personal communication March 2, 2004, from Sandy Moody (DeWitt County Assessor).
(a) Estimated.

(a) Personal communication March 2, 2004, from Sandy Moody (DeWitt County Assessor).

Bloomington-Normal has three interstate freeways running through it. Interstate-55 comes in from the southwest from Springfield, and runs northeast connecting to Chicago to the north. Interstate-74 comes in from the southeast and connects to Urbana-Champaign to the southeast and Peoria to the northwest. Interstate-39 comes in from Rockford, Illinois, to the north and intersects Interstates I-74 and I-55 at Bloomington-Normal.

Decatur has I-72 that connects it to Urbana-Champaign (terminating at I-57) to the northwest and Springfield to the west. Interstate-72 runs through Springfield to the west and continues west, while I-55 runs northeast and south, connecting Bloomington-Normal to the north and St. Louis to the south. All three cities (Decatur, Urbana-Champaign, and Bloomington-Normal) have regional airports offering flights to Chicago, Detroit, and other destinations.

The City of Clinton has two highways running through it. U.S. Highway 51 runs north-south through Clinton, connecting to Bloomington-Normal to the north and Decatur to the south. SR 54 runs northeast to southeast through Clinton, connecting with I-74 to the northeast and Springfield and to I-55 to the southeast.

With the improvements to its streets, Clinton has greatly alleviated congestion. Access to the CPS site is via good roads. Congestion only exists at shift changes and is short-lived, usually dissipating within a half-hour.

2.8.2.4 Aesthetics and Recreation

Clinton Lake State Recreation Area is 3760 ha (9300 ac), including Clinton Lake, which is the cooling water source for the current CPS. The lake, 1981 ha (4895 ac) in size, is located just 3 miles east of the City of Clinton. Numerous recreational sites are located around the reservoir, including boat ramps, camping sites, and picnic areas (IDNR 2004c). Although AmerGen owns the lake and 91 m (100 yards) up the shoreline from the lake, public access is available to most of the lake. However, for security purposes, a small part of the lake is off limits to public access, primarily around the plant itself and its water intake structures.

Clinton Lake State Recreation Area is heavily used for recreation. Recreational activities include boating, hiking, swimming, and camping, among other activities. Fishing has been described as outstanding, with species available including crappie, catfish, walleye, stripers, bass, and bluegill (IDNR 2004c).

The CPS can be seen from several vantage points around Clinton Lake. The terrain around the lake is gently undulating and wooded. From these areas, most of the CPS structures are screened from public view. Noise from the plant is not particularly noticeable, even from vantage points where the plant can be clearly seen.

2.8.2.5 Housing

The largest number of current employees at CPS's nuclear facility live in three areas: approximately 30 percent live in DeWitt County, 30 percent in Macon County (Decatur), and 20 percent in McLean County (Bloomington-Normal). The remaining 20 percent are scattered in other communities, generally within a 80-km (50-mi) radius of the ESP site.

Within the 80-km (50-mi) radius, residential areas are found in the cities, towns, and smaller communities with farmsteads scattered throughout the area. Rental property is scarce in the rural regions, but is found in the larger cities such as Bloomington-Normal, Urbana-Champaign, Decatur, and Springfield. Near the vicinity of the ESP site, residential areas are generally older single-family residences and mobile homes. Newer residential developments are primarily located in the four cities previously mentioned.

Table 2-15 provides the number of housing units and housing unit vacancies for the region of potential impact for 1990 and 2000. Total housing units further subdivide into owner-occupied, renter-occupied, and vacant. The percentages change for each classification over the decade of the 1990s.

Generally, the counties with the larger populations (Champaign, McLean, and Macon) have more available vacant housing. The percent change in the number of vacant units between 1990 and 2000 in the region ranges from 3.7 percent (Champaign County) to 36.2 percent (McLean County). The counties with smaller populations (e.g., Piatt, DeWitt, and Logan) show a percent change in vacant units ranging between 10.2 percent (Piatt) and 25.5 percent (Logan).

Macon County had a decline in the number of vacant units (-9.2 percent). In 2000, there were 296,904 total housing units for Champaign, DeWitt, Logan, McLean, Macon, Piatt, and Sangamon Counties. Of that total, 93,326 were renter-occupied (44 percent of the total). Vacant units numbered 19,920 (9 percent of the total for 2000).

Table 2-16 presents more detailed 2000 Census data on vacant housing units for communities close to the ESP site: Clinton, Farmer City, Monticello, and Lincoln. Of the 238 vacant houses in Clinton, 110 were for rent. Of its 426 vacant units, Lincoln had 124 units available for rent.

2.8.2.6 Public Services

Public services and facilities consist of schools (discussed in Section 2.8.2.7), social services, public utilities, police, fire departments, and hospitals. Most of these services are located in municipal boundaries and are near population centers (Exelon 2003a).

Table 2-15. Housing Units and Housing Units Vacant (Available) by County During 1990 and 2000

	1990	2000	Approximate Percentage Change
Champaign County			
Total Housing Units	68,416	75,280	10.0
Occupied Units	63,900	70,597	10.5
Owner-occupied	34,857	39,329	12.8
Renter-occupied	29,043	31,268	7.7
Vacant Units	4516	4683	3.7
DeWitt County			
Housing Units	6942	7282	4.9
Occupied Units	6488	6770	4.3
Owner-occupied	4599	5076	10.4
Renter-occupied	1889	1694	-10.3
Vacant Units	454	512	12.8
Logan County			
Housing Units	11,638	11,872	2.0
Occupied Units	11,033	11,113	0.7
Owner-occupied	7476	7925	6.0
Renter-occupied	3557	3188	-10.4
Vacant Units	605	759	25.5
McLean County			
Housing Units	49,164	59,972	22.0
Occupied Units	46,796	56,746	21.3
Owner-occupied	29,696	37,710	27.0
Renter-occupied	17,100	19,036	11.3
Vacant Units	2368	3226	36.2
Macon County			
Housing Units	50,049	50,241	0.4
Occupied Units	45,996	46,561	1.2
Owner-occupied	32,268	33,345	3.3
Renter-occupied	13,728	13,216	-3.7
Vacant Units	4053	3680	-9.2
Piatt County			
Housing Units	6227	6798	9.2
Occupied Units	5934	6475	9.1
Owner-occupied	4539	5191	14.4
Renter-occupied	1395	1284	-8.0
Vacant Units	293	323	10.2

Sources: USCB 2000d; County and City Data Books 1994b

Table 2-16. Vacant Housing Units for Clinton, Farmer City, Monticello, and Lincoln, 2000

	Number	Percent of Total Vacant Units
Clinton		
Vacant housing units	238	
For rent	110	46.1
For sale only	37	15.5
Rented or sold, not occupied	24	10.1
For seasonal, recreational, or occasional use	20	8.4
For migratory workers	0	0.0
Other vacant	47	19.7
Farmer City		
Vacant housing units	76	
For rent	29	38.2
For sale only	12	15.8
Rented or sold, not occupied	1	1.3
For seasonal, recreational, or occasional use	8	10.5
For migratory workers	0	0.0
Other vacant	26	34.2
Monticello		
Vacant housing units	80	
For rent	14	17.4
For sale only	17	21.3
Rented or sold, not occupied	11	13.8
For seasonal, recreational, or occasional use	4	5.0
For migratory workers	0	0.0
Other vacant	34	42.5
Lincoln		
Vacant housing units	426	
For rent	124	29.1
For sale only	89	20.9
Rented or sold, not occupied	101	23.7
For seasonal, recreational, or occasional use	14	3.3
For migratory workers	0	0.0
Other vacant	98	23.0

Source: USCB 2000e.

Water and Waste Water Treatment

In the vicinity of the ESP site, drinking water is primarily obtained from groundwater via wells. The Clinton Sanitary District Sewage Treatment Plant serves the waste water needs of the City of Clinton. In the region, rural communities generally have private wells for water and septic systems for sanitary wastes. Larger communities obtain water from groundwater extraction wells and are served by public waste water treatment systems. Individual residents in rural areas obtain their water primarily from wells. A survey was performed for water and water facilities in the region, and the facilities were found to have excess capacity to accommodate potential population increases (Exelon 2003a). An independent analysis conducted by the NRC staff confirms Exelon's finding.

Table 2-17 summarizes the source and daily peak, average, and excess capacity of water consumed in the major towns and cities within an 80-km (50-mi) radius of the ESP site. Excess capacity exists in the public water supply systems of all major cities and towns within the region. Springfield has the largest water-treatment capability. Its peak demand is 140 million L/d (38 million gallons per day [mgd]), average daily demand is 83 million L/d (22 mgd), and excess capacity is 30 million L/d (8 mgd). Closer to the ESP site, the Cities of Clinton, Farmer City, Monticello, and Lincoln all have excess capacity ranging from 1.1 million L/d (0.3 mgd) (Clinton) to 5.7 million L/d (1.5 mgd) (Lincoln). The combined excess capacity for these four small towns, all within 25 miles of the CPS, is 10.2 million L/d (2.7 mgd).

Table 2-18 summarizes the type and treatment capacity, current load, and excess capacity of the waste water treatment facilities in the same cities and towns within 80 km (50 mi) of the ESP site. Excess capacity exists in the public waste water treatment systems of all major cities and towns within the region. Springfield has the largest waste-treatment excess capacity. Its daily peak is 227 million L/d (60 mgd), current load of 83 million L/d (22 mgd), and excess capacity of 144 million L/d (38 mgd). Closer into the ESP site, the Cities of Clinton, Farmer City, Monticello, and Lincoln all have excess capacity ranging from 1.6 million L/d (0.4 mgd) (Clinton) to 26.5 million L/d (7 mgd) (Lincoln). The combined excess capacity for these four small towns, all within 25 miles of the CPS site, is 31.8 million L/d (8.4 mgd).

Public water supply and waste water treatment are not a constraint to growth in the vicinity of the ESP site, assuming that growth increases hold to the historical norm. However, there are no limitations on new sources of water from groundwater. In addition, most treatment plants located in the area have reserve treatment capacity.

Table 2-17. Public Water Supply Systems in Select Towns and Cities in the Region of the Exelon ESP Site

Water System	Source	Peak Daily Demand, Million L/d (mgd)	Average Daily Use, million L/d (mgd)	Excess Capacity, million L/d (mgd)
Clinton (DeWitt)	Well	6.4 (1.7)	5.3 (1.4)	1.1 (0.3)
Monticello (Piatt)	Well	3.4 (0.9)	2.5 (0.7)	1.3 (0.4)
Farmer City (DeWitt)	Well	0.8 (0.2)	0.7 (0.2)	1.9 (0.5)
Lincoln (Logan)	Well	12.5 (0.3)	9.5 (2.5)	5.7 (1.5)
Urbana-Champaign (Champaign)	Well	125.3 (33.1)	73.1 (19.3)	26.3 (6.9)
Decatur (Macon)	Lake	166.2 (43.9)	146.5 (38.7)	27.5 (7.3)
Bloomington (McLean)	Lake	75.7 (20.0)	141.6 (11.0)	7.6 (2.0)
Normal (Macon)	Well	19.5 (5.2)	15.2 (4.0)	17.0 (4.5)
Springfield (Sangamon)	Lake	143.9 (38.0)	83.3 (22.0)	30.3 (8.0)

Sources: IDOCEO 2002, 2003.

Table 2-18. Waste Water Treatment Systems in Select Towns and Cities in the Region of the Exelon ESP Site

Water System	Type of Treatment	Treatment Capacity, million L/d (mgd)	Current Load, million L/d (mgd)	Excess Capacity, million L/d (mgd)
Clinton (DeWitt)	Tertiary	6.4 (1.7)	4.9 (1.3)	1.6 (0.4)
Monticello (Piatt)	Tertiary	3.8 (1.0)	2.1 (0.6)	1.7 (0.5)
Farmer City (DeWitt)	Tertiary	3.4 (0.9)	1.4 (0.4)	2.0 (0.5)
Lincoln (Logan)	Tertiary	45.0 (12.0)	19.0 (5.0)	26.0 (7.0)
Urbana (Champaign)	Tertiary	87.8 (23.2)	65.1 (17.2)	22.6 (6.0)
Champaign (Champaign)	Tertiary	23.1 (6.1)	16.7 (4.4)	6.5 (1.7)
Decatur (Macon)	Secondary	155.2 (41.0)	117.0 (31.0)	38.0 (10.0)
Bloomington-Normal (McLean)	Tertiary	118.1 (31.2)	61.0 (16.0)	57.5 (15.2)
Springfield (Sangamon)	Tertiary	227.0 (60.0)	83.0 (22.0)	144.0 (38.0)

Sources: IDOCEO 2002, 2003.

Police, Fire, and Medical Services

Within the 16-km (10-mi) radius of the ESP site, there is one fire department and there are two police (city police and county sheriff) departments that serve the City of Clinton. In the region, there are a total of 89 fire departments and 76 police departments. Outside of the major cities of the area (Decatur, Urbana-Champaign, Bloomington-Normal, and Springfield), communities typically share fire-fighting services (Exelon 2003a).

Within the 16-km (10-mi) radius of the ESP site, there are two nursing homes and one hospital serving Clinton. Within the (80-km [50-mi]) region, there are 52 hospitals and 84 nursing homes. Exelon concludes that the projected capacity of public services is adequate and is expected to expand modestly to meet the demands of a slight population growth (Exelon 2003a). Annual population growth projections of less than 0.5 percent a year would tend to support this conclusion (see Table 2-6).

Social Services

Social services in Illinois are overseen at the State level of government by the Department of Human Services (DHS), which is the largest agency in Illinois, with more than 19,000 employees and an annual budget of nearly $5 billion. The services of the agency are provided through nearly 200 local offices and in partnership with a network of local providers that reaches every part of Illinois. The services touch the lives of one out of five Illinois citizens in the course of a year (IDHS 2004).

DHS serves Illinois citizens through seven main programs: (1) alcoholism and substance abuse treatment and prevention services; (2) developmental disabilities; (3) health services for pregnant women and mothers, infants, children, and adolescents; (4) prevention services for domestic violence and at-risk youth; (5) mental health; (6) rehabilitation services; and (7) welfare programs, including temporary assistance for needy families, food stamps, and child care (IDHS 2004).

2.8.2.7 Education

The public school systems in the region are organized into 110 primary, secondary, or unit school districts. Within DeWitt County, there are two school districts. The Blue Ridge Community School District 18 is based in Farmer City, Illinois. It has one high school (enrollment 285), a junior high school (enrollment 150), an elementary school (enrollment 240), and a pre-school (enrollment 290) (School 2004a). Clinton School District 15 has one high school (enrollment 750), a junior high school (enrollment 500), and three elementary schools (enrollment 1050, including pre-school) (School 2004b). Clinton School District 15 is the main beneficiary of the current CPS tax base (Exelon 2003a).

Over the last several years, Clinton School District 15 has been meeting obligations by cutting its budget by $3 million and spending reserves. For the first time since 1965, the school district had to go before the voters in mid-March to request an increase in the tax rate to $1.20 per thousand of assessed valuation,[a] only to have it defeated by a three-to-one margin. It has

(a) Personal interview March 3, 2004, with Roger Little (Superintendent, Clinton Unit School District 15).

seen the percentage of the property taxes from Exelon to total property taxes collected in DeWitt County decline from 80 percent in 1996 to 53 percent in 2002.[(a)]

Monticello Community Unit School District's 25 schools are financially stable. The district has had some financial strain from their reliance on the corporate profit tax because of the recession and firms closing and leaving the area. There have been recent improvements in corporate profit tax collection as a result of renewed economic growth in the area. The income tax for corporations is 7 percent, which includes the 2.5-percent personal property replacement tax (Lawrence County 2004). A $21-million construction phase has been undertaken, and with the new construction there will be excess capacity in the school system.[(b)]

A survey of class size of some schools in the region was performed and found that of those districts surveyed (a total of 69), 70 percent of schools have class sizes at or below the national average (Exelon 2004b). From this, Exelon concluded that this is an indication that there is sufficient capacity in the classrooms for a small increase in population. Although the Blue Ridge and Clinton school districts were not included in the Exelon survey, the NRC staff interviewed the superintendents of the Clinton and Monticello school districts. They found classrooms to be adequate for the numbers of students.[(c)]

There are three community colleges and eight 4-year colleges and universities in the region. Richland Community College District has students on the main campus in Decatur and is a beneficiary of the Exelon property taxes. It has a full-time equivalent enrollment of 1155.[(d)] Other 4-year colleges and universities with enrollment are as follows (Exelon 2003a): Eureka College, Eureka (525); Illinois Central College, Peoria (13,930); Illinois State University, Bloomington (20,504); Illinois Wesleyan, Bloomington (2028); Millikin University, Decatur (2079); Parkland College, Champaign (9280); Southern Illinois University, Carbondale and Springfield (4334); and University of Illinois, Urbana-Champaign (36,936).

2.9 Historic and Cultural Resources

This section discusses the cultural background and the known historic and archaeological resources at the Exelon ESP site and in the surrounding area of DeWitt County. It also details

(a) Personal communication March 2, 2004, with Christy Long (DeWitt County Treasurer).
(b) Personal interview conducted on March 5, 2004, in the City of Monticello, Illinois, with Lawrence J. McNabb (Superintendent, Monticello Community School District 25).
(c) Personal interviews conducted on March 3, 2004, in the City of Clinton, Illinois, with Roger A. Little (Superintendent, Clinton Unit School District 15), and on March 5, 2004, in the City of Monticello, Illinois, with Lawrence J. McNabb (Superintendent, Monticello Community School District 25).
(d) Personal communication February 11, 2004, with Nancy Cooper (Dean, Enrollment Services, Richland Community College, Decatur, Illinois).

measures that will be taken to protect cultural resources, and describes consultation efforts accomplished to date.

2.9.1 Cultural Background

The area in and around the ESP site has a rich cultural history and a substantial record of significant prehistoric and historic resources. In March 2004, NRC staff conducted a site file search at the Illinois State Historic Preservation Agency (IHPA). The site files identified a total of 95 archaeological sites and isolated finds within a 3.2-km (2-mi) radius of the plant. Ten archaeological sites contained features or artifacts dating from the historic period; 92 sites contained features and/or artifacts from the prehistoric period.

The Salt Creek River system flows through the area and influenced settlement in the area. Of the 92 sites with prehistoric remains, 22 sites are dateable. The record indicates that prehistoric occupation of the area began in the Early Archaic period (ca. 8000 B.C. - 1000 B.C.) and extended through the Woodland Period (1000 B.C. - A.D. 900) and the Mississippian Period (A.D. 900 -1600).

When Euroamericans arrived in the area in approximately 1600 A.D., the area was occupied by American Indian groups associated with the Illini Confederacy and the Kickapoo, who remained in the area until the 1820s. Present-day tribes with ancestral ties to the area include the Kickapoo of Kansas Tribal Council, the Kickapoo of Oklahoma Business Committee, the Kickapoo Traditional Tribe of Texas, the Eastern Delaware Tribe, the Delaware Tribe of Western Oklahoma, and the Peoria Tribe of Indians of Oklahoma.

The historic period in this region began with the pioneers who entered the area as part of the general westward expansion. The first permanent settlers came from Kentucky and Tennessee to farm the land in the 1830s. Clinton emerged as a major commercial center with the arrival of the Illinois Central Railroad locomotive in 1854. DeWitt County retains many of the rural characteristics that were part of its early history. Standing structures within a 3.2-km (2-mi) radius of the CPS include the Harp Township Hall and the Centenary Methodist Episcopal Church Barn, which are located in Birkbeck.

2.9.2 Historic and Cultural Resources at the Exelon ESP Site

The original CPS project consisted of the power plant site and the portion of the North Fork Salt Creek dammed to make Clinton Lake, which supports plant operations. Most of the lake was subsequently leased to the IDNR and has been developed as the Clinton State Recreation Area. Although much of the current plant consists of disturbed areas impacted by industrial facilities, roads, parking lots, and former laydown yards, portions of the plant remain undisturbed or minimally disturbed.

A Phase 1 archaeological survey was conducted in the early 1970s prior to the construction of the CPS. In addition to the area proposed for the CPS, the survey included selected portions of the Salt Creek floodplain and adjacent uplands (Lewis 1973), recording 132 sites. The exact areas surveyed are not known, but were concentrated in the North Fork Salt Creek drainage, which was planned to be dammed to create a lake to serve water intake and outflow needs of the nuclear plant. Ten sites that had diagnostic evidence, such as a projectile point to provide an age, were recommended for additional investigation.

The Illinois State Museum performed archaeological testing of the 10 recommended sites in 1974 (Lewis 1975). In 1975, the Museum conducted an additional archaeological excavation at the Pabst Site (11DW32), located near the proposed water intake structure, and recovered a substantial amount of archaeological data (Lewis 1976). The Pabst Site was an area that prehistoric peoples repeatedly occupied beginning approximately 4000 years ago. The site appears to have been a base camp from which small task groups departed to hunt and gather foods to bring back to use at the camp. Remains from these activities formed an archaeological deposit 1 m (3.3 ft) thick and 2 ha (5 ac) in size. Lewis reports that he prepared an application for nominating the Pabst Site to the National Register of Historic Places and that the application was accepted on April 30, 1975 (Lewis 1976); however, no records of this acceptance were found at the IHPA in 2004.

Also prior to the original plant construction, research identified the Valley Mill (ca. 1850; 11DWH24), located on the North Fork, and eight iron bridges (ca. 1870s), which crossed the North Fork and Salt Creek, as historic resources worthy of attention. All of these would be inundated by the proposed reservoir. Plans were made to move two of the bridges for use as footbridges and to move the Valley Mill to higher ground where the DeWitt County Museum Association would assist with interpretation to the public (AEC 1974). Neither of these events ever occurred.

In 2000, Dynegy Midwest Generation, Inc., funded an archaeological survey at the CPS, prior to construction of a wastewater treatment plant to be located near the water outfall structure (Howe 2000). Background historical research indicated the presence of a road through the area and a historic structure as early as 1875 on an 32-ha (80-ac) parcel owned by P. Wakefield. During the archaeological survey, one historic site (11DW360) was recorded, characterized by a small scatter of historic debris such as glass, pottery, and brick. Subsequent shovel-testing failed to identify any intact prehistoric or historic deposits, and no additional work was recommended.

To determine if significant historic and cultural resources have been identified or may exist at the ESP site, the National Historic Preservation Act of 1966 (NHPA), Section 106 process is being integrated with the National Environmental Policy Act of 1969 process, in accordance with

36 CFR 800.8. As part of this integration, an Area of Potential Effect (APE), that is, the area within which cultural and historical sites could be impacted, was defined as

> the area at the power plant site and its immediate environs which may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of new transmission lines that may follow parallel with some of the existing transmission line systems now serving the Clinton Power Station (NRC 2003).

Prior to defining the APE, consideration was given to including the Clinton Lake shoreline in the APE; it was not included because water intake demands and outflow projections from the proposed new plant will be negligible and will not have any significant impact on fluctuating lake levels. Therefore, the new plant will not have any effect on any archaeological sites located on the lake.

The APE includes the areas where new facilities and associated infrastructure are planned. This includes all areas where construction laydown yards may be located. Because laydown yards and, in some cases, associated infrastructure have yet to be identified, the APE is that area within the current plant boundary. Disturbed areas within the APE are considered because the extent of disturbance in many areas is not known. Previous laydown yards, for example, are clearly disturbed at the surface, but that disturbance may be relatively shallow. Other areas were farmed previously, causing significant disturbance within the plow-zone; however, plowed fields are not considered totally disturbed because prehistoric archaeological deposits are often found below the plow-zone in Illinois. If these areas were selected for siting portions of a new nuclear unit, additional work might need to be conducted, such as tilling the area, conducting an archeological pedestrian survey, and performing shovel-tests.

Within the APE, previous cultural resource identification efforts indicate the presence of several archaeological sites and the potential for additional sites. The most significant known site is the Pabst Site (11DW32), located near the proposed water-intake structure. The Pabst Site was excavated in 1975 to mitigate the effects of Unit 1 at CPS; a large number of prehistoric artifacts from a Late Archaic midden, dated approximately 4000 to 6000 years ago, were recovered (Lewis 1976). The site is currently under water, but may be exposed when construction of the water intake structure begins. According to the project archaeologists who performed the original excavations at the Pabst Site, the site may no longer exist:

> It is extremely doubtful that further archaeological investigations will ever be undertaken at Pabst. A visit to the site in February of 1976 showed that much of the site was buried under fill from earthmoving along the crest of the bluff. The construction of the ultimate heat sink will undoubtedly remove more of the site area. Finally, the reservoir waters will eventually cover what remains, if anything (Lewis 1976).

Nevertheless, if, when construction of the water intake structure begins, any evidence of an archaeological site is found, Exelon will need to contact the IHPA for guidance (NRC 2003).

Two additional sites (11DW223 and 224) were identified during the original 1974 survey in the area between the new power plant footprint and the proposed cooling tower. Both sites are small prehistoric occupations of unknown cultural affiliation. These sites were not further investigated due to the lack of diagnostic material. Nevertheless, the presence of these sites and the discovery of similar sites nearby suggest that there is high potential for prehistoric sites in this general area (Ahler 1990a, 1990b). Prior to construction, this area will need to be further investigated using appropriate methods such as tilling, surveying, and shovel-testing.

Previous investigations did not discover any human remains. During initial consultation efforts with American Indian tribes formerly from this area, some of the tribes have requested they be contacted if human remains are discovered during construction.

Documentary research indicates that a 19th-century road and several farms were located in the area to be impacted by the proposed construction (Warner and Beers 1875; Ogle 1915). Previous investigations have not identified significant archaeological resources associated with these farms; however, the possibility remains that such deposits exist.

No analysis of historic and cultural resources was conducted for the transmission line rights-of-way. The full extent of potential land-use impacts in the transmission line rights-of-way can be estimated only after following the Federal Energy Regulatory Commission (FERC) process for connecting new large generation sources to the grid. This process is detailed more specifically in Section 3.3.

2.9.3 Consultation

In December 2003, the NRC initiated consultation on the proposed action by writing the IHPA and the Advisory Council on Historic Preservation. Also in December 2003, the NRC initiated consultations with the Kickapoo of Kansas Tribal Council, the Kickapoo of Oklahoma Business Committee, the Eastern Delaware Tribe, the Delaware Tribe of Western Oklahoma, the Peoria Tribe of Indians of Oklahoma, and the Kickapoo Traditional Tribe of Texas by first calling and then following up with a letter. In the letters, the NRC provided information about the proposed action, indicated that review under the NHPA would be integrated with the NEPA process in accordance with 36 CFR 800.8, invited participation in the identification and possible decisions concerning historic properties, and invited participation in the scoping process (see Appendix F).

On December 18, 2003, NRC conducted a public scoping meeting in Clinton, Illinois. No comments or concerns regarding historic and cultural resources were made at this meeting.

The NRC did receive two letters in response to its earlier communications. The Peoria Tribe indicated that it had no objection to the proposed construction, but requested that if human remains or objects falling under Native Graves Protection and Repatriation Act (NAGPRA) were discovered, construction would stop until State and Tribal representatives were contacted (Froman 2004). The Delaware Nation NAGPRA Office requested that NRC work with the State Historic Preservation Officer to take appropriate steps and that the Delaware Nation be kept informed of any changes and cultural work competed; they also requested that work stop and that the State and tribe be contacted in the case of inadvertent discovery of human remains or other archaeological materials (Wahahrockah-Tasi 2003).

During discussions with the NRC staff In March 2004, the IHPA indicated that cultural resource studies should be conducted prior to construction, depending on where construction would occur. Consultation efforts will continue when other Federal, State, local, and Tribal organizations as well as members of the public receive a copy of the draft version of this EIS along with a request for comment.

2.10 Environmental Justice

Environmental justice refers to a Federal policy under which each executive agency identifies and addresses, as appropriate, disproportionately high and adverse impacts on human health or environmental effects of its programs, policies, and activities on minority[a] or low-income populations. Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969. The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although it is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. The staff uses as guidance the NRC Office of Nuclear Reactor Regulation office instruction number LIC-203 (NRC 2001,[b] 2004a).

The staff examined the geographic distribution of minority and low-income populations within an 80-km (50-mi) radius of the CPS site, employing the 2000 Census (USCB 2000f, 2000g). The

(a) Minority categories are defined as: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; Hispanic ethnicity; and "other," considered a separate minority category. The 2000 Census included multi-racial data. Some minority populations can be composed of one or more minority races (USCB 2000f).

(b) NRC also issued a policy statement on Environmental Justice and an update to LIC 2003 (see 69 FR 52040 and NRC 2004a, respectively).

analysis was also supplemented by field inquiries to planning, economic development, real estate, and social service agencies and to county and city officials.[(a)]

For the purpose of the staff's review, a *minority population* exists if the percentage of any minority or aggregated minority category within the census block groups[(b)] within the 80-km (50-mi) radius of the proposed ESP site exceeds the corresponding percentage of minorities in the entire State of Illinois by 20 percent, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A *low-income population* exists if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the entire State of Illinois by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent. For counties and census block groups within an 80-km (50-mi) radius of the ESP site, the percentage of minority and low-income populations is compared to the percentage of minority and low-income populations in Illinois, as applicable.[(c)]

Exelon followed the convention of including census blocks in its evaluation. It used 2000 Census data for both minority and low-income populations. However, their approach to assessing minority and low-income populations did not follow NRC guidance. Exelon's reason for not following NRC guidelines was the presence of one Native American in one census block (the only person in that census block), 1.2 km (0.75 mi) from the ESP site (Exelon 2003a).

(a) Personal interviews were conducted: on March 2, 2004, with Sandi Thayer (Thayer Real Estate), Duane Harris (DeWitt County Board Chairman), Terry Ferguson (DeWitt County Board and Land Use Chairman), Sherrie Brown (Administrator, DeWitt County Zoning), Sandy Moody (DeWitt County Supervisor of Assessments), Dee Dee Rentmeister (Administrative Assistant, DeWitt County Board of Supervisors), and Christy Long (DeWitt County Treasurer); on March 3, 2004, with Roger Cyrulick (Mayor of Clinton), Steve Lobb, (Director of Public Works, Clinton), Tim Followell (Administrative Assistant, Clinton), Steven Vandiver (Economic Development Director, Clinton), Camill Tedrick (General Manager, Brady Weaver Real Estate), Cheryl Leitz (Executive Direct, DeWitt County Human Resources Center), and Roger Little (Superintendent, Clinton Unit School District 15); and on March 5, 2004, with Sue Gortner (Executive Director, Monticello Chamber of Commerce and Tourism), Bill Mitze (Mayor, Town of Monticello), Mary Jo Hetrick (Community and Economic Development Director, Monticello), Floyd Allsop (Superintendent of City Services, Monticello), and Lawrence J. McNabb (Superintendent, Monticello Community Unit School District 25).

(b) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the U.S. Census Bureau collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census-data users in accordance with U.S. Census Bureau guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2001).

(c) Low-income households should be identified using the annual statistical poverty threshold from the U.S. Census Bureau (NRC 2004a).

Exelon aggregated within the 80-km (50-mi) radius the total population and the total minority and low-income populations. It then calculated the percentage of total minority and low-income populations in the region and compared the resultant figures against the percentage of minority and low-income populations in Illinois. The total minority population within the region was 13 percent, while that of Illinois was 39 percent. For low-income populations, 10 percent of the population within the region had incomes below the poverty level, compared to the State of Illinois as a whole, which had 11 percent of the population below the poverty level (Exelon 2003a). By not following NRC convention, Exelon under-emphasized individual census block groups where the corresponding percentage of minority or low-income populations exceed the 20- or 50-percent criterion. However, in deriving the minority and low-income maps contained in the ER, Exelon showed all census blocks with minority or low-income populations, including blocks containing 0 to 5 percent minority or low-income populations (Exelon 2003a).

The staff followed the convention of using census block groups to determine distribution of minority populations within the 80-km (50-mi) radius. Figure 2-6 shows the distribution of minority populations (shaded areas) within the 80-km (50-mi) radius. All census blocks with at least 50 percent of their area within the 80-km (50-mi) radius around the CPS site are included in the analysis. Data from the 2000 Census characterize 32.2 percent of the Illinois population as minority (USCB 2000a). The percentage that the staff determined is different from the percentage that Exelon determined (39 percent). Applying the NRC criterion of "more than 20 percent greater," the census block groups were identified to contain minority populations. Within the 80-km (50-mi) radius, census block groups containing minority populations are concentrated in the larger cities of Urbana-Champaign, Decatur, and Springfield. The shaded area in Logan County is where two prisons are located.

Figure 2-7 shows the distribution of low-income populations (shaded areas) within the 80-km (50-mi) radius. All census blocks with at least 50 percent of their area within the 80-km (50-mi)radius around the CPS site are included in the analysis. Data from the 2000 Census classified 10.7 percent of Ilinois individuals as low-income (USCB 2000b). Applying the NRC criterion of "more than 20 percent greater," the census block groups were identified to contain low-income populations. Within the 80-km (50-mi) radius, census block groups containing low-income populations are concentrated in the larger cities of Urbana-Champaign, Decatur, Bloomington-Normal, and Springfield. The shaded area in Logan County is where two prisons are located.

2.11 Related Federal Projects

The staff reviewed the possibility that activities of other Federal agencies might impact the granting of an ESP to Exelon. Any such activities could result in cumulative environmental impacts and the possible need for a Federal agency to become a cooperating agency for preparation of the EIS (10 CFR 51.10(b)(2)).

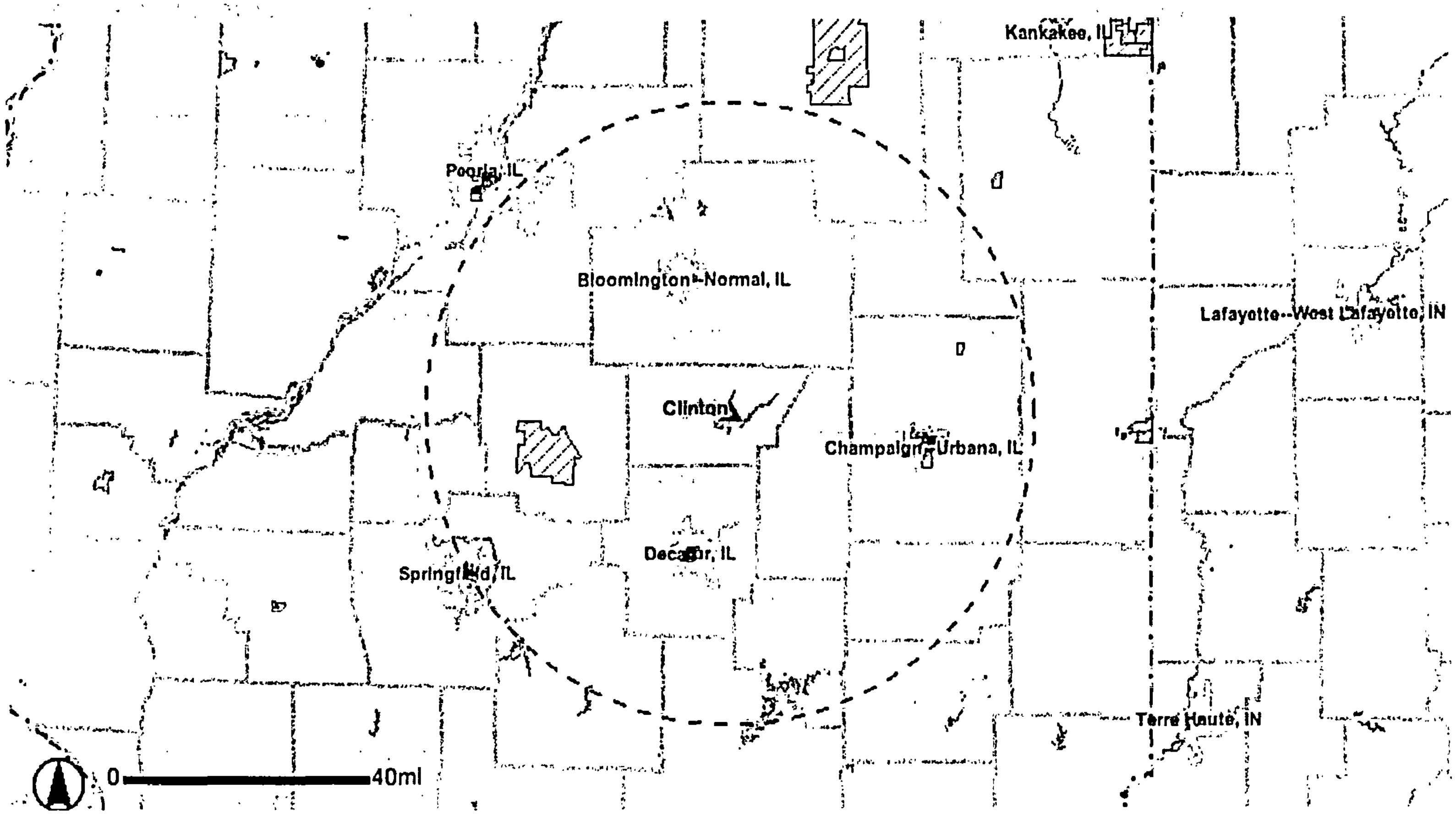

Figure 2-6. Geographic Distribution of Minority Populations (shown in shaded areas) Within an 80-km (50-m) Radius of Exelon ESP Site

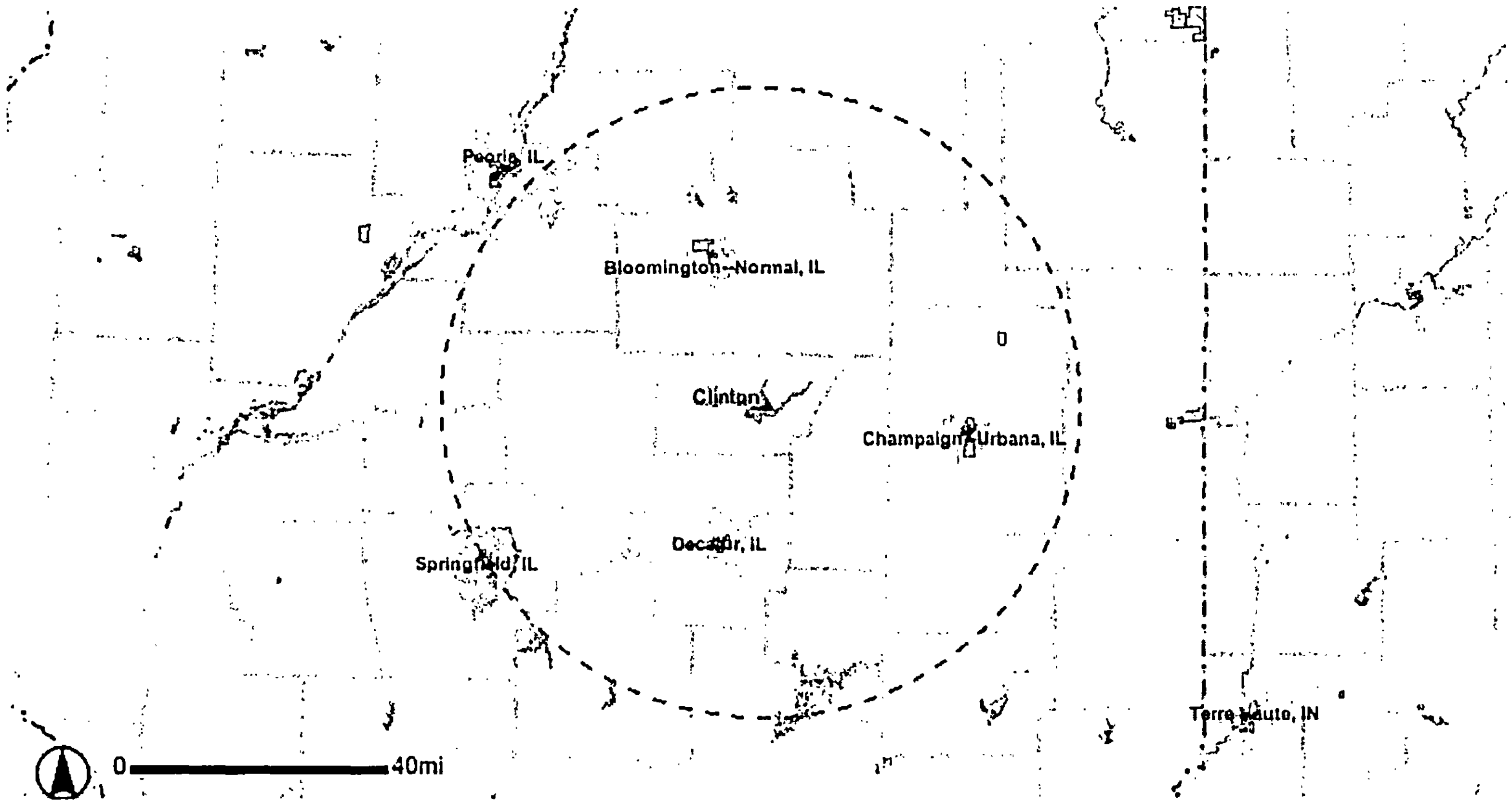

Figure 2-7. Locations of Low-Income Populations (shown in shaded areas) Within an 80-km (50-m) Radius of Exelon ESP Site

After reviewing the Federal activities in the vicinity of the ESP site, the staff determined that there were no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparation of this EIS. Future Federal actions related to this project include permits and licenses that may be required at the time of the CP or COL application. Other Federal projects may be required at the CP or COL stage, such as transmission-related studies by FERC. However, these activities do not relate to the ESP and have not been started. In summary, no other Federal activities or projects are associated with the permitting of this ESP site.

The geographic region covered by this EIS extends as far as Pontiac, Illinois, to the north. As such, the extreme northern portion of the region is overlapped by the regions of several other nuclear power stations, including Braidwood 1 and 2, Dresden 2 and 3, and LaSalle 1 and 2 (all considered possible alternative sites). As such, the 80-km (50-mi) region for the ESP site would encompass the communities in the area of Pontiac, Chattsworth, Fairbury, Forrest, and Chenoa, Illinois, as would several of the alternative ESP sites considered. These communities would be within the 80-km (50-mi) region of seven nuclear power stations if a new nuclear unit were constructed at the Exelon ESP site.

2.12 References

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10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

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3.0 Site Layout and Plant Parameter Envelope

The site for the proposed Exelon Generation Company, LLC (Exelon) early site permit (ESP) is located in DeWitt County in rural central Illinois, within the current Clinton Power Station (CPS) boundary. The site is situated approximately 10 km (6 mi) east of the City of Clinton, Illinois. This chapter describes the approach Exelon used to identify the key plant parameters and site characteristics that Exelon and the U.S. Nuclear Regulatory Commission (NRC) staff used to assess the environmental impacts of the proposed action. The site layout and existing facilities are discussed in Section 3.1. The plant parameters and power transmission system are discussed in Sections 3.2 and 3.3, respectively, and references for this chapter are in Section 3.4.

3.1 External Appearance and Plant Layout

The existing CPS site consists of one operating boiling water reactor (BWR) manufactured by General Electric, a turbine building, a switchyard, intake and discharge structures, and support buildings. The site is located on the shore of Clinton Lake, an impoundment that was created in 1977 by erecting a dam on the arm of Salt Creek as a cooling source for the CPS. The existing unit uses Clinton Lake as an ultimate heat sink (UHS). A radioactive waste disposal system, a fuel-handling system, and the auxiliaries, structures, and other onsite facilities required for a complete nuclear power station exist on the CPS site. The existing CPS site development is shown in Figure 2-1. The existing CPS site would remain as is. The ESP site is located in a previously disturbed area adjacent to the existing unit.

A specific plant design has not been chosen for a new nuclear unit at the Exelon ESP site; instead, a set of bounding plant parameters known as a plant parameter envelope (PPE) has been specified to envelop the design to be considered for the ESP site. This PPE is based on the addition of a new nuclear unit, which would be a standalone plant with its own support systems. Exelon states that a new nuclear unit would share ancillary support structures, such as maintenance facilities, office centers, or waste- and water-treatment plants. A new nuclear unit may consist of one or more reactors or reactor modules. These multiple reactors or modules (the number of which may vary depending on the reactor type selected) would be grouped into one operating unit, and could have a total core thermal power rating between approximately 2400 and 6800 MW(t) (Exelon 2003a). For the purposes of the evaluation described in this environmental impact statement (EIS), the staff assumed a power rating of 6800 MW(t), unless stated otherwise. For the cooling system, Exelon has proposed either a wet cooling system that will utilize mechanical or natural draft cooling towers, or a hybrid wet/dry cooling system that will use a combination of the wet and dry systems. Exelon also states that a third option, use of a dry cooling system, is being proposed. However, the applicant states that full wet or hybrid wet/dry cooling processes have been assumed for most purposes because out of the options proposed, they have the greatest consumptive water uses.

Exelon does not provide information on a dry cooling system to support an environmental analysis not does the applicant address the adverse environmental impacts of such a system (noise, large footprint, and inefficiency). Therefore, the staff did not evaluate a dry cooling system during its review. Should Exelon choose to use a dry cooling system at the ESP site in a CP or COL application, the staff will evaluate the environmental impacts of construction and operation of the system during that review.

3.2 Plant Parameter Envelope

As described in Subpart A of Title 10 of the *Code of Federal Regulations* (CFR) Part 52, the applicant for an ESP need not provide a detailed design of a reactor or reactors and the associated facilities but must provide sufficient bounding parameters and characteristics of the reactor or reactors and the associated facilities so that an assessment of site suitability can be made. Consequently, the ESP application may refer to a PPE as a surrogate for a nuclear power plant and its associated facilities.

A PPE is a set of values of plant design parameters that an ESP applicant expects will bound the design characteristics of the reactor or reactors that might be constructed at a given site. The PPE values are a surrogate for actual reactor design information. Analysis of environmental impacts based on a PPE approach permits an ESP applicant to defer the selection of a reactor design until the construction permit (CP) or combined CP and operating license (combined license or COL) stage. The PPE reflects upper or lower bounds (as appropriate) of the values for each parameter that it encompasses rather than the characteristics of any specific reactor design. Appendix J lists the complete set of PPE values that are provided in the Exelon ESP application.

Reactor Designs Considered in the PPE

In its ESP application, Exelon used a composite of values from seven reactor designs to develop the PPE (Exelon 2003a). The values used for the seven reactor designs are not necessarily the same values used in the safety evaluation. The values in this report are not design-specific; rather, they are used to determine the environmental impacts of a reactor design that falls within the values used in this report. The reactor designs used to develop the PPE include the following five light water reactor (LWR) and two gas-cooled reactor types:

- Advanced Canada Deuterium Uranium Reactor (ACR-700) – This reactor, developed by Atomic Energy Canada Limited, is an evolutionary extension of the CANDU 6 plant using very slightly enriched uranium fuel and light water coolant.

- Advanced Boiling Water Reactor (ABWR) – This reactor, developed by General Electric Company, is a standardized plant that has been certified under the NRC requirements in 10 CFR Part 52. The ABWR is fueled with slightly enriched uranium and uses a light water cooling system.

- Advanced Pressurized Water Reactor (AP1000) – This is an earlier version of the AP1000 reactor final design that was developed by Westinghouse Electric Company and subsequently approved by the NRC. The design uses slightly enriched uranium and a light water cooling system. Because the ESP ER was developed before the staff's review of the AP1000 was complete, this design is not the AP1000 that received final design approval from the NRC on September 13, 2004. It is an earlier version that is referred to as the "surrogate AP1000" throughout the rest of this report.

- Economic Simplified Boiling Water Reactor (ESBWR) – This reactor, developed by General Electric Company, is fueled with slightly enriched uranium and uses a light water cooling system.

- International Reactor Innovative and Secure (IRIS) next-generation pressurized water reactor (PWR) – This reactor is under development by a consortium led by Westinghouse Electric Company and is a modular light water reactor.

- Gas Turbine Modular Helium Reactor (GT-MHR) – This reactor, developed by General Atomics, is a modular helium-cooled graphite-moderated reactor.

- Pebble Bed Modular Reactor (PBMR) – This reactor, developed by PBMR (Pty) Ltd., is a modular graphite-moderated helium-cooled gas turbine reactor.

For illustration, power ratings and the number of reactors or modules identified as a potential single unit for the ESP site are listed in Table 3-1. The facility or unit that might be built on the ESP site might consist of one to eight reactors of the types listed in Table 3-1, or a combination of these different designs. Moreover, Exelon would not be required to use any of these designs

Table 3-1. Power Ratings for Reactor Designs Considered in the PPE

	ABWR	ESBWR	AP1000	ACR-700	IRIS	GT-MHR	PBMR
Power rating per reactor or reactor module (MW[t])	3926 (4300)[(a)]	4000	3400	1983	1000	600	400
Number of reactors or reactor modules per plant	1	1	2	2	3	4	8
Power rating per unit (MW[t])	3926 (4300)[(a)]	4000	6800	3966	3000	2400	3200

(a) Exelon states that the site-related parameters for the ABWR are based on one 3926 MW(t) reactor. However, Exelon used parameters from an uprated 4300 MW(t) ABWR reactor in some of its analyses.

if it elects to proceed with a CP or COL application; however, the applicant would have to demonstrate that the characteristics of the reactor(s) or reactor module(s) ultimately selected were within the bounds of the PPE for the assessment of a given characteristic contained in this EIS to be applicable.

Other Considerations in the Review

Site-specific values were used to determine the atmospheric dispersion factors. Atmospheric dispersion factors were calculated using site meteorological conditions to determine the dilution capability of the site. At the CP or COL stage, the staff will need to verify that the atmospheric dispersion factors for the selected reactor are bounded by the values specified by the site atmospheric dispersion factors.

In its evaluation of uranium fuel cycle impacts for the Exelon ESP site, Exelon used the PPE approach for the advanced LWR designs but not for the two gas-cooled reactors. In its evaluation of the impacts from transportation of radioactive materials, Exelon did not use the PPE approach but rather evaluated each reactor design individually. In situations where designs were evaluated individually, Exelon would have to perform a new evaluation if a different design is proposed at the CP or COL stage. In its evaluation of the radiological consequences on the environment of potential design basis accidents, Exelon used the PPE approach focusing on two LWRs: the certified ABWR with an uprated power level of 4300 MW(t) and a surrogate AP1000 reactor design. The PPE does not include source terms for severe accidents; therefore, Exelon used source terms for the ABWR and the surrogate AP1000 reactors instead of PPE values. The staff did not evaluate the design basis or severe accident impacts for gas-cooled reactors. Therefore, at the CP or COL stage, Exelon and the staff will need to evaluate whether the environmental impacts of design basis and severe accidents at the Exelon ESP site remain bounded by the impacts from the surrogate (ABWR and AP1000) designs. The staff's evaluation of this analysis can be found in Section 5.10.

Review Approach

NUREG-1555, *Environmental Standard Review Plan* (ESRP) (NRC 2000) and review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004), provide guidance to the NRC staff to help ensure a thorough, consistent, and disciplined review of any ESP application. The staff's June 23, 2003, responses to comments received on draft RS-002 (NRC 2003) provide additional insights on the staff's expectations and approach to the review of an application employing the PPE approach.

If PPE values are used as a surrogate for design-specific values, the staff expects Exelon to provide sufficient information for the staff to develop a reasonable independent assessment of potential impacts to specific environmental resources. In some cases, the design-specific information called for in the ESRP may not have been provided in the Exelon ESP application because it did not exist or was not available, so the NRC staff could not apply the ESRP guidance in these review areas. In these cases, the NRC staff used its experience and judgement to adapt the review guidance in the ESRP and to develop assumptions necessary to evaluate impacts to certain environmental resources to account for this missing information. These assumptions are discussed in the appropriate sections of the EIS.

Because the Exelon PPE values do not reflect a specific design, they were not reviewed by the NRC staff for correctness. However, the NRC staff made a determination that the application was sufficient to enable the staff to conduct its required environmental review and that the PPE values are not unreasonable for consideration by the staff when making its finding in accordance with Subpart A of 10 CFR Part 52. During its environmental review, the staff used its judgement to determine whether Exelon provided sufficient information for the staff to perform its independent assessment of the environmental impacts of construction and operation of a new nuclear unit. The staff considered the PPE values to be bounding parameters. Therefore, the staff's evaluation serves as a bounding estimate of the potential environmental impacts resulting from constructing and operating the new nuclear unit.

Throughout the Environmental Report (ER) supporting the Exelon ESP application, Exelon provides

(1) commitments to address certain issues in the design, construction, and operation of the facility

(2) statements of planned compliance with current laws, regulations, and requirements

(3) commitments to future activities and actions that it will take should it decide to apply for a CP or COL

(4) descriptions of Exelon's estimate of the environmental impacts resulting from the construction and operation of a new nuclear unit on the ESP site

(5) descriptions of Exelon's estimates of future activities and actions of others and the likely environmental impacts of those activities and actions that would be expected should Exelon decide to apply a CP or COL.

The activities described include, but are not limited to, such actions as:

- considering the results of testing and monitoring during the development of the CP or COL application

- complying with NRC and other agency regulations, including obtaining appropriate permits from other agencies

- taking actions to mitigate adverse environmental impacts, including following industry or company standards, practices, or protocols

- addressing certain issues at the CP or COL stage that were not addressed in the ESP application.

Some of these future actions are those that Exelon would be required to implement because they are currently required by law, and others are actions that Exelon has indicated that they will implement without the obligation of law to take such actions. Those matters considered by the staff in determining the level of impacts to a resource are discussed throughout this EIS and are listed in Appendix K.[a] Table K-1 lists those matters that were considered in the staff's evaluation of the environmental impacts related to the construction and operation of a new nuclear unit at the Exelon ESP site. Table K-2 lists those matters that are identified in the ER, but are not directly considered by the staff in its evaluation. Table K-3 lists statements related to activities and actions of others that were considered by the staff.

The staff performed its evaluation of the impacts of constructing and operating a new nuclear unit at the ESP site assuming that these commitments, activities, and actions would be undertaken by Exelon and others during future licensing activities.[b] As discussed previously, the staff developed assumptions necessary to evaluate impacts to certain environmental resources to account for missing detailed information. In addition to other sources of information obtained independently, the staff considered the commitments, future activities and actions, and estimates of expected environmental impacts that were identified by Exelon in its ER and listed in Appendix K, as well as the PPE values listed in Table J-1, when developing the inputs and assumptions used in the staff's own independent evaluation of the environmental impacts of constructing and operating a new unit on the Exelon ESP site.

In addition, as a result of the staff's environmental review of the Exelon ESP application, the staff determined that conditions or limitations on the ESP may be necessary in specific areas, as set forth in 10 CFR 52.24. Therefore, the staff identified when and how assumptions and bounding values limit its conclusion on the environmental impacts to a particular resource, where appropriate.

(a) The listing is not intended to be a complete list of the commitments described in the ER.
(b) Those actions required to be undertaken by current law could change through the passage of future laws and regulations, and therefore, are listed in Appendix K to provide a listing of those laws and regulations considered during the staff's ESP environmental review.

During the review of a CP or COL application referencing an ESP, the staff will assess the environmental impacts of the construction and operation of a specific plant design. If the environmental impacts addressed in the ESP EIS are found to be bounding by the staff, no additional analysis of these impacts will be required, even if the ESP applicant employed the PPE approach. However, environmental impacts not considered or not bounded at the ESP stage have to be assessed at the CP or COL stage. In addition, measures and controls to limit adverse impacts will need to be identified and evaluated for feasibility and adequacy in limiting adverse impacts at the CP or COL stage. The inputs and assumptions that were used or considered during the staff's evaluation of the ESP application (listed in Appendices J and K) will provide the basis for the staff's verification review in which the staff must determine whether or not a specific design in a CP or COL application falls within the PPE, and the environmental impacts of the construction and operation of that specific design fall within the bounds of environmental impacts estimated by the staff at the ESP stage.

3.2.1 Plant Water Use

The PPE provides bounding constraints on portions of plant water use. Other constraints on plant water use are based on site-specific information. This EIS assesses the impacts of plant water use bounded by the PPE and site-specific constraints. The following sections describe both the consumptive and nonconsumptive water uses of the proposed ESP facility and the associated plant water-treatment systems. The cooling systems are described in more detail in Section 3.2.2.

3.2.1.1 Plant Water Consumption

The primary water demand for the proposed ESP facility is for condenser cooling. Exelon discusses using either a wet tower closed-loop cooling system, or a hybrid wet/dry closed-loop cooling system. The PPE provides bounds for a wet tower cooling system but no similar values for the hybrid wet/dry cooling system. The staff assumed that water use for the hybrid wet/dry cooling system is bounded by the wet cooling system values. Therefore, the following discussion is limited to the wet tower system. The hybrid wet/dry cooling system will not be addressed further in this EIS.

The current CPS relies on once-through cooling. The original environmental analysis for the CPS found that Clinton Lake was expected to be able to support two once-through cooling units. In its ER, however, Exelon proposed that a closed-cycle cooling tower be used with the new nuclear unit (Exelon 2003b). While the nonconsumptive water use of a closed-cycle tower is far less than a once-through cooling system, the consumptive water use is greater. For a wet tower, the majority of water withdrawn from Clinton Lake would be lost to the atmosphere as evaporation. To prevent the concentration of solids and dissolved solids from increasing to a level that would impair the functioning of the cooling tower, a fraction of the water in the tower is continuously released as blowdown. A once-through system returns the same amount of water as it withdraws; however, the elevated temperature returned to Clinton Lake from a once-through cooling system does result in some induced evaporation from the lake to the environment.

A new nuclear unit would normally withdraw 2829 L/s (44,843 gpm) through the intake structure. Blowdown from the cooling tower(s) would return approximately 760 L/s (12,000 gpm) as blowdown to Clinton Lake via the discharge flume.

A new nuclear unit would also have demands for potable water, demineralized water, filtered water, and fire protection water. In Table 3.3-2 of its ER, Exelon estimates these combined consumptive water uses would be 49.1 L/s (778 gpm) per unit under normal conditions and 226.7 L/s (3593 gpm) when demands are at maximum levels (including filling the fire protection system to full capacity) (Exelon 2003a).

For safety-related cooling, the ultimate heat sink (UHS) for a new nuclear unit would provide cooling water to reactor cooling systems and safety-related components. Exelon proposes to use the same UHS reservoir as the CPS uses as its UHS reservoir, which was designed to accommodate two units. The UHS reservoir will provide makeup water to mechanical draft UHS towers.

3.2.1.2 Plant Water Treatment

Because a specific design has not been selected, the ultimate water-treatment systems for the ESP units are not specified. Details and limits of the plant water-treatment system will be provided in the CP or COL application. The water quality of effluents from any water treatment would be regulated by the new nuclear unit's National Pollutant Discharge Elimination System (NPDES) permit.

3.2.2 Cooling System

In Sections 3.4.1 and 3.4.2 of its ER, Exelon describes the operational modes and components, respectively, for the cooling systems for a new nuclear unit (Exelon 2003a). While the design of the cooling system has not been specified, parameters from the PPE are used to bound the impacts of the cooling system on the environment. The specific details and limits of the cooling system will be provided in the CP or COL application.

3.2.2.1 Description and Operational Modes

The following sections describe the operating modes under normal operating conditions and emergency/shutdown conditions for a new nuclear unit at the Exelon ESP site.

Normal Cooling

During normal operation at full power, based on the PPE, the cooling tower system is required to reject a heat load of 4420 MW (15.1 x 10^9 Btu/hr) to the environment. The new unit will reject this heat load using cooling towers. Based on the PPE, the maximum blowdown temperature is 38°C (100°F).

During low-water conditions, the existing CPS unit is allowed to operate down to a lake-level elevation of 206 m (677 ft) above mean sea level (MSL). Exelon is proposing that the new nuclear unit also be allowed to operate down to 206 m (677 ft) above MSL.

Ultimate Heat Sink

Based on the PPE, during shutdown, the UHS system for each unit would reject 123 MW (420 x 10^6 Btu/hr) to the environment. Makeup water for the mechanical draft UHS cooling towers is withdrawn from the UHS reservoir. The reservoir is required to maintain an adequate supply of water for 30 days of emergency operation. Based on the PPE, the maximum blowdown discharged to the discharge canal is 54 L/s (850 gpm).

3.2.2.2 Component Descriptions

The following sections describe the intake, discharge, and heat-dissipation systems. Pursuant to the 316(a) and 316(b) provisions of the Clean Water Act (33 USC 1251), prior to any construction activities, Exelon will be required to obtain approval from the Illinois Environmental Protection Agency (IEPA) by documenting plant design and site-specific analyses regarding the impacts of the thermal discharges and intake systems on the Clinton Lake aquatic environment.

Intake System

The proposed location of the intake structure is shown on Figure 2-1 (Exelon 2003b). The location of the intake would be approximately 20 m (65 ft) south of the location of the CPS intake structure. The intakes for both the normal heat sink and UHS of a new nuclear unit would be at the same location. Trash racks and traveling screens (or similar facilities) would be used to prevent debris from entering the intake pumps. The approach velocity to the intake would be limited to no more than 0.15 m/s (0.5 ft/s).

Discharge System

The proposed location of the discharge structure for a new nuclear unit is shown in Figure 2.1 (Exelon 2003b). The cooling tower blowdown and other discharges would enter the discharge flume near the location of the CPS discharge.

Heat Dissipation Systems

No specific design information on the normal heat dissipation systems was provided in the Exelon ESP application. While a cooling tower system bounded by the PPE is required to reject 4420 MW (15.1 x 10^9 Btu/hr) to the environment, the exact design is unknown. To meet UHS needs, Exelon proposed mechanical draft UHS cooling towers with makeup water withdrawn from the UHS reservoir.

3.2.3 Radioactive Waste Management System

Liquid, gaseous, and solid radioactive waste-management systems will be used to collect and treat the radioactive materials that are produced as a by-product of operating a new nuclear unit on the Exelon ESP site. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as reasonably achievable (ALARA) before releasing them to the environment. Waste-processing systems would be designed to meet the design objectives of 10 CFR Part 50, Appendix I (*Numerical Guide for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radiological Material in Light Water-Cooled Nuclear Power Reactor Effluents*). Radioactive material in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in LWRs. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained in the sealed fuel rods, but small quantities escape the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system would also be responsible for coolant contamination.

Exelon did not identify specific radioactive waste-management systems for a new nuclear unit on the ESP site. The PPE concept was used to provide an upper bound on liquid radioactive effluents, gaseous radioactive effluents, and solid radioactive waste releases (Exelon 2003a). Bounding effluent concentrations were determined, based on a composite of the highest activity content of the individual isotopes from two surrogate AP1000 reactors (6400 MW[t]), three IRIS reactors (3000 MW[t]), one ABWR reactor (3926 MW[t]), one ESBWR reactor (4000 MW[t]), four GT-MHR modules (2400 MW[t]), and eight PBMR modules (3200 MW[t]). Bounding liquid effluent releases are found in Table 3.5-1 of the ER (Exelon 2003b). Bounding gaseous effluent releases are found in Table 3.5-3 and bounding solid waste activities in Table 3.5-5 of the ER (Exelon 2003b). The bounding total annual volume of solid radioactive waste is estimated at 427.2 m^3/yr (15,087 ft^3/yr) with a bounding total amount of radioactive material activity of 2.2 x 10^{14} Bq (5900 Ci/yr), as found in the SSAR in the application for the ESP (Exelon 2003a).

3.2.4 Nonradioactive Waste Systems

The following sections provide descriptions of the nonradioactive waste systems for a new nuclear unit at the ESP site. These systems include chemical, biocide, and sanitary system effluents, as well as other effluents.

3.2.4.1 Effluents Containing Chemicals or Biocides

In the PPE approach, specific quantities and concentrations of chemicals or biocides used for proper water chemistry in the reactors are not identified and will need to be revisited in the CP or COL stage. Exelon identified principal chemical, biocide, and pollutant sources that may be produced during operations, including sodium hydroxide and sulfuric acid (to regenerate resins), phosphate in cleaning solutions, biocides used for condenser defouling, boiler blowdown chemicals, oil and grease from plant floor drains, chloride, sulphates, copper, iron, and zinc (Exelon 2003b). These chemicals would be discharged to the environment through treatment of domestic water, circulation water, and plant blowdown. Exelon (2003b) states the approved NPDES permit for the ESP site issued by the IEPA will limit the volume and concentration of these discharges.

Table 3.6-1 of the ER (Exelon 2003b) provides bounding concentrations of impurities in the blowdown water. Small volumes of waste water from other station systems will be combined with cooling water discharges.

Chemical waste effluents may consist of nonradioactive wastes produced from regeneration of demineralizers, waste discharges from reverse osmosis units, filter backwash water, or wastes from laboratory sampling processes. Chemical waste discharges will be collected in a tank for sampling and pH adjustment before being discharged as neutralized wastes to Clinton Lake (Exelon 2003b).

Cooling water systems will likely be treated with biocides, dispersants, molluskicides, and scale inhibitors on a periodic basis. Use of these chemicals will be approved by the IEPA and will be in compliance with an approved NPDES permit.

Clinton Lake is classified as an impaired water body by the IEPA due to excessive algal growth and moderate metals levels. Excessive algal growth is caused by high nutrient levels in the lake due to the dominant agricultural use of surrounding land. The metal concentrations are due to natural geologic formations, agricultural practices, and industrial sources. The bounding metal releases from a new nuclear unit at the ESP site would be minimal.

3.2.4.2 Sanitary System Effluents

Sanitary systems during pre-construction and construction activities will include the use of portable toilets. During operation, sanitary system wastes will likely be handled through the existing CPS sanitary sewage treatment plant. Discharges from this plant will be controlled in accordance with an approved NPDES permit issued by the IEPA. Exelon (2003b) provided a bounding sanitary discharge rate to Clinton Lake of 3.8 L/s (60 gpm) normal and 6.2 L/s (98 gpm) maximum.

3.2.4.3 Other Effluents

Discharges from the chemical waste-treatment system, plant drains, and storm drainage will go into Clinton Lake. The bounding liquid effluent discharges are 20.4 L/s (323 gpm) for normal operation and 29.7 L/s (470 gpm) maximum. Exelon indicates that the design of the plant storm water drainage systems will be presented at the CP or COL stage.

In the PPE, Exelon has identified bounding estimates for the total quantity of sulfur oxides (SO_x), nitrogen oxides (NO_x), hydrocarbons, and suspended particulates to be discharged annually during station operations by diesel engines, gas turbines, and heating facilities. The bounding annual pollutant amounts are provided in Tables 3.6-4 and 3.6-5 of the ER (Exelon 2003b) for auxiliary boilers, standby generators, and standby power system gas turbine flue gas.

3.3 Power Transmission System

The proposed ESP site is adjacent to the CPS, which is owned and operated by AmerGen within the service area of the Illinois Power Company (the regional electrical transmission system owner/operator). The primary electrical transmission system in central Illinois operates at 345 kV with secondary systems operating at 138 kV. The CPS connects to the Illinois Power Company transmission system at the CPS 345-kV switch station. From the CPS switch station, the Illinois Power Company has 345-kV interconnections to the Brokaw, Oreana, Rising, and Latham substations.

The existing transmission system from the CPS switch station has excess capacity and could handle a portion, but not all, of the power generated by a new nuclear unit. To the extent that additional transmission lines would be required to transmit power from the site, Exelon considers it most likely that the interconnections would be to the Brokaw and Oreana substations (Exelon 2003b). According to the ER, four new transmission lines would be required. Two parallel, double-circuit lines would run north approximately 37 km (23 mi) to the Brokaw substation near Bloomington, and two parallel, double-circuit lines would run south approximately 32 km (20 mi) to the Oreana substation (Exelon 2003b).

According to the ER, the existing transmission line rights-of-way between the CPS and the Brokaw and Oreana substations are generally 40 m (130 ft) wide. If past Illinois Power Company practices were to be followed, these rights-of-way would have to be widened to 76 m (250 ft) to accommodate a pair of parallel lines. Use of more typical designs for steel-lattice structures or monopoles could reduce the rights-of-way requirement to about 49 m (160 ft). However, in any case, it is likely that additional rights-of-way would be required. Land use in the existing rights-of-way is discussed in Section 2.2.2 of this report. Land-use impacts of construction of additional transmission lines along the existing rights-of-way and in the general area are discussed in Section 4.1.2, and land use impacts associated with operation of new lines are discussed in Section 5.1.2.

Exelon has not submitted an Interconnection Request to Illinois Power Company. The following paragraphs describe the process for requesting connection to the transmission system that Exelon would be required to follow should it decide to build a new nuclear unit at the ESP site. It is expected that the process for obtaining transmission services would be completed before submission of an application for construction and operation of a new nuclear unit.

Procedures for requesting connection to the transmission line rights-of-way system are set forth by the Federal Energy Regulatory Commission (FERC) in 18 CFR Part 35 and by the State of Illinois in the Illinois Power Company Open Access Transmission Tariff. The FERC process starts when an interconnection customer, in this case Exelon, submits an interconnection request to the transmission provider (Illinois Power Company). When the interconnection request is determined to be valid, the transmission provider and interconnection customer have a scoping meeting to discuss alternative interconnection options and exchange information. On the basis of this meeting, the interconnection customer designates its point of interconnection and one or more alternative points of interconnection.

Following the scoping meeting, the transmission provider conducts an Interconnection Feasibility Study to preliminarily evaluate the feasibility of the proposed interconnection to the transmission line system. This study includes a power flow and short-circuit analysis. The Interconnection Feasibility Study is followed by an Interconnection System Impact Study that focuses on the impact of the interconnection on the reliability of the transmission line system.

Finally, the transmission provider conducts an Interconnection Facilities Study to specify and estimate the cost of the equipment, engineering, procurement, and construction work needed to implement the conclusions of the Interconnection System Impact Study, in accordance with good utility practice, to physically and electrically connect the interconnection facility to the transmission line system. These studies are conducted by the transmission line provider, but the interconnection customer pays for the studies.

3.4 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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."

18 CFR Part 35. Code of Federal Regulations, Title 18, *Conservation of Power and Water Resources*, Part 35, "Filing of Rate Schedules and Tariffs."

Clean Water Act (CWA). 33 USC 1251, et seq. (also referred to as the Federal Water Pollution Control Act).

Exelon Generation Company, LLC (Exelon). 2003a. *Exelon Generation Company, LLC, Early Site Permit Application: Site Safety Analysis Report.* Exelon Nuclear, Kennett Square, Pennsylvania.

Exelon Generation Company, LLC (Exelon). 2003b. *Exelon Generation Company, LLC, Early Site Permit Application: Environmental Report.* Exelon Nuclear, Kennett Square, Pennsylvania.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan (ESRP).* NUREG-1555, Vol. 1, NRC, Washington D.C.

U.S. Nuclear Regulatory Commission (NRC). 2003. Letter from J.L. Lyons, Office of Nuclear Reactor Regulation, NRC, to R.L. Simard, Nuclear Energy Institute, dated June 23, 2–3, U.S. Nuclear Regulatory Commission Responses to Nuclear Energy Institute (NEI) Comments on Draft RS-002, Processing Applications for Early Site Permits (ML031710698).

U.S. Nuclear Regulatory Commission (NRC). 2004. *Processing Applications for Early Site Permits.* RS-002, NRC, Washington, D.C.

4.0 Construction Impacts at the Proposed Site

This chapter examines the environmental issues associated with the potential site-preparation activities and construction of the proposed new nuclear unit adjacent to the Clinton Power Station (CPS) as described in the application for an early site permit (ESP) submitted by Exelon Generation Company, LLC (Exelon). As part of this application, Exelon submitted an Environmental Report (ER) and a site redress plan (Exelon 2003a). The ER provides the plant parameter envelope (PPE) as the basis for the environmental review. The parameters included in the PPE and their values are listed in Appendix J. The site redress plan allows for specific site-preparation activities to be conducted with approval of an ESP. The activities evaluated for the Exelon ESP site are those permitted by Title 10 of the Code of Federal Regulations (CFR), 50.10(a)(1) and 52.25(a). In the event that the ESP is approved and Exelon conducts site-preparation activities but does not build the new nuclear unit, Exelon would be required to implement its site redress plan.

In Sections 4.1 through 4.9, the staff evaluates the potential impacts on land use, meteorology and air quality, water, terrestrial and aquatic ecosystems, socioeconomics, historic and cultural resources, environmental justice, nonradiological and radiological health effects, and applicable measures and controls that would limit the adverse impacts of station construction. In accordance with 10 CFR Part 51, impacts have been analyzed, and a significance level of potential adverse impacts (i.e., SMALL, MODERATE or LARGE) has been assigned to each analysis. In the area of socioeconomics, related to taxes, the impacts may be considered beneficial and are stated as such. Possible mitigation of adverse impacts, where appropriate, is presented in Section 4.10, followed by a description of the site redress plan in Section 4.11. A summary of the construction impacts is presented in Section 4.12. Full citations for the references cited in this chapter are listed in Section 4.13. Cumulative impacts of construction and operation are discussed in Chapter 7. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 9 and 10.

The staff relied on the mitigation measures and the required Federal, State, and local permits and authorizations presented in the ER in reaching its conclusion on the significance level of the adverse impacts. The staff relied on the infrastructure upgrades planned by the counties, cities, and towns, such as road and school expansions, in assigning significance levels to the impacts. Failure to implement such infrastructure upgrades may result in larger impact levels.

4.1 Land-Use Impacts

This section provides information regarding land-use impacts associated with site-preparation activities and construction of a proposed new nuclear unit at the Exelon ESP site. Topics discussed include land-use impacts at the site and in the vicinity of the site, land-use impacts in transmission line rights-of-way and offsite areas, and impacts on historic and cultural resources.

4.1.1 The Site and Vicinity

The ESP site is located entirely within the existing CPS site, which is zoned for transportation and utility use by DeWitt County.

All construction activities for a new nuclear unit, including ground-disturbing activities, would occur within the Exelon ESP site boundary. The area that would be affected on a long-term basis as a result of permanent facilities is approximately 39 ha (96 ac) (Exelon 2003a). Additional areas within the existing CPS site would be disturbed on a short-term basis as a result of temporary activities, facilities, and laydown areas.

No new or modified highways or railroad lines are planned to support a new nuclear unit. Clearing and removal of trees growing within the ESP site would be required. No agricultural lands would be directly affected by construction activities.

A few small wetland areas exist on the ESP site. Exelon intends to avoid wetlands to the extent possible during any construction (Exelon 2003a). Any work that has the potential to impact a wetland would be performed in accordance with applicable regulatory requirements.

Any work conducted immediately adjacent to the Clinton Lake Recreation Area would be performed in accordance with applicable Federal, State, and local laws and regulations, permits, and authorizations. Therefore, construction-related impacts would not affect the recreational uses of Clinton Lake or other areas in the vicinity. See Section 4.4 for potential ecological impacts and Section 4.5.1 for physical impacts associated with a new nuclear unit.

Construction of a new nuclear unit at the Exelon ESP site and its associated intake structure would not cause any alteration in flood levels because no facilities would be constructed in the post-construction flood-prone area. Therefore, no construction-related impacts would be expected to affect current land uses within floodplains.

Offsite land-use changes as a result of construction activities are expected to be minimal. The majority of the construction workforce would be expected to commute from other communities, and, therefore, little impact in terms of new housing construction would be expected in the vicinity of the ESP site.

The staff reviewed the available information on the land-use impacts of constructing a new nuclear unit at the CPS site. Based on this review, the staff concludes that there are no land-use impacts that would render the site unsuitable for a new nuclear unit. There are no cumulative construction-related land-use impacts at the site and the vicinity of the site beyond those impacts discussed in this section. Therefore, the staff concludes that the environmental impact resulting from land use would be SMALL, and mitigation would not be warranted.

4.1.2 Transmission Line Rights-of-Way and Offsite Areas

Based on an initial evaluation, the existing transmission lines do not have sufficient capacity to carry the total output of the existing unit and a new unit. Exelon indicated that as a result of receiving an ESP, agreements would be made with the Regional Transmission Operator (RTO) and, if required, transmission lines would be upgraded in the event that the power demands and power production exceeded the line capabilities. The full extent of potential land-use impacts in the transmission line rights-of-way can be estimated only after following the Federal Energy Regulatory Commission (FERC) process for connecting new large generation facilities to the grid. This process is described in more detail in Section 3.3.

Based on statements in the ER, the staff assumed that any modification to the transmission line rights-of-way would likely be accomplished by expanding existing rights-of-way. Exelon identified a northern and a southern transmission line right-of-way that may be impacted (see Section 2.2.2). Any modifications to the existing rights-of-way would be accomplished using accepted construction techniques and practices and follow the applicable regulations. Therefore, the staff concludes that the disruption of access or other uses of the rights-of-way would be temporary, the impacts would be SMALL, and mitigation would not be warranted.

4.2 Meteorological and Air Quality Impacts

Sections 2.3.1 and 2.3.2 describe the meteorological characteristics and air quality of the Exelon ESP site. The primary impacts of construction of a new nuclear unit at the Exelon ESP site on local meteorology and air quality would be from dust from construction activities, open burning, emissions from equipment and machinery used in construction, concrete batch plant operations, and emissions from vehicles used to transport workers and materials to and from the site.

4.2.1 Construction Activities

Activities associated with construction of a new nuclear unit would be similar to the activities associated with construction of any large structure. There would be ground-clearing, grading, excavation, and movement of materials and machinery. Ground-clearing, grading, and excavation activities would raise dust, and fugitive dust would be raised by the movement of materials and machinery. Fugitive dust might also rise from cleared areas during windy periods.

A State air permit is not required for dust generated by construction activities (35 IAC 201.146[tt]). However, Exelon stated in its ER (Exelon 2003a) that dust from construction activities would be mitigated to the extent possible. In addition, Exelon stated that applicable air quality regulations would be adhered to as they apply to open burning and fuel-burning equipment.

The ER (Exelon 2003a) lists several measures that would be taken to mitigate air emissions from construction sources, including wetting during dry periods, seeding of bare areas, paving the most traveled construction roads, obtaining permits and certificates for construction equipment and activities, maintaining fuel-burning equipment in good condition, and equipping concrete facilities with dust-control systems.

Construction activities take place for a limited duration and can be controlled using standard measures. Impacts on meteorology and air quality that might occur would be temporary and limited in magnitude. Therefore, the staff concludes that the impacts from construction activities at the Exelon ESP site would be SMALL, and mitigation would not be warranted.

4.2.2 Transportation

Exelon estimates that construction activities would generate approximately 3300 additional car and truck trips daily on Illinois State Routes (SRs) 10 and 54 (Exelon 2003a). Exhaust from these vehicles will decrease air quality somewhat, but it is unlikely that air quality would be degraded sufficiently to be noticeable beyond the immediate vicinity of these highways. The effects of vehicle exhaust from 2300 cars (4600 trips per day) were considered in NUREG-1437 (NRC 1996) and found to be of potential concern if the trips were made in an area where air quality was out of compliance with the National Ambient Air Quality Standards. Air quality in DeWitt County and the surrounding counties is in compliance with all standards. Therefore, the staff concludes that the impact on air quality of increased traffic associated with construction at the Exelon ESP site would be SMALL, and additional mitigation would not be warranted.

4.3 Water-Related Impacts

Water-related impacts involved in the construction of a nuclear plant are similar to impacts that would be associated with any large industrial construction project. Likewise, Exelon must be granted the same permits and follow the same construction best management practices as any other builder of a large industrial facility. Before initiating construction, Exelon is required to obtain permits regulating alterations to the hydrologic environment. These permits may include:

- Clean Water Act (CWA) Section 404 permit. This permit would be issued by the U.S. Army Corps of Engineers (ACE) and regulate impacts of construction activities on wetlands and management of dredged material.

- CWA Section 401 certification. This certification would be issued by the State of Illinois and ensure that projects do not conflict with State water quality management programs.

- CWA Section 402(p) National Pollutant Discharge Elimination System (NPDES) storm water permit. This permit would be issued by the Illinois Environmental Protection Agency (IEPA) and regulates point-source storm water discharges. The U.S. Environmental Protection Agency's (EPA) 1990 Phase 1 Storm Water Regulation established requirements for storm water discharges, listing various activities including construction activities disturbing an area of at least 2.0 ha (5.0 ac). The EPA has delegated the responsibility for administering the NPDES program in Illinois to the IEPA.

4.3.1 Hydrological Alterations

According to the National Wetland Inventory database, there are four minor herbaceous wetlands (less than 0.4 ha [1 ac]) within the Exelon ESP site boundary. These wetlands do not occur within the power block, cooling tower, switchyard expansion, or new intake footprint areas and, therefore, are not anticipated to be impacted by construction of these structures (Exelon 2003). However, the locations of associated equipment laydown and fill disposal areas and the conduit for the new intake are currently unknown and could, thus, impact these wetlands, depending on their ultimate locations. Nevertheless, Exelon plans to site these so as to preclude impacts to these wetlands (Exelon 2003).

The descriptions of wetlands in the National Wetland Inventory database are based on interpretation of visible geography, vegetation, and hydrology in high altitude aerial photos. As such, the aerial extent and characteristics of these wetlands are not considered to be sufficiently accurate to be used as a baseline for potential construction impacts. Consequently, delineations and jurisdictional determinations of the upland wetlands, and any submerged lake areas, that could be impacted by construction have not yet been made. Exelon would have to submit an application for a 404 permit to the ACE that would address these areas before undertaking any construction activities. The ACE's permitting process ensures that impacts of construction are limited by requiring the appropriate construction best management practices. In addition, Exelon currently has not obtained a 401 certification from the State of Illinois for construction activities on the ESP site. The ACE would require that Exelon obtain a 401 certification before issuance of a 404 permit.

Many of the possible reactor designs covered in the PPE would require that dewatering systems be installed during construction of the foundation of the reactor and various other buildings. Dewatering systems would depress the water table in the local vicinity and possibly change the direction of groundwater flow and the available capacity of local wells. These impacts would be temporary. The staff therefore concludes that impacts of hydrologic alterations due to construction activities would be localized and temporary. The IEPA 401 and ACE 404 permit process would be adequate to ensure that impacts of hydrologic alterations are SMALL.

4.3.2 Water-Use Impacts

Water-use requirements for construction activities are similar to other large industrial construction projects. Additional potable water supplies for the construction workforce would be required. Dewatering systems that are active during excavation and construction would result in a decline in the local water table. Water for various standard construction activities, such as dust abatement, would be required. The staff assumed that water use during construction would be less than 10 percent of the consumptive water loss from the wet towers at a new nuclear unit. The staff therefore concludes that water-use impacts due to construction activities would be SMALL, localized, and temporary.

4.3.3 Water Quality Impacts

Water quality impacts for the construction activities are similar to those for other large industrial construction projects. Construction best management practices are required to ensure that accidental spills and storm water runoff will have minimal impact. Once Exelon has established formal construction plans, a storm water NPDES permit from IEPA would likely be required before any construction activities could commence. The staff therefore concludes that water quality impacts due to construction activities would be SMALL, localized, and temporary.

4.4 Ecological Impacts

This section describes the potential impacts to ecological resources from construction of a new nuclear unit at the Exelon ESP site and anticipated expansion of the existing transmission line rights-of-way. The section is divided into three subsections: terrestrial impacts, aquatic impacts, and impacts to threatened and endangered species.

4.4.1 Terrestrial Impacts

The staff considered impacts on habitat, wildlife, and State-listed species during the construction of a new nuclear unit at the Exelon ESP site.

4.4.1.1 Habitat

A total of 187 ha (461 ac) is located within the Exelon ESP site (Exelon 2003a). All of the ESP site has been graded or otherwise developed for operation of the existing CPS (Exelon 2004b).

Most of the footprint of the new nuclear unit at the ESP site consists of areas that would be occupied by the power block structures, normal heat sink cooling towers, switchyard expansion, new intake structures, and safety-related cooling towers. The anticipated footprint of these structures is provided in Figure 4-1. Existing access roads and infrastructure (see Chapter 2, Figure 2-3) would primarily be used for construction of the new nuclear unit. Construction would disturb up to approximately 39 ha (96 ac), comprising permanent facilities and equipment laydown areas, most of which would occur about 213 m (700 ft) south of the existing CPS (Figure 4-1) (Exelon 2003a).

Construction of a new nuclear unit would occur primarily in previously disturbed areas that currently support virtually no biota (e.g., impervious surfaces, crushed stone, existing structures, etc.), and in open fields (e.g., previously used as equipment laydown areas during construction of the CPS, etc.) (Exelon 2003a). However, two small forest stands of about 1.25 ha (3 ac) and about 0.2 ha (0.5 ac) in the northern corner of the power-block footprint and within the new intake footprint (see Figure 4.1), respectively, would be cleared. Consequently, a loss of a total of 1.45 ha (3.5 ac) of forest habitat onsite is anticipated. Because these are small stands of young regenerating forest (by virtue of the fact that the entire ESP site was disturbed for construction of the existing CPS) that do not support any important species (as defined in NRC 2000), their loss is considered negligible.

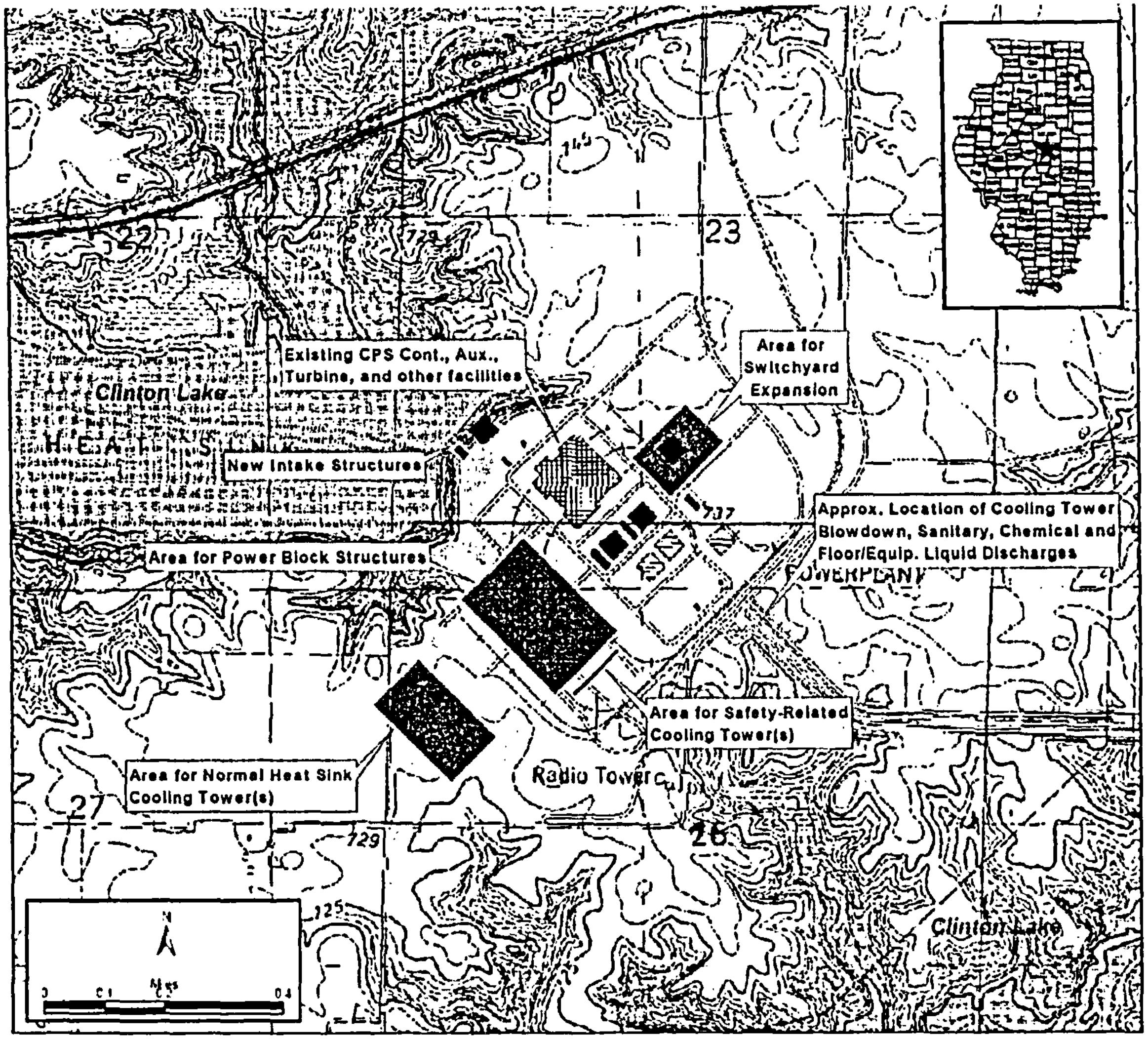

Figure 4-1. Areas Proposed for the Structures of a New Nuclear Unit (Exelon 2003a)

Construction of a new nuclear unit at the ESP site would not be anticipated to adversely affect wetlands onsite. The four minor wetlands (less than 0.4 ha [1 ac]) listed in the National Wetlands Inventory database do not occur within the power block, cooling tower, switchyard expansion, or new intake footprint areas and, therefore, would not be impacted by construction of these structures (Exelon 2003a). However, the locations of associated equipment laydown and fill disposal areas and the conduit for the new intake are currently unknown and could, thus, impact wetland and forest habitat, depending on their ultimate locations. Nevertheless, Exelon would site these so as to preclude impacts to these wetlands (Exelon 2003a).

The descriptions of wetlands in the National Wetland Inventory database are based on interpretation of visible geography, vegetation, and hydrology in high altitude aerial photos. As such, the aerial extent and characteristics of these wetlands are not considered to be sufficiently accurate to be used as a baseline for potential construction impacts. Consequently, delineations and jurisdictional determinations of the wetlands that could be impacted by construction have not yet been determined. Exelon would have to submit an application for a 404 permit to the U.S. Army Corps of Engineers (ACE) that would address these areas before undertaking any construction activities. The ACE's permitting process ensures that impacts of construction are limited by requiring that the appropriate construction best management practices be followed.

Exelon currently anticipates that four new 345-kV transmission lines (two parallel, double-circuit lines running north to the Brokaw Substation near Bloomington and two running south to the Oreana Substation) would be required to accommodate the bounding case of an output of 2180 MW(e) from a new nuclear unit at the ESP site (see Section 3.3) (Exelon 2003a). However, the actual need for and nature of any transmission system improvements would be determined by the transmission and distribution system owner and operator (currently Illinois Power) under FERC Order No. 2003 (18 CFR Part 35), *Standardization of Generator Interconnection Agreements and Procedures* (FERC 2004). This order mandates performance of feasibility, system impact, and facilities studies when there is a proposed load increase on the existing transmission system of 20 MW(e) or more. If a new nuclear unit was constructed, any transmission system improvement studies under FERC Order No. 2003 would be carried out by the transmission and distribution system owner and operator before or during the construction permit (CP) or combined CP and operating license (combined license or COL) stage.

The actual amount of disturbance associated with any transmission system improvements would be contingent, among other factors, on the construction techniques used; these also would be determined during the CP or COL phase. Exelon currently anticipates that any transmission system modifications would be located within or immediately adjacent to the existing CPS substation (for necessary switchyard expansion) and within or along the existing transmission line rights-of-way. Transmission system improvements, such as the addition of new lines and support structures, would occur within the existing rights-of-way to the greatest extent possible. However, it is anticipated that widening the existing rights-of-way from 40 m (130 ft) to 76 m (250 ft) would be required. Right-of-way clearing and waste disposal methods would be dictated in large part by landowner requirements. However, without direction from the property owner, clearing would be done in accordance with industry guidelines and best practices (Exelon 2003a).

Construction for any transmission system improvements would impact agriculture and open fields within or along the existing rights-of-way, but these would be replanted and allowed to revegetate, respectively, to pre-construction conditions. Consequently, there would be only a temporary loss of agricultural or open field habitat resulting from construction of transmission system improvements. Where right-of-way expansion would be required in forested lands, cutting would be tapered to minimize disturbance and eliminate the need to clear-cut the entire width of the rights-of-way. The existing transmission line rights-of way are approximately 69 km (43 mi) long (see Section 3.3), of which forested habitat covers less than 12 percent. Given the anticipated expansion of the existing rights-of-way by 36 m (120 ft), a loss of no more than 30 ha (74 ac) of forest would be expected. Such a loss, distributed over the existing 69-km (43-mi) rights-of-way, would be considered minor. However, if a new nuclear unit were constructed, the nature and magnitude of impacts to forest habitat from transmission line rights-of-way widening would be established definitively by the transmission and distribution system owner and operator under FERC Order No. 2003 before or during the CP or COL phase.

There are three 100-year floodplains within the existing transmission line rights-of-way, and there are minor wetland areas in the vicinity. Adverse impacts to watercourses, wetlands, and floodplains would be avoided to the greatest extent possible during transmission line rights-of-way expansions. For example, transmission towers would be sited in upland areas within the existing transmission line rights-of-way where possible (Exelon 2003a), which would help minimize potential impacts on watercourses, wetlands, and floodplains. Further, if impacted, these would be restored so that there would be no net loss of these resources. Consequently, impacts to forest habitat, floodplains, wetlands, and watercourses due to transmission system improvements would be expected to be minimal. However, if a new nuclear unit were constructed, the magnitude of these impacts would be established definitively by the transmission and distribution system owner and operator under FERC Order No. 2003 before or during the CP or COL phase.

4.4.1.2 Wildlife

During construction of a new nuclear unit at the Exelon ESP site, wildlife could be destroyed or displaced, primarily as a result of operating heavy equipment (e.g., for land clearing). Less mobile animals (e.g., reptiles, amphibians, small mammals) would likely incur greater mortality than more mobile animals (e.g., birds). Relatively large tracts of open fields and some small forest parcels would be available to displaced animals just west and south of the power-block and cooling tower footprints. Species that can adapt to disturbed or developed areas, e.g., raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), and northern cardinal (*Cardinalis cardinalis*), might recolonize portions of the disturbed area where suitable habitat remained or had been replanted. To minimize construction-related impacts to wildlife (e.g., destruction of nests and eggs of migratory birds), Exelon would adhere to any permit conditions designed to restrict the timing of construction activities based on important biological periods (e.g., nesting of migratory birds).

Construction impacts to wildlife in the Clinton Lake State Recreation Area would likely be negligible because of the very small section of shoreline that would be disturbed for the new intake, relative to the total 132 km (82 mi) of shoreline. Impacts associated with the new intake would be expected to consist of very localized destruction and displacement of wildlife during construction and some recolonization following construction. Due to its distance from the Exelon ESP site (10 km [6 mi]), no impacts to wildlife within the Weldon Springs State Recreation Area would be anticipated as a result of construction of a new nuclear unit (Exelon 2003a).

Construction of a new nuclear unit would proceed according to Federal and State regulations, permit conditions, existing procedures, good construction practices, and established best management practices (e.g., directed drainage ditches, silt fencing). Fugitive dust would be minimized by watering the access roads and construction site as necessary. Thus, impacts from dust would be considered negligible and further mitigation would not be warranted. Emissions from heavy construction equipment would be minimal due to scheduled equipment maintenance procedures.

Construction activities would generate noise due to the movement of workers, materials, and equipment, and the operation of construction equipment (e.g., earth-moving equipment, portable generators, pile drivers, pneumatic equipment, and hand tools). Noise generated by human activity can affect wildlife by inducing physiological changes, nest or habitat abandonment, and behavioral modifications, or it may disrupt communications required for breeding or defense. However, it is not unusual for wildlife to adapt to noise generated by human activity (Larkin 1996). It has been estimated that construction noise levels 15 m (50 ft) from the source would range from 76 to 100 decibels on the A scale (Exelon 2003a). These noise levels would not be expected to extend far beyond the boundaries of the ESP site because at a distance of 122 m (400 ft) from the source most construction noise ranges from approximately 60 to 100 decibels on the A scale (Golden et al. 1980). This is below the threshold of 80 to 85 decibels on the A scale at which birds and small mammals are startled or frightened (Golden et al. 1980). Additionally, construction would occur near the CPS, where wildlife has presumably become accustomed to typical operating facility noise levels. Thus, noise from construction activities would not be likely to disturb wildlife beyond 122 m (400 ft) from the source. Impacts within this distance are considered negligible because there are no important terrestrial species (as defined in NRC 1999) on the ESP site.

Avian collisions with fabricated structures are a result of numerous factors related to species' characteristics, such as flight behavior, age, habitat use, seasonal habits, and diurnal habitats, as well as to environmental characteristics, such as weather, topography, land use, and orientation of the structures. Most authors on the subject of avian collisions with utility structures agree that collisions are not a biologically significant source of mortality for thriving populations of birds with good reproductive potential (EPRI 1993). The NRC (1996) reviewed monitoring data concerning avian collisions at nuclear power plants with large cooling towers and determined that the overall avian mortality is low. No avian collisions with existing structures at the CPS site have been reported (Exelon 2003a); however, there is currently no monitoring plan in place at the CPS that facilitates detection and reporting of dead birds. The number of construction-related bird collisions with structures is expected to be negligible.

Daily traffic on Illinois SR 54 and 10 near the Exelon ESP site currently consists of 2750 cars and 2000 trucks. During construction, daily traffic on these highways would be expected to increase by an additional 1650 cars and trucks on each highway (an increase of about 60 and 83 percent for Illinois SR 54 and 10, respectively). During that time, wildlife mortalities due to collisions would thus be expected to increase, but only marginally (Exelon 2003a). Consequently, impacts to wildlife from increased traffic are expected to be negligible.

4.4.1.3 State-Listed Species

No impacts to State-listed threatened or endangered terrestrial plant species are anticipated because none is known to occur on or within 16 km (10 mi) of the Exelon ESP site (IDNR 2004).

There are no State-listed threatened or endangered terrestrial animal species known to occur on or within 16 km (10 mi) of the Exelon ESP site (IDNR 2004). However, according to the local Audubon Society and other birding sources in Illinois, there have been documented sightings of several State-listed threatened or endangered bird species in the vicinity (see Section 2.7.1.1 for additional details) (Exelon 2003a). Individuals of these species that frequent the vicinity of the ESP site would be expected to be minimally exposed, if at all, to disturbance (e.g., noise, human presence, etc.) associated with construction of a new nuclear unit at the site and anticipated expansion of the existing transmission line right-of-way improvements. Consequently, it is expected that construction impacts to State-listed animal species would be negligible. Exelon has committed to contact the Illinois Department of Natural Resources

(IDNR) before commencement of construction activities to ensure that these assumptions remain valid.

In summary, loss of a small amount of young regenerating forest within the footprint of the new power block and intake structures would be negligible. There would be no construction impacts to wetlands onsite. Construction impacts to forest habitat, floodplains, wetlands, and watercourses from transmission line improvements offsite are tentatively expected to be minimal. Impacts to wildlife onsite and offsite from land clearing and construction noise are expected to be negligible. Impacts from fugitive dust and emissions from heavy construction equipment would be considered minimal. Avian collisions with fabricated structures and traffic-related wildlife mortalities would also be considered negligible. In addition, there would be no construction impacts to State-listed threatened or endangered terrestrial species.

Based on its review of the proposed Exelon ESP site and anticipated transmission line right-of-way expansion, the staff concludes that the impacts of construction on terrestrial ecological resources would be SMALL, and mitigation would not be warranted. However, the nature of transmission line improvements would be determined definitively before or during the CP or COL stage by the transmission and distribution system owner and operator. It may be determined at that time that the transmission system improvements could range from upgrade components being sited within the existing rights-of-way without any need for right-of-way expansion, to needing one or more new rights-of-way to accommodate the upgrade. The staff expects that Exelon would consult with the transmission and distribution system owner and operator at that time to ascertain whether the above determination of construction impacts is still valid. The staff would also conduct its own independent review of this determination at the CP or COL stage.

4.4.2 Aquatic Impacts

Impacts to the aquatic ecosystem from construction of a new nuclear unit at the Exelon ESP site would mainly be associated with construction of a new cooling water intake structure. It is expected there would be loss of benthic macroinvertebrates and some open water and shoreline habitat at Clinton Lake, as well as temporary displacement of other aquatic species.

The proposed location for a new cooling water intake structure is approximately 19.8 m (65 ft) west of the existing CPS intake structure (see Figure 4-1) (Exelon 2003a). Based on the anticipated intake velocity and flow rate for a new nuclear unit at the ESP site, Exelon expects the intake would be approximately 34 by 46 m (110 by 150 ft) in dimensions. During construction, fish (including those with recreational value, as described in Section 2.7.2.1) might be displaced from part of the nearshore as a result of methods used to displace water from the construction zone. Noise associated with the construction activity and increased turbidity and boating activity associated with dredging activities might also cause fish to leave the area temporarily. Use of best management practices to minimize sedimentation and timing of construction activities to minimize impacts on fish during critical spawning or rearing periods are both ways to mitigate potential impacts. Once construction was complete, it is expected that fish would return to the area. Benthic macroinvertebrates and nearshore habitat would be lost as a result of dredging, dewatering, and other construction activities. However, the amount of open water, shoreline, benthic habitat, and benthic fauna that would be lost would be a small fraction of the total present at Clinton Lake.

No impacts to the aquatic ecosystem as a result of construction of a new nuclear unit are anticipated at any of the important aquatic habitats described in Section 2.7.2 (Exelon 2003a). These include the environmentally sensitive areas along Tenmile Creek and Salt Creek, the Weldon Springs State Recreation Area, and the several small wetlands associated with tributaries to Salt Creek, the North Fork of Salt Creek, and the sediment basins within the CPS site.

One State-listed threatened mussel species, the spike (*Elliptio dilatata*), is known to occur approximately 16 km (10 mi) from the ESP site. However, adverse impacts to this species are not anticipated because this nonmotile mussel is so distant from the cooling-water intake construction site (Exelon 2003a). No impacts to any other State-listed threatened or endangered aquatic animal or plant species is anticipated because none is known to occur in the vicinity of the ESP site (Exelon 2003a; IDNR 1999). Exelon has committed to contact the IDNR before commencement of construction activities to ensure that these assumptions remain valid.

In conclusion, impacts to aquatic species and habitat from construction of a new nuclear unit at the Exelon ESP site are expected to be SMALL, and mitigation would not be warranted.

4.4.3 Threatened or Endangered Species

This section describes the potential impacts to Federally listed threatened or endangered aquatic and terrestrial species and associated designated and proposed critical habitat resulting from construction of a new nuclear unit on the Exelon ESP site, the anticipated expansion of the existing transmission line rights-of-ways, and offsite facilities. The biology of these species is presented in Sections 2.7.1 and 2.7.2.

The staff has prepared a biological assessment documenting the expected impacts resulting from construction of a new nuclear unit to the Federally listed threatened and endangered terrestrial species described in U.S. Fish and Wildlife Service (FWS) correspondence

(FWS 2004b). The staff's impact determinations from the biological assessment are reiterated in this section.

There are two Federally listed species, the threatened bald eagle (*Haliaeetus leucocephalus*) and the endangered Indiana bat (*Myotis sodalis*), that may occur in the vicinity of the ESP site and transmission line corridors (FWS 2004b).

Bald Eagle - Threatened

Bald eagles are not known to nest, but are known to winter along large rivers, lakes, and reservoirs in DeWitt County (FWS 2004a) and have been observed in the vicinity of the ESP site (Exelon 2003a). However, there are no known night roost sites in DeWitt County (FWS 2004b). Further, no concentrations of foraging eagles have been reported on or in the vicinity of the Exelon ESP site (Exelon 2003a; FWS 2004b; IDNR 2004). Individual bald eagles that frequent the vicinity of the ESP site could be exposed, albeit minimally if at all, to disturbance (e.g., noise, human presence, etc.) associated with construction of a new nuclear unit and at the sites of any transmission system improvements. No critical habitat is designated for the bald eagle (FWS 2004a). Consequently, construction impacts to bald eagles are expected to be negligible.

Indiana Bat - Endangered

Because the Indiana bat potentially occurs throughout Illinois where forest habitat is present (FWS 2004a, b), it could occur on and in the vicinity of the ESP site although there are no records of its occurrence within 16 km (10 mi) (IDNR 2004). If present, Indiana bats would most likely occur in association with small streams with well-developed riparian woods, as well as with mature floodplain and upland forests. The Indiana bat roosts and rears its young beneath the loose bark of large dead or dying trees and tends to return to the same roosting area year after year (FWS 2004a).

To be impacted by the project, suitable Indiana bat summer habitat must occur within 0.8 km (0.5 mi) of the project site. If suitable summer habitat occurs in any area on the ESP site or along the existing transmission line rights-of-way where construction would take place and the species was present, impacts could occur if forests are cleared. Large-scale habitat alterations within known or potential Indiana bat summer habitat should not be undertaken without a bat survey and/or consultation with the FWS Rock Island, Illinois, Field Office. Minor alterations of summer habitat (e.g., clearing small forest stands) should be limited to non-maternity periods between September 16 and April 14. All potentially suitable habitat should be surveyed to determine if it is suitable and, if so, if it is occupied (FWS 2004a).

The staff expects that Exelon would determine, before commencement of construction, if the approximately 1.25-ha (3-ac) forest stand within the power block footprint and the approximately 0.2-ha (0.5-ac) forest stand within the new intake footprint, for a total of 1.45 ha (3.5 ac), were potentially suitable for Indiana bats, using the criteria found in Section 2.7.1.2 or other contemporaneous criteria established by the FWS. If these forest stands were not potentially suitable, they may be cleared without any timing restrictions for Indiana bats, but timing restrictions imposed for other species, e.g., migratory birds, are still applicable. However, if they were found to be potentially suitable, they would be surveyed to determine their suitability and there would be a determination of whether or not they were occupied by the Indiana bat. If the forest habitat was suitable and unoccupied, clearing might be undertaken during the nonmaternity period between September 16 and April 14. However, if the habitat was suitable and occupied, forest clearing activities should not take place without first consulting with the FWS Rock Island, Illinois, Field Office. The staff expects that Exelon would undertake such a consultation, if appropriate.

Exelon currently anticipates adding two new transmission lines to the existing rights-of-way for the new nuclear unit at the ESP site. This would require widening the existing rights-of-way from 40 m (130 ft) to 76 m (250 ft) (Exelon 2003a). Right-of-way expansion would require clearing forest habitat where it occurs along the existing rights-of-way, which could impact Indiana bats. However, if a new nuclear unit were constructed, the actual need for and nature of any transmission system improvements would be determined definitively before or during the CP or COL phase by the transmission and distribution system owner and operator (currently Illinois Power) under FERC Order No. 2003, *Standardization of Generator Interconnection Agreements and Procedures* (FERC 2004).

These studies could determine that addition of a new right-of-way is needed (hypothetical bounding case scenario) for a new nuclear unit. This could require clearing more forest habitat than would be required by adding two new transmission lines and widening existing rights-of-way, as currently envisioned by Exelon. However, because 88 percent of the existing rights-of-way and more than 92 percent of land use within a 80-km (50-mi) radius of the ESP site is agricultural, potential impacts to Indiana bats from any transmission system improvements (including the hypothetical bounding-case scenario) would be expected to be negligible.

In any case, if transmission system improvement studies indicate that transmission line improvements requiring clearing forest habitat were needed, Exelon should determine its suitability as Indiana bat summer habitat and occupancy, as explained above, before forest clearing activities are undertaken. Furthermore, Exelon would have to abide by any timing or other contemporaneous restrictions imposed by FWS for protection of the Indiana bat.

Indiana bats winter in caves and abandoned mines (FWS 2004a), but such habitat features are not known to occur on the ESP site or along its transmission line rights-of-way. The only critical habitat designated for the Indiana bat is the Blackball Mine in LaSalle County, Illinois (FWS 1976). Consequently, there would be no construction impacts to Indiana bat critical habitat because none occurs in the vicinity of the ESP site.

If the above recommended actions are taken, impacts from construction to the Indiana bat are expected to be negligible.

Federally Listed or Proposed Aquatic Animals

No impacts to Federally listed or proposed threatened or endangered aquatic animal species or associated proposed or designated critical habitat are anticipated (Exelon 2003a; FWS 2003b, 2004b; IDNR 1999), because none is known to occur on or within 16 km (10 mi) of the ESP site (IDNR 2004) or in the vicinity of the transmission line corridor (FWS 2004b).

Federally Listed or Proposed Terrestrial and Aquatic Plants

No impacts to Federally listed or proposed threatened or endangered terrestrial (FWS 2004) or aquatic (Exelon 2003a; FWS 2003a, b, 2004a; IDNR 1999) plant species are anticipated because none are known to occur on or within 16 km (10 mi) of the ESP site (IDNR 2004) or in the vicinity of the transmission line corridor (FWS 2004b).

Conclusions

In summary, there would be no construction impacts to Federally listed terrestrial or aquatic plant species. There would be no construction impacts to Federally listed aquatic animal species. Construction impacts to Federally listed terrestrial animal species, the bald eagle and Indiana bat, are expected to be negligible. There would be no construction impacts to critical habitat for Federally listed terrestrial or aquatic animal species. Exelon has committed to contact the FWS before beginning construction activities to ascertain whether these assumptions remain valid or whether further evaluation is needed.

Based on its review of impacts resulting from construction of a new nuclear unit at the Exelon ESP site and associated transmission line rights-of-way, the staff determined that the impacts of construction on threatened and endangered species would be SMALL, and mitigation would not be warranted. However, this determination is contingent on the outcome of the evaluation of potentially suitable Indiana bat summer habitat, as discussed in this section.

4.5 Socioeconomic Impacts

This section discusses the socioeconomic impacts of construction activities. It includes impacts that could result from the construction-related activities at the Exelon ESP site and from the activities and demands of the workforce on the surrounding region. Evaluated socioeconomic impacts include potential effects on individual communities, the surrounding region, and minority and low-income populations.

4.5.1 Physical Impacts

Construction activities at the ESP site might cause temporary and localized physical impacts, including, but not limited to, noise, odor, vehicle exhaust, and dust. This section qualitatively addresses these potential impacts as they might affect people, buildings, roads, and recreational facilities (such as Clinton Lake).

4.5.1.1 Workers and the Local Public

Within the ESP site boundary, 100 percent (187 ha [461 ac]) has been graded or otherwise developed for the operation of the existing nuclear power plant. Except for the CPS, there are no industrial, commercial, or institutional structures on the site property. Industrial land use is the only type of land use within the site.

The area around the CPS site is 82 percent agricultural land. Industrial land use is less than 1 percent and is limited to areas near Clinton and Weldon. Less than 1 percent of land within the site vicinity is residential and consists primarily of areas in Clinton and Weldon (Exelon 2003a).

Recreational areas are the only special land uses within the vicinity (16.6 percent of total land use), consisting of the Clinton Lake State Recreation Area and Weldon Springs State Recreation Area.

People who work or live around the proposed ESP site could be subjected to noise, fugitive dust, and gaseous emissions resulting from construction activities. Construction workers and personnel working onsite could be the most impacted. Next impacted would be individuals working or living immediately adjacent to the site and least impacted would be transient populations, such as temporary employees, recreational visitors to Clinton Lake, and tourists passing through the area.

Onsite mitigation efforts and the relative isolation of the ESP site from neighboring residential houses would mitigate the potential adverse impacts normally expected from increased noise levels. Activities with significant noise impacts, such as blasting, would be limited to normal weekday business hours. In addition, noise levels would be controlled by using the following State and Federal criteria (Exelon 2003a):

- the Occupational Safety and Health Administration (OSHA) noise-exposure limit to workers and workers' annoyance that are determined through consideration of acceptable noise levels for offices, control rooms, etc. (29 CFR 1910.95)

- Federal (40 CFR Part 204) noise-pollution control regulations

- State regulation Illinois Administrative Code, Title 35, *Environmental Protection*, Subtitle H: Noise, or local noise-pollution control rules.

Dust emissions would occur with onsite construction activity and exhaust emissions with the operation of construction equipment and vehicles. Fugitive dust and fine particulate matter emissions, including those less than 10 microns (PM_{10}) in size, will be generated during earth-moving, material-handling, and open burning of construction waste. PM_{10} emissions can impact human health. Other pollutants of potential concern are emissions of oxides of nitrogen, carbon monoxide, reactive organic gases, and sulfur dioxide.

Sensitive receptors are not proximate to the construction site. The nearest residence to the planned construction site is 1.2 km (0.73 mi) away and the nearest campground, church, and school are 1.6 km (1 mi), 6.1 km (3.8 mi), and 7.7 km (4.8 mi) distant from the site, respectively. Exelon would be subject to applicable Federal, State, and local regulations governing emissions from construction activities and vehicular traffic. In Illinois, dust generated as part of construction activities is exempt from State permit requirements (Exelon 2003a), even though fugitive dust and fine particulate matter emissions may be subject to EPA air-pollution standards.

Exelon has stated it would adhere to applicable air-pollution control regulations as they relate to open burning or the operation of fuel-burning equipment. Even though dust generated from construction activities is exempt from State permit requirements, Exelon has committed to mitigate dust emissions to the extent possible (Exelon 2003a).

In summary, offsite noise impacts would be expected to be minor because of the noise-control devices on the vehicles, the adherence to applicable State and Federal criteria, the distance of nearby residences to the site, and the fact that construction activities entailing significant noise impacts would be limited to normal weekday business hours. Exelon has stated it would adhere to applicable air-pollution control regulations as they relate to open burning or the operation of fuel-burning equipment and mitigate dust emissions from construction to the extent possible. Therefore, based on the information provided by Exelon and the staff's independent verification during a site visit the week of March 1, 2004, the staff concludes that any physical impacts of construction to the workers and the local public would be SMALL, and further mitigation beyond the mitigation actions stated above would not be warranted.

4.5.1.2 Buildings

It is not expected that construction activities would impact any offsite buildings. Most buildings not located on the site are well away from the site boundaries. The buildings most vulnerable to shock and vibration from pile driving are those located on the ESP site.

Based on the staff's independent review and verification during a site visit the week of March 1, 2004, the staff concludes that any physical impacts of construction on offsite buildings would be SMALL, and mitigation would not be warranted.

4.5.1.3 Roads

Exelon stated that none of the roads and highways in the vicinity would be physically impacted by constructing a new nuclear unit at the ESP site. The roads and highways would have to accommodate an increase of approximately 3300 vehicle trips. Exelon estimated that if each construction worker commuted individually, 50 additional miscellaneous trips would occur throughout the day and 100 truck deliveries during the peak hours of the workday. Exelon concludes that, because these roads and highways are two-lane, rural, and not heavily traveled, they could withstand the increase in vehicular traffic (Exelon 2003a).

In summary, the staff observed during its site visit that the roads in the vicinity of the ESP site are lightly traveled and well maintained. However, if all construction materials were hauled over these roads by truck, the rural roads might be physically impacted by the heavy loads. Exelon did not give any justification for its statement that none of the roads or highways in the vicinity would be adversely physically impacted. Therefore, based on the information provided by Exelon and the staff's independent verification during a site visit the week of March 1, 2004, the staff concludes that any impacts of construction on roads would be SMALL to MODERATE. Mitigation of moderate impacts could be achieved by upgrading the existing rail line into the Exelon ESP site and hauling the heavier construction material by rail.

4.5.1.4 Aesthetics

The proposed construction site is far removed from most of the permanent population that would view the construction activities. The closest residence is approximately 1.2 km (0.73 mi) to the southwest, and the closest town is DeWitt, which is approximately 5 km (3 mi) to the east.

Recreational users of Clinton Lake would be able to view the construction areas from certain parts of the lake surface. However, for most of Clinton Lake, the construction area would not visually impact most recreational users and areas of the lake. Mitigation measures planned by Exelon to lessen the visual impact of construction activities from the lake would include restricting construction laydown to as small an area as possible and removing construction debris from the site in a timely and suitable manner (Exelon 2003a).

Construction of new transmission line rights-of-way would be required to support a new nuclear unit at the ESP site. These lines would be within the existing maintained utility rights-of-way to the greatest extent possible and hence would be in rights-of-ways already disturbed. Construction of the proposed transmission line rights-of-way might temporarily impact watercourses existing along the proposed rights-of-ways, including Clinton Lake. It is expected that the visual impacts caused by construction would be temporary (Exelon 2003a).

In summary, the staff considered the overall visual impacts at distances away from the proposed ESP site, which revealed that the visual impacts of construction on offsite viewers would be limited. The impacts of constructing or installing new transmission lines within existing rights-of-ways would be temporary. Exelon stated that it would abide by applicable Federal and State laws to control runoff and sedimentation in the lake, which could affect the aesthetic enjoyment of the lake, and, if necessary, they would do more to control runoff to Clinton Lake. Therefore, based on the information provided by Exelon and the staff's independent review during a site audit the week of March 1, 2004, the staff concludes that the impacts of construction on aesthetics would be SMALL, and further mitigation beyond the mitigation actions stated above would not be warranted.

4.5.2 Demography

Population within the 80-km (50-mi) radius of the region is 764,366 and projected to grow to 942,556 by 2060, for an average annual growth rate over the 60-year period of 0.35[a] percent (see Table 2-4). Exelon anticipates employing 3150 construction workers to build a new nuclear unit at the ESP site. Most of these workers are anticipated to come from within the region (see further discussion under Section 4.5.3.1). Thus, increases in population directly attributable to the construction workforce would be minimal.

(a) This numerical mean is obtained by taking the average of the annual percentage for the 60-year period from 2000 to 2060.

Some new jobs might result from the multiplier effect[(a)] attributable to the construction workforce. But these increases, when compared to the total population base in the region, would be minimal as well.

Should a larger-than-expected number of construction workers decide to locate to DeWitt County, there could be a noticeable increase in population, but it would not be excessive. If 20 percent of the construction workforce, or 650 workers, decided to relocate temporarily to DeWitt County, it would represent only a 3.9-percent increase in total population, based on 2000 Census data. Any multiplier effects resulting from construction worker expenditures would most likely mean that some residents would obtain new or higher-paying jobs as a result of the increased economic activity.

In summary, most construction workers would be expected to come from within the region. The number of construction workers who might relocate to the region is a small percentage of the larger population base. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the impacts of construction on increases in population within the region would be SMALL, and mitigation would not be warranted.

4.5.3 Impacts to the Community

This section evaluates the social, economic, infrastructure, and community impacts to the surrounding region as a result of constructing a new nuclear unit at the Exelon ESP site. The evaluation assesses impacts of construction and of those demands placed by the workforce on the surrounding region. It is expected that construction activities would last up to 5 years and employ up to 3150 construction workers. This is in addition to the estimated 550 permanent operations personnel currently employed at the CPS site.

4.5.3.1 Economy

The impacts of construction at the ESP site on the local and regional economy depend on the region's current and projected economy and population. Some insight can be obtained on the projected economy and population by consulting county comprehensive plans and data from the U.S. Census Bureau. The ESP, if approved, will be in effect for 20 years after approval. Within that period, construction could start at any time once a CP or COL authorizing construction had been issued. In addition, the issuance of an ESP allows, under certain

(a) In the multiplier effect, each dollar spent on goods and services by a construction worker becomes income to the recipient who saves some but re-spends the rest. His re-spending becomes income to someone else, who in turn saves part and re-spends the rest. The number of times the final increase in consumption exceeds the initial dollar spent is called the "multiplier."

regulatory conditions, the start of limited early construction activities. Therefore, the positive economic benefits of construction could begin some time before the start of the construction of the principal structures of the facility.

It is expected that construction activity would last between 3 and 5 years and employ 3150 construction workers at the peak. The peak usually occurs during the installation of piping and electrical wiring, which takes place when 50 to 70 percent of construction is completed. Exelon anticipates that the workforce would then continue to decline steadily until completion of the job (Exelon 2003a). This is in addition to the estimated 550 permanent operating personnel currently employed at the CPS.

The employment of such a large workforce for such a period of time would have economic impacts on the surrounding region. DeWitt County would probably be the most impacted. From there, the impacts would become diffuse as a result of interacting with the economic base of the surrounding counties, particularly the larger economies of Macon, McLean, and Champaign Counties. The magnitude of the impacts hinges on (1) the percentage of the construction workforce who would come from within the 80-km (50-mi) radius of the region and thus commute to the construction site and (2) those who would relocate to the area to live in DeWitt, Piatt, or Logan Counties or the larger cities of the area such as Decatur, Bloomington–Normal, or Urbana-Champaign.

The construction workforce of 3150 workers would create additional jobs in the region through the multiplier effect of direct employment. The expenditures of the construction workforce in the region for food and services could, through the multiplier effect of expenditures, also create a number of new jobs.

During its review, the staff questioned whether there would be a sufficient number of construction workers (3150) available, with the requisite skills, to build a new nuclear unit at the ESP site. The staff analysis and information obtained from the interviews conducted by the staff during a site visit the week of March 1, 2004, confirm that sufficient numbers of construction workers would be available to meet demand.

In the counties surrounding the ESP site (Champaign, DeWitt, Logan, McLean, Macon, and Piatt Counties), there are 16,214 workers in the construction industry (see Table 2-11). In the region (within 80 km [50 mi]) of the CPS, there were 38,485 people employed in the construction industry in the year 2000 (Exelon 2003a). In the construction of the CPS, more than 9000 workers were employed, with a significant number of that workforce coming from within the region (Exelon 2003a). In addition, it is not unusual for construction workers to commute fairly long distances to a project site.

Based on the information provided by Exelon and the staff's independent review, the staff concludes that there would be little problem in recruiting the required labor skills to enable construction of a new nuclear unit at the ESP site. Therefore, the staff concludes that recruiting construction labor should not be difficult.

In summary, the magnitude of the positive economic impacts would be diffused in the larger economic bases of Macon, McLean, and Champaign Counties. DeWitt County is the site of the construction, and as a result, would be impacted more than Piatt and Logan Counties. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the impacts of construction on the economy of the region would be beneficial and SMALL everywhere in the region except DeWitt County, where the impacts could be MODERATE, and that mitigation would not be warranted.

4.5.3.2 Taxes

The type of reactor selected would impact the size of the workforce and, thus, the amount of taxes paid. Because reactor selection would occur only if Exelon decides to proceed with a CP or a COL, only a qualitative assessment of the impacts to the surrounding area and region of interest can be provided at this time.

There would be several types of taxes generated by the construction of the plant and the workforce employed there. These include income taxes on wages and salaries paid and corporate profits, sales and use taxes on construction-related purchases and on any new, non-ESP facility, and property taxes related to the building of a new nuclear unit at the ESP site. No additional property taxes would be paid during construction of the new nuclear unit itself. Each is briefly discussed in turn.

Income Taxes

Illinois has a personal income tax, a flat tax of 3 percent on taxable income. As the Illinois return is based on the Federal return's adjusted gross income, income that is taxable at the Federal level is also generally taxed by Illinois (IDOR 2003). Construction workers and employees of Exelon would pay income taxes to Illinois if their residences were in Illinois or if they were nonresidents working in Illinois (IDOR 2003). While the exact amount of tax payable to Illinois is not known, it could be fairly large over a 3- to 5-year construction period.

Corporations in Illinois pay a flat 4.8 percent income tax and a 2.5 percent replacement tax. Before 1979, business entities were required to pay personal property taxes. Legislation then abolished the personal property taxes. To replace the money lost by units of local government and school districts, the replacement tax was enacted. The replacement taxes are income taxes received from corporations (including S corporations), partnerships and trusts, collected by the State of Illinois and paid to local governments (IDOR 2004a).

Corporations undertaking the construction of a new nuclear unit at the Exelon ESP site would pay corporate income and replacement taxes on the net income earned from the construction activity (IDOR 2004a). Again, while the exact amount of tax payable to Illinois is not known, it could be fairly large, in absolute terms, over the 3- to 5-year construction period.

The salaries of the construction workforce would have a multiplier effect, where money was spent and re-spent within the region. Because of the multiplier effect, local businesses in and around the City of Clinton probably would see an increase in business, especially in the retail and services sectors. This would have a positive impact on the business community within the vicinity, could provide opportunities for new businesses to get started, and could provide increased job opportunities for residents of the area. In addition, these businesses and employees would have profits or increases in profits upon which income taxes would be paid, as well.

Sales and Use Taxes

Illinois has two types of sales and use taxes. Sales taxes are imposed on a seller's receipts from sales of tangible personal property for use or consumption. In Illinois, the term "sales tax" actually refers to several tax acts. Sales taxes are a combination of "occupation" taxes that are imposed on seller's "receipts" and "use" taxes that are imposed on amounts paid for by purchases. Sellers owe the occupation tax to the Illinois Department of Revenue; they reimburse themselves for this liability by collecting use tax from the buyers.

The "sales tax" is the combination of all state, local, mass transit, water commission, home-rule occupation and use, non-home-rule occupation and use, and county public safety taxes. The tax rate is 1 percent for qualifying food, drugs, and medical appliances and 6.25 percent for everything else (IDOR 2004b). Of that, 5 percent goes to the State of Illinois, 1 percent goes to the municipalities in which it was collected, and 0.25 percent goes to the county in which it was collected.

Illinois and the counties surrounding the Exelon ESP site would experience an increase in the amount of sales and use taxes collected from construction materials and supplies purchased for the project. Additional sales and use taxes would be generated by retail expenditures of construction workers (restaurants, hotels, merchant sales, and food). It is difficult to assess which counties and local jurisdictions would be most impacted by the expenditures and resultant sales and use taxes collected. It is probable that the City of Clinton could receive a large increase in taxes collected given its location near the ESP site. Other towns of significant size are more than 30 km (20 mi) from the site, making it more likely that workers would seek services and make purchases at locations closer to the ESP site.

Summary of Tax Impacts

In summary, the amount of income taxes collected over a potential 3- to 5-year construction period could be large in absolute amount, but small when compared to the total amount of taxes that Illinois collects in any given year or in a 5-year period. In absolute terms, the amount of sales and use taxes collected over a potential 3- to 5-year construction period could be large, but small when compared to the total amount of taxes collected by Illinois and the governmental jurisdictions within the region. However, given its proximity to the ESP site and smaller economic base, the City of Clinton could be the exception and the sales and use taxes collected could have a moderate impact. The taxes collected would be of benefit to both State and local jurisdictions. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential beneficial impacts of taxes collected during construction would be SMALL to MODERATE and that mitigation would not be warranted.

4.5.3.3 Transportation

To the extent possible, the CPS roads would be used for construction traffic. The site has at least one access road that can be used to transport heavy construction equipment (Exelon 2003a). Traffic and traffic-control impacts during construction might include, but are not limited to, the following: working adjacent to or in active roadways (day/night), traffic-control zones, traffic-control device installation and removal, flagging, inspection and maintenance of traffic-control devices, equipment, and general roadway traffic-control zone safety (Exelon 2003a).

The expected 3150 construction workers and the existing CPS permanent workforce of 550 employees would put increased traffic on the road system in the vicinity of the proposed Exelon ESP site. Increased use of the roads in the vicinity of the site would be particularly noticeable during shift changes.

To determine the impact of additional workers on traffic, Exelon obtained average daily traffic counts from the Illinois Department of Transportation (IDOT) website for Illinois SRs 54 and 10. Near the Exelon ESP site, 2500 cars and trucks and 1850 cars and trucks travel daily on Illinois SRs 54 and 10, respectively (IDOT 2004). According to IDOT's *Bureau of Design and Environmental Manual*, the typical average daily traffic count for a rural two-lane highway is 5000 cars and trucks (Exelon 2003a).

Exelon calculated that during construction of the Exelon ESP facility, there could be an additional 1650 cars and trucks added to each highway. To arrive at these estimates, Exelon assumed a total of 3200 vehicle trips, plus 100 truck deliveries. The increased traffic was divided equally between Illinois SRs 54 and 10. Based on the addition of the average daily traffic counts and the assumed expected number of additional trips due to construction, Exelon concluded that the additional construction workers would not put an excessive amount of burden on the roadways near the ESP site. In its estimates, Exelon does not appear to have accounted for the existing operations workforce for the CPS.

As shown in Table 2-6, the population in DeWitt County, the county most impacted by the presence of the CPS and a new nuclear unit at the ESP site is projected to decrease from approximately 16,798 to 16,018, a decline of approximately 0.5 percent, between 2000 and 2010. It is expected to decrease by another 0.2 percent between 2010 and 2020. However, Clinton is billing itself as a bedroom community to the larger Cities of Urbana-Champaign, Decatur, Bloomington–Normal, and, to a lesser extent, Springfield. It could be expected that if such billing is successful, increased growth in and around Clinton could occur. Another attraction, which could encourage such growth, is the relatively low tax base of DeWitt County when compared to other surrounding counties (see Section 2.8). So, while the Illinois Department of Commerce and Economic Opportunity forecasts a decline in population for DeWitt County as a whole, Clinton's growth aspirations, if successful, could increase the county's population, thus placing additional traffic on the area roads and highways.

During the site visit the week of March 1, 2004, the staff observed that most of the roadways within DeWitt, Logan, and Piatt Counties are rural and lightly traveled. The current road system in the vicinity of the site is well-maintained, rural, and lightly traveled most times of the day. As discussed in Section 2.8, business route U.S. 51 through Clinton has had a center turn-lane constructed, which has alleviated congestion through Clinton at shift changes. Population growth could put pressure on the local transportation system but, given the state of the current transportation system around the ESP site, in DeWitt County and those counties abutting DeWitt, the local transportation system would probably not be overwhelmed with added construction traffic.

Should there be congestion, there are Federal regulations for traffic control signs, signals, and barricades (29 CFR Part 1926). Illinois State and U.S. Department of Transportation plans may have more stringent requirements. Exelon states that local, State, and Federal requirements would be adhered to regarding traffic control onsite and offsite during construction activities (Exelon 2003a). In addition, a way to alleviate truck traffic congestion is to upgrade the rail link to the ESP site.

In summary, the roads are currently lightly traveled and, except at shift changes, would not be overly congested by increased construction traffic. Exelon has stated it would adhere to applicable local, State, and Federal requirements regarding traffic control during construction of a new nuclear unit at the ESP site. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impacts of construction on the transportation system would be SMALL and that mitigation, beyond that previously stated, would not be warranted.

4.5.3.4 Recreation

From most of Clinton Lake, the construction area would not be seen. Mitigation measures planned by Exelon would lessen the impact from the few places on the lake where the construction would be visible. Therefore, it is expected that the visual impacts of construction would have minimal impact on the recreational experiences of lake users.

There would be the potential for short-term water quality impacts on the lake from construction, which, if left unchecked, could impact open water, shoreline habitats (including benthic ecosystems), and water quality. Some fish species might be temporally displaced as a result of minor water quality impact disturbances surrounding the construction of the water-intake structure. This could, in turn, impact recreational opportunities on the lake, including fishing. Exelon has stated it would abide by applicable Federal and State regulations governing runoff and, where necessary, would implement additional special control measures to minimize impacts to the lake and lake users (Exelon 2003a).

In summary, the distance of recreational access points to the plant site effectively limits the impacts of construction to recreational users of the lake, and Exelon has committed to mitigation activities during construction, which should lessen impacts on the lake's water quality. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impacts of construction of a new nuclear unit on aesthetic and recreational opportunities at Clinton Lake would be SMALL and that mitigation would not be warranted beyond Exelon's commitments.

4.5.3.5 Housing

Rental property is scarce in the rural counties in proximity to the Exelon ESP site, but is found in more plentiful supply in the larger cities such as Bloomington-Normal, Urbana-Champaign, Decatur, and Springfield. Generally, the counties with larger populations (Champaign, McLean, Macon, and Sangamon) have more available vacant housing. In 2000, there were 296,904 total housing units in counties close to the ESP site, i.e., Champaign, DeWitt, Logan, McLean, Macon, Piatt, and Sangamon Counties. Of the total housing units, 93,326 were renter-occupied, or 31.4 percent of the total. Vacant units numbered 19,920, or 6.7 percent of the total. The percentage vacancy rate varied, ranging from a low of 4.8 percent (Piatt County) to a high of 7.3 percent (Macon County). Macon County showed a decline in rental and vacant units between 1990 and 2000 (see Table 2-15).

Exelon estimates it would need a construction workforce of 3150 over a 3- to 5-year period to construct a new nuclear unit (Exelon 2003a). Impacts on housing from the construction workforce depend on how many workers come from within the region of interest (80 km [50 mi]) and already have housing, and those who might need to relocate to the area and thus require housing. Exelon maintains in its ER that the majority of the construction workforce would come from within the region (Exelon 2003a).

If the entire workforce was derived from within the 80-km (50-mi) radius of the region, there would be little or no impact on housing, except potentially on the smaller counties of DeWitt, Piatt, and Logan and the Cities of Monticello, Farmer City, Lincoln, and Clinton and only if workers sought more housing there than was available (see Tables 2-15 and 2-16).

Some construction workers might originate from outside the 80-km (50-mi) radius of the region. It is not unusual for construction workers to drive 80 km (50 mi) or more from their place of residence to a job site, and some might commute to the job site, stay the work week, and then return to their place of residence on the weekends. These workers would likely share motel accommodations, rooms over existing businesses and in homes in the area, and trailers and campers at existing mobile home parks. Increased demand for RV/trailer spaces could result in an increase in the number of spaces being made available through new construction. The issue of having adequate water and sewer services available is discussed in Section 4.5.3.6 of this EIS.

Assuming that trends remain much the same in the future as they were in 2000, there would be sufficient vacant housing to meet the demands put on the housing system by 3150 construction workers. This also assumes that some of the vacant units could and would be converted to rental housing. Most of the vacant units and rental-occupied housing would be found in the larger cities within 48 to 80 km (30 to 50 mi) of the Exelon ESP site.

However, if these assumptions prove incorrect, there could be a problem with housing availability, particularly in the smaller counties of DeWitt, Logan, and Piatt, where there is shortage of rental housing (see Tables 2-15 and 2-16). If too many "imported" workers tried to live in these counties, one would expect an upward effect on rents paid for housing. Some low-income populations could be priced out of their rental housing if there was upward pressure on rents. Such pressures are less likely to occur in the larger metropolitan area where there is a greater supply of rental housing.

In summary, most of the construction workforce would be expected to come from within the region. Generally, housing is available in the larger cities to accommodate any construction workers who might move into the region. However, if the assumption that most of the construction workforce would come from within the region is invalid, there could be a shortage of housing in DeWitt, Logan, and Piatt Counties. If too many "imported" workers tried to live in these counties, there could be upward pressure on rents. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impacts of the new nuclear unit construction on housing would be SMALL to MODERATE (MODERATE in DeWitt, Piatt, and Logan Counties) and that mitigation would not be warranted where the impacts were small. Mitigation of the moderate impacts would most likely be market-driven with temporary accommodations being provided and/or constructed.

4.5.3.6 Public Services

Water Supply and Waste Water Treatment Facilities

In the vicinity of the CPS, drinking water is primarily obtained from groundwater via wells. Only a small number of residents have private well systems. The Clinton Sanitary District Sewage Treatment Plant serves the waste water needs of the City of Clinton. In the region, rural communities generally have private wells for water and septic systems for sanitary wastes. Larger communities obtain water from groundwater extraction wells and are served by public waste water treatment systems. Exelon performed a survey of water and waste water facilities in the region and found that the facilities have excess capacity to accommodate potential population increases (Exelon 2003a). An independent analysis conducted by the NRC staff confirms Exelon's conclusion (see Tables 2-17 and 2-18).

Public water supply and waste water treatment are not a constraint to growth in the vicinity and region of the Exelon ESP site, assuming that growth increases hold to the historical norm. Should there be a disproportionate increase in the populations of Clinton, Monticello, and Farmer City as a result of construction, there could be some capacity constraints. The small number of vacant and rental housing units available in these three areas, however, would constrain water supply and treatment usage. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impacts of construction of a new nuclear unit on water and waste water treatment facilities would be SMALL and that mitigation would not be warranted.

Police, Fire, and Medical Facilities

Within a 16-km (10-mi) radius of the ESP site, there is one fire department, the sheriff's department of DeWitt County, and the City of Clinton police force. In the region, there are a total of 89 fire departments and 76 police departments. Outside the major cities of the area, communities typically share fire-fighting services (Exelon 2003a).

Within a 16-km (10-mi) radius of the proposed ESP site, there are two nursing homes and one hospital serving Clinton. Within the region (80 km [50 mi]), there are 52 hospitals and 84 nursing homes. Exelon concludes that the projected capacity of public services is adequate and is expected to expand modestly to meet the demands of a slight population growth (Exelon 2003a). Annual population growth projections of 0.8 percent or less per year (between 2000 and 2020) would tend to support their conclusion (see Table 2-6). Exelon plans to employ its own security force for a new nuclear unit at the ESP site (Exelon 2003a).

The construction workforce is generally considered to come from within the region; hence, the demand for services would be on established entities, which could provide adequate service to the existing and small increases in population expected in the future. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impacts of a new nuclear unit on police, fire, and medical facilities would be SMALL and that mitigation would not be warranted.

Social Services

This section focuses on the potential impacts of construction on the social and related services provided to disadvantaged segments of the population in DeWitt and Logan Counties. This section is distinguished from issues surrounding environmental justice, which is discussed in more depth in Section 4.7.

Generally, construction of the new units at the Exelon ESP site would be viewed as beneficial economically to the disadvantaged population segments served by the Departments of Human Resources for DeWitt and Piatt Counties. Construction of a new nuclear unit might enable the disadvantaged to improve their social and economic position by having construction jobs. At a minimum, the expenditures of the construction workforce in the counties for food and services would have a multiplier effect and increase the number of jobs that could be filled by the disadvantaged. Because it might take some time to get hired, there might be an increased demand for social services for construction workers newly moving to the area and looking for work either at the ESP construction site or in secondary jobs created by the construction.

Summary of Public Services

In summary, public water supply and waste water treatment are not a constraint to growth in the vicinity and region of the ESP site, assuming that growth increases hold to the historical norm. Because the construction workforce is generally considered to come from within the region, the demand for police, fire, and medical services would impact established entities, which could provide adequate service to the existing population and the small increases in population expected in the future. The construction of the ESP facility would have a beneficial economic impact to the economically disadvantaged population, which should lessen the demand for social services. There could be an initial increase in demand for social services at the beginning of the construction period, but this is considered manageable. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impacts of construction of a new nuclear unit on the demand for social and related services would be SMALL and that mitigation would not be warranted.

4.5.3.7 Education

Exelon undertook a survey of class size of some schools within the region and found that of those districts surveyed (a total of 69), 70 percent of the schools have class sizes at or below the national average (Exelon 2004a). From this, Exelon concludes that there is sufficient capacity for a small increase in school population. The Blue Ridge and Clinton school districts, based in DeWitt County, were not included in the Exelon survey.

NRC staff interviews of the superintendents of the Clinton and Monticello school districts indicated that an increased number of students per classroom was not an issue,[a] which, at least locally around the Exelon ESP site, tends to support Exelon's conclusions.

The majority of the construction workers would be expected to come from the region, with little anticipated in-migration of construction workers from outside the region. Should there be construction workers coming from outside the region, chances are they would commute to the construction site, stay for the week, and return to their permanent residences on the weekends. If that is the case, there would be minimal impact of additional children being placed in the educational systems within the region. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impacts of construction of a new nuclear unit construction on education would be SMALL and that mitigation would not be warranted.

4.6 Historic and Cultural Resources

The National Environmental Policy Act of 1969, as amended (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966, as amended (NHPA), as amended through 1992, also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (such resources are referred to as

(a) Personal interviews conducted on March 3, 2004 in the City of Clinton with Roger A. Little, Superintendent, Clinton Unit School District 15, and on March 5, 2004 in the City of Monticello with Lawrence J. McNabb, 2004, Superintendent, Monticello Community School District 25.

"Historic Properties" in NHPA). As outlined in 36 CFR 800.8, "Coordination with the National Environmental Policy Act of 1969," the NRC is coordinating compliance with Section 106 of the National Historic Preservation Act in meeting the requirements of NEPA.

Construction, operation, and decommissioning of new power units can affect either known or undiscovered cultural resources. Therefore, in accordance with the provisions of NHPA and NEPA, the NRC is required to make a reasonable and good faith effort to identify historic properties in the area of potential effect (APE) and, if present, determine if any significant impacts are likely to occur. Identification is to occur in consultation with the State Historic Preservation Officer, American Indian Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, if no historic properties (i.e., places eligible for listing on the National Register of Historic Places) are present or affected, the NRC is required to notify the State Historic Preservation Officer before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve adverse effects of the undertaking.

For specific historic and cultural information on the Exelon ESP site, see Section 2.9.

In conducting its analysis of potential impacts to cultural resources from construction at the Exelon ESP site, the NRC defined an APE as the area at the power plant and its immediate environs that might be impacted by the construction and operation of a new nuclear unit and construction and operation of new transmission line rights-of-way that might follow, parallel with some of the existing transmission line rights-of-way now serving the CPS. Because laydown yards and, in some cases, associated infrastructure have yet to be identified, the APE is that area within the current plant boundary. Disturbed areas within the APE are considered because the extent of disturbance in many areas is not known.

Exelon has indicated that construction of the additional unit would involve land disturbance within a designated site (a previously disturbed area), the ESP cooling tower area, and areas designated for support facilities for functions such as water intake and outfalls. The area designated for the cooling towers and associated infrastructure exhibits less previous ground disturbance than the area where a new nuclear unit would be constructed. Additionally, temporary parking, module fabrication areas, and laydown zones would involve some ground disturbance. Following construction activities, disturbed support areas would be landscaped and replanted to match the overall site appearance.

As explained in Section 2.9.2, previous cultural resource identification efforts indicated the presence of several archaeological sites and the potential for additional sites, primarily in the areas associated with the construction of the cooling towers. Before construction, consultation with the Illinois Historic Preservation Agency would identify any protective measures that should be taken (Exelon 2003c). Possible measures might include methods such as tilling, surveying, and shovel testing. One area of potential concern is the area adjacent to a new water intake structure, where the National Register-eligible Pabst Site (IIDW32) was located. Although the site was excavated in the 1970s and impacted by the original construction of the CPS, some remnants of the site may still exist under fill or within the lake (Lewis 1976).

To date, literature reviews and consultations with regional American Indian Tribes have not identified any traditional cultural properties in the vicinity of the proposed construction area of a new nuclear unit.

No analysis of cultural and historic resources was conducted for the transmission line rights-of-way. The full extent of potential land-use impacts in the transmission line rights-of-way can be estimated only after following the FERC process for connecting new large generation sources to the grid. This process is detailed more specifically in Section 3.3. Once this process is completed, the appropriate cultural resource studies will be undertaken to ensure that resources are identified and addressed before construction. In addition, the CP process through the State of Illinois would establish requirements to follow should archaeological, historical, or other cultural resources be uncovered during construction (Exelon 2003c).

Based on (1) the pre-construction and construction measures that Exelon would take to avoid adverse impacts to significant cultural resources and (2) the staff's cultural resource analysis and consultation, it is the staff's conclusion that the potential impacts on historic and cultural resources would be SMALL. Mitigation might be warranted in the event of an inadvertent discovery.

4.7 Environmental Justice Impacts

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). Figures 2-7 and 2-8 (Section 2.10) show the locations of minority and low-income populations around the Exelon ESP site and within the 80-km (50-mi) radius of the region.

The staff identified the pathways through which the environmental impacts associated with construction of a new nuclear unit at the ESP site could affect human populations. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. During its March 2004 site audit, the staff interviewed local government officials and the staff of social welfare agencies concerning potentially disproportionate impacts to minority and low-income populations. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately impacted by construction of a new nuclear unit and that would result in those populations being adversely affected. In addition, the staff did not identify any location-dependent disproportionately high and adverse impacts affecting minority and low-income populations.

Based on the information provided by Exelon and the staff's independent review, the staff concludes that offsite impacts of construction of a new nuclear unit at the Exelon ESP site to minority and low-income populations would be SMALL and that additional mitigation would not be warranted.

4.8 Nonradiological Health Impacts

Exelon (2003a) indicated that the physical impacts of construction, including public health, occupational health, and noise, would be small and were discussed qualitatively. The area around the Exelon ESP site is predominantly rural with a population of approximately 12,400 people within 16 km (10 mi) of the site. No significant industrial or commercial facilities are currently located or planned in this area. The following sections discuss the results of the staff's assessment of nonradiological health impacts for the ESP site.

4.8.1 Public and Occupational Health

Public Health

Exelon indicated in its ER that the physical impacts to the public from construction at the ESP site might include dust, smoke, engine exhaust, and concrete operations as sources of air pollution during site preparation and redress. Exelon stated that operational controls would be imposed to mitigate dust emissions, employing such methods as providing good drainage and dry weather wetting, seeding bare areas to provide ground cover, and paving most traveled construction roads. The concrete facility would be equipped with dust-control systems to minimize releases of concrete dust (Exelon 2003a). Dust generated by construction activities is exempt from State permit requirements pursuant to Illinois Administrative Code 35 IAC 201.146tt. The following sections discuss the results of the staff's assessment of nonradiological health impacts for the Exelon ESP site.

Engine exhaust would be minimized by maintaining fuel-burning equipment in good mechanical order. Exelon (2003a) stated that applicable air-pollution control regulations would be adhered to as they relate to open burning or the operation of fuel-burning equipment to reduce smoke. Permits and operating certificates would be secured where required.

The public would not be close to the construction site. The nearest residence is 1.2 km (0.73 mi), and the nearest campground, church, and school are 1.6 km (1 mi), 6.1 km (3.8 mi), and 7.7 km (4.8 mi) respectively, from the Exelon ESP site (Exelon 2003a). Based on the mitigation measures identified by Exelon in its ER, the permits and authorizations required by State and local agencies, and the staff's independent review, the staff concludes that the nonradiological health impacts to the public from construction activities would be SMALL and that additional mitigation beyond the actions stated above would not be warranted.

Site Preparation Worker Health

In general, human health risks for construction workers and personnel working onsite would be expected to be dominated by occupational injuries (e.g. falls, electrocution, asphyxiation) to workers engaged in activities such as construction, maintenance, and excavation. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks associated with construction. The staff assumes strict adherence to NRC, OSHA, and State safety standards, practices, and procedures during construction activities.

Other nonradiological impacts to construction workers include noise, fugitive dust, and gaseous emissions resulting from construction activities. Mitigation measures discussed in this section (e.g., a dust control system on a concrete facility) would also help limit exposure to construction workers. Onsite impacts to construction workers would also be mitigated through training and use of personal protective equipment to minimize the risk of potentially harmful exposures. Emergency first-aid care and regular health and safety monitoring of construction personnel could also be undertaken.

Based on mitigation measures identified by Exelon in its ER, on permits and authorizations required by State and local agencies, and on the staff's independent review, the staff concludes that the nonradiological health impacts to workers from construction activities would be SMALL and that additional mitigation beyond the actions stated above would not be warranted.

4.8.2 Noise Impacts

Large construction projects involve many noise-generating activities. Regulations governing noise from construction activities are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 and 40 CFR Part 204. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors. Illinois noise-control regulations are found in the Illinois Administrative Code, Title 35, *Environmental Protection*, Subtitle H: Noise.

Activities associated with construction of a new nuclear unit at the ESP site would generate noise levels typical of larger construction projects. The PPE indicates that construction noise would be between 76 and 101 decibels at a distance of 15 m (50 ft) from the source. Noise levels for common construction activities are typically about 90 decibels at a distance of 3 m (10 ft). At 30 m (100 ft), the noise level would be about 70 decibels, and at a distance of 300 m (1000 ft), the noise level would be 50 decibels. A 10-decibel decrease in noise level is generally perceived as cutting the loudness in half. A few activities (e.g., jack hammering) have noise levels of about 110 decibels.

Many of the construction activities at the Exelon ESP site would take place near the existing CPS unit. It is unlikely that much of the noise from this location would be discernable at the exclusion area boundary or offsite. A 90-decibel noise at the center of the exclusion area would decrease to less than 40 decibels at the nearest residence, and a 110-decibel noise would decrease to about 60 decibels. The nearest school, almost 8 km (5 mi) from the site, would not be impacted by construction noise.

Construction activities would be expected to take place 24 hours per day, 7 days per week. However, the ER (Exelon 2003a) lists a number of measures that would be taken to mitigate the potential adverse effects of construction noise. Among the mitigation measures are compliance with Federal and State regulations, use of standard noise-control devices, development of a hearing conservation program, and limitation of activities with significant noise impacts to weekdays.

Considering the temporary nature of construction activities and the location of the Exelon ESP site, the staff concludes that the noise impacts from construction would be SMALL and that further mitigation beyond that discussed above would not be warranted.

4.9 Radiological Health Impacts

The sources of radiation exposure for construction workers include direct radiation exposure, exposure from liquid radioactive waste discharges, and exposure from gaseous radioactive effluents from the existing CPS unit during the site-preparation and construction phase. For the purposes of this discussion, construction and site preparation workers are assumed to be members of the public, and therefore, the dose estimates are compared to the dose limits for the public, pursuant to 10 CFR 20, Subpart D. Exelon (2003a) noted that all major construction activities are expected to occur outside the CPS protected area boundary but inside the restricted area boundary, as shown in Figure 4-2.

4.9.1 Direct Radiation Exposures

In its ER, Exelon identified two sources of direct radiation exposure from the CPS: (1) the cycled condensate storage tank located at the northern boundary of the protected area adjacent to the existing switchyard, and (2) skyshine from the nitrogen-16 activity present in the reactor steam in the high-pressure and low-pressure turbines, the intercept valves, and the associated piping located on the main floor of the turbine building (Exelon 2003a). The staff did not identify any additional sources of direct radiation during the site visit or during document reviews.

Exelon used fenceline thermoluminescent dosimeters (TLDs) and environmental TLDs to measure direct radiation levels at locations in and around the CPS protected area (Exelon 2004b). Eleven fenceline TLDs are located along the protected area fence (see Figure 4-2). Environmental TLDs are located in two rings around the CPS, an inner ring near the site boundary, and an outer ring about 8 km (5 mi) from the plant (AmerGen 2002b). The TLDs are read quarterly.

For 2001, the average quarterly reading for the inner- and outer-ring environmental TLDs was 0.181 mSv (18.1 mrem) with measurements ranging from 0.131 to 0.219 mSv (13.1 to 21.9 mrem) (AmerGen 2002b). This compared to average quarterly readings from control locations of 0.169 mSv (16.9 mrem) with measurements ranging from 0.150 to 0.195 mSv (15.0 to 19.5 mrem) (AmerGen 2002b). AmerGen concluded that these results were not significantly different and showed no increase in environmental gamma radiation levels resulting from plant operations at the CPS. Similar results were observed for the past several years (AmerGen 2000a, 2001b, 2003).

Exelon estimated direct radiation exposure to construction workers by using fencing TLD measurements. The average quarterly readings for the fenceline TLDs for a 2-year period (second quarter 2001 to first quarter 2003) was 0.265 mSv (26.5 mrem). This corresponds to a dose rate of 0.121 μSv/h (12.1 μrem/h). Assuming that a construction worker was present for 2080 hours per year, the worker would receive 0.25 mSv (25 mrem) annually (Exelon 2004b). The Exelon construction worker dose estimate is conservative for the following reasons: (1) the fenceline TLD readings on the south side of the protected area closest to the new nuclear unit were lower than the average of all the values (i.e., using the TLD results from the south side of the protected area only would result in an estimated annual dose to the construction worker of only 0.14 mSv [14 mrem]), (2) estimates were adjusted to consider the reactor operating 100 percent of the time, and (3) adjustments to subtract out background radiation were not

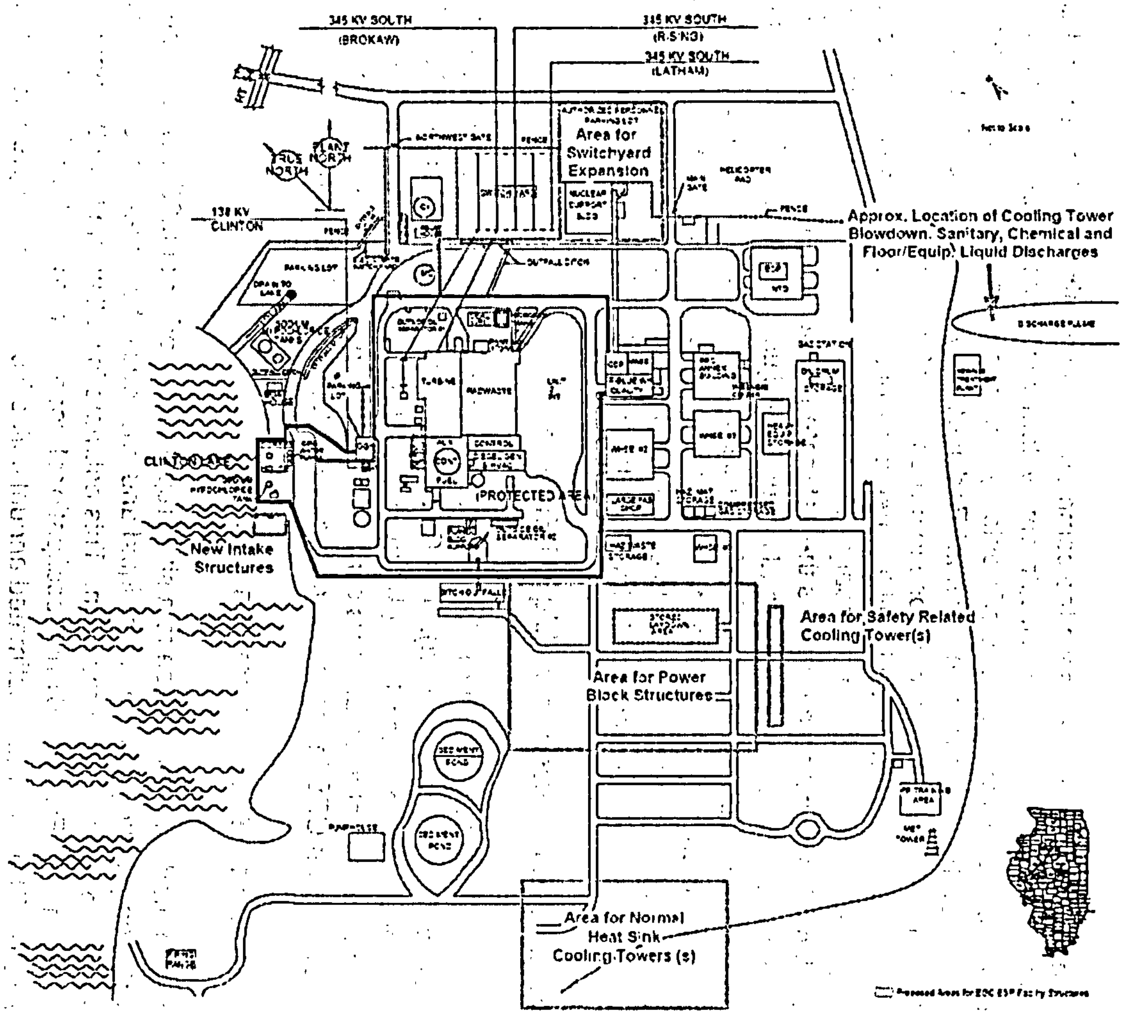

Figure 4-2. Location of Exelon ESP Structures Relative to Existing CPS Facility

made. AmerGen (2002b) reported an average quarterly background reading of 0.169 mSv (16.9 mrem). Adjusting for worker occupancy, a construction worker would get approximately 0.16 mSv (16 mrem) annually from natural background.

4.9.2 Radiation Exposures from Gaseous Effluents

The CPS releases gaseous effluents via the common station heating, ventilating, and air conditioning stack and the standby gas treatment system vent. Exelon (2003a) estimated construction worker dose from gaseous effluents by taking the dose estimates to the maximally exposed member of the public from the *Annual Radioactive Effluent Release Report* (AmerGen 2002a). The highest annual dose to a member of the public from gaseous effluents was 3×10^{-5} mSv (0.003 mrem) to an individual using the public access road in the southeast sector of the site within the CPS site boundary. This dose was based on an occupancy of 243 hr/yr (Exelon 2004b), which represents the estimated amount of time a member of the public would spend on the public access road annually. Adjusting this dose for the expected occupancy of a construction worker (i.e., 2080 hours per year), the annual dose becomes 3×10^{-4} mSv (0.03 mrem). A review of annual effluent release reports for the past several years showed this dose to be typical. The dose to construction workers from the gaseous effluent releases would be negligible compared to the dose from direct radiation exposure.

4.9.3 Radiation Exposures from Liquid Effluents

Exelon considered radiation exposures from liquid effluents to be negligible for estimating dose to construction workers (Exelon 2003a). The CPS has not released any liquid radioactive effluents to the environment since 1992 (AmerGen 2002a). A review of radioactive effluent release reports for the past several years confirmed that there have been no radioactive liquid effluents released from CPS in recent years (AmerGen 2000b, 2001a, 2002a).

4.9.4 Total Dose to Site-Preparation Workers

Exelon has estimated an annual dose to a site-preparation worker of 0.25 mSv (25 mrem) from the direct radiation pathway. Doses from liquid and gaseous effluent releases are negligible compared to the dose from direct radiation. This estimate is well within both the dose limit to the public found in 10 CFR 20.1301 and occupational dose limits to workers found in 10 CFR 20.1201. The maximum estimated annual collective dose to site-preparation workers, based on an annual individual dose of 0.25 mSv (25 mrem) and an estimated workforce of 3150 workers, is 0.80 person-Sv (80 person-rem). The annual dose limit to an individual member of the public is 1 mSv (100 mrem) total effective dose equivalent and less than 0.02 mSv (2 mrem) in any 1 hour. The annual occupational dose limit is 0.05 Sv (5 rem) total effective dose equivalent.

4.9.5 Summary of Radiological Health Impacts

Having reviewed Exelon's estimate of dose to site preparation workers during construction activities, the staff found the doses to be well within NRC exposure limits designed to protect the public health, even if workers exceeded the 2080 hr/yr occupancy factor. The staff concludes that the impacts of radiological exposures to site preparation workers would be SMALL and that no mitigation would be warranted.

4.10 Measures and Controls to Limit Adverse Impacts During Site-Preparation Activities

The following measures and controls would limit adverse environmental impacts:

- compliance with applicable Federal, Illinois, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emissions, noise control, storm water management, spill response and cleanup, hazardous material management)

- compliance with applicable requirements of existing permits and licenses (e.g., the IEPA/NPDES Permit and the Operating License) for the existing units and other permits or licenses required for construction of the new units (e.g., ACE Section 404 Permit, Illinois Department of Environmental Quality wetlands permit)

- compliance with existing Exelon processes and/or procedures applicable to construction environmental compliance activities for the Exelon ESP site (e.g., solid waste management, hazardous waste management, and spill prevention and response)

- incorporation of environmental requirements into construction contracts

- identification of environmental resources and potential impacts during the development of the ER and the ESP process.

4.11 Site Redress Plan

Site-Preparation and Preliminary Construction Activities

Exelon requested that it be allowed to conduct site-preparation activities at the ESP site as authorized by 10 CFR 52.17(c), 10 CFR 52.25, and 10 CFR 50.10(e)(1). Exelon stated that it might choose to perform none, some, or all of the activities described in Section 1-3 of the site redress plan (Exelon 2003a). Exelon included in its application, as required by 10 CFR 52.17(c), a site redress plan that would be implemented if site-preparation activities were performed, should the ESP expire before the issuance of a CP or COL by the NRC (Exelon 2003b). The objective of the site redress plan is to ensure that the ESP site would be returned to an environmentally stable and aesthetically acceptable condition suitable for non-nuclear uses consistent with DeWitt County zoning requirements. Under the site redress plan, areas that were permanently disturbed would be stabilized and contoured to conform to surrounding areas. Revegetation of disturbed lands would be conducted.

Prerequisites of site-preparation activities that must be fulfilled before performing such activities include:

- documentation of existing site conditions within the Exelon ESP site by way of photographs, surveys, listings of existing facilities and structures, or other documentation — This record would serve as the baseline for redressing the site in the event ESP site-preparation activities were terminated as a result of project cancellation or expiration of the ESP.

- coordination of the movement of the existing CPS protected area boundary, as required — These activities would be coordinated with the CPS to accomplish the movement of structures reflected in the CPS licensing basis in a manner consistent with its operating license and the applicable regulations governing that license.

- movement, demolition, or ownership transfer of existing CPS buildings and structures within the Exelon ESP site — These activities will be coordinated with the CPS to accomplish the movement, demolition, or ownership transfer of structures reflected in the CPS licensing basis in a manner consistent with its operating license and the applicable regulations governing that license.

- obtaining the necessary permits to perform preconstruction activities, such as local building permits, IEPA NPDES permit, IEPA CWA permit, IEPA General Storm Water Permit, etc.

After these prerequisites were completed, planned site-preparation activities could proceed and might include none, some, or all of the following activities pursuant to 10 CFR 52.17(c) and 10 CFR 50.10(e)(1). In the ESP application, Exelon requested approval to perform the following site-preparation activities for a new nuclear unit at the ESP site (Exelon 2003a):

- prepare the site for construction of the facilities (including such activities as clearing, grading, construction of temporary access roads, and preparation of borrow areas)

- install temporary construction support facilities (including items such as warehouses, shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and construction support buildings)

- excavate for facility structures

- construct service facilities (including items such as roadways, paving, railroad spurs, fencing, exterior utility and lighting systems, transmission lines[(a)], and sanitary sewage treatment facilities)

- drill sample/monitoring wells or additional geophysical borings

- construct structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public, including but not limited to

  - cooling towers
  - intake and discharge structures
  - circulating water lines
  - fire protection equipment
  - switchyard and onsite interconnections
  - transmission system[(a)]
  - underground utilities.

The environmental impacts of site-preparation activities allowed pursuant to 10 CFR 50.10(e)(1) are bounded by environmental impacts for construction of the entire facility. In many cases, the impacts of site-preparation activities and construction may be similar, but the impacts resulting solely from site-preparation activities would be of a shorter duration. In the preceding sections in this chapter, the staff has presented impacts of construction that bound the impacts of site preparation. If the ESP expires before an application for a CP or COL is received under 10 CFR Part 52, Subpart C, and site-preparation activities have occurred, the site redress plan would be activated to return the ESP site to an environmentally stable and aesthetically acceptable condition suitable for future alternative use (presumably non-nuclear) that conforms to local zoning laws, thus minimizing the long-term environmental impacts.

(a) As discussed in Section 3.3 of this EIS, Exelon has not submitted an Interconnection Request to Illinois Power Company. The process for obtaining transmission services discussed in that section would have to be completed before construction of the transmission lines could begin.

Site Redress Plan

Exelon provided a site redress plan as part of its ESP application in the event that site-preparation work did not proceed to full construction (Exelon 2003b). The plan identifies the overall objective as providing "an environmentally stable, self-draining, self-maintaining, esthetically acceptable site that can be left unattended." In its plan, Exelon states that redress activities would reflect applicable land-use and zoning requirements and identifies the following five general redress activities for consideration:

- recontouring, revegetation, and replanting of cleared areas

- restoration of sensitive water resource features disturbed for intake and/or discharge structures

- habitat replacement

- use of constructed facilities for alternative purposes, or their removal

- remediation of contamination resulting from site-preparation or site redress activities.

The staff has reviewed the list of allowed site-preparation activities in the event that the ESP is granted and has reviewed the full site redress plan submitted by Exelon. As a result of its own independent review, the staff, in accordance with 10 CFR 52.25(a), concludes that the potential site-preparation activities described in Exelon's site redress plan would not result in any significant adverse environmental impacts that could not be redressed.

4.12 Summary of Construction Impacts

Impact level categories are denoted in Table 4-1 as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. A brief statement explains the basis for the impact level. Some impacts, such as the addition of tax revenue from Exelon for the local economies, are likely to be beneficial impacts to the community.

Table 4-1. Characterization of Impacts from Construction of a New Nuclear Unit at the Exelon ESP Site

Category	Comments	Impact Level
Land-Use Impacts		
Site and Vicinity	Construction activities would take place within existing site boundaries.	SMALL
Transmission Line Rights-of-Way and Offsite Areas	Existing rights-of-way likely to be expanded.	SMALL
Meteorological and Air Quality Impacts		
Construction Activities and Transportation	Construction activities would be conducted in accordance with applicable State administrative codes, and dust and emissions would be minimized through a dust control plan. Air quality would not be degraded sufficiently to be noticeable beyond the immediate vicinity.	SMALL
Water-Related Impacts		
Hydrological Alterations	Impacts localized and temporary. IEPA 401 permit process will be adequate to ensure impacts will be SMALL.	SMALL
Water Use	Dewatering may cause localized declines in the water table. Water needed for construction activities will be far less than the consumptive water loss from a wet tower.	SMALL
Water Quality	Construction would be conducted using best management practices to control spills and storm water runoff.	SMALL
Ecological Impacts		
Terrestrial Ecosystems	Construction activities would have minimal impact to terrestrial ecological resources and habitat.	SMALL
Aquatic Ecosystems	Construction activities would have minimal impact to aquatic ecological resources and habitat.	SMALL
Threatened and Endangered Species	Construction impacts to Federally listed species are expected to be negligible.	SMALL
Socioeconomic Impacts		
Physical Impacts		
Workers/Local Public	Impacts to the public would be minimal due to construction activities taking place within existing plant boundaries.	SMALL
Buildings	Construction would not affect any offsite buildings.	SMALL
Roads	Construction traffic could physically impact the road system, particularly heavy truckloads of construction equipment. These impacts could be mitigated by upgrading the rail line into the CPS site.	SMALL to MODERATE
Aesthetics	Construction activities would be temporary, and observation points would be limited because of site location.	SMALL
Demography	Percentage of construction workers relocating to the region would be small. Most would already live within the region.	SMALL

Table 4-1. (contd)

Category	Comments	Impact Level
Impacts to Community - Social and Economic		
Economy	Economic impacts of construction overall are beneficial to local economies. DeWitt County impacts may be MODERATE.	SMALL to MODERATE
Taxes Income Taxes Sales and Use Taxes	Generally, impacts are beneficial to State and local governments.	SMALL to MODERATE
Impacts to Community - Infrastructure and Community		
Transportation	Roads are lightly traveled and, except at shift changes, would not be overly congested by increased construction traffic. If congestion does occur or is anticipated, mitigation measures can be undertaken.	SMALL
Recreation	Recreational impacts would be minimal and temporary during construction activities.	SMALL
Housing	Rental property is scarce near the ESP site, but found near larger cities. Generally, there is sufficient housing to meet the demands put on the housing system by construction workers.	SMALL to MODERATE
Public Services	Public services are adequate for any temporary influx of workers due to the construction at the ESP site. Construction may lessen the demand for social services due to beneficial economic impacts.	SMALL
Education	Majority of construction workers are expected to already live in the region.	SMALL
Historic and Cultural Resources	Proposed construction area is previously disturbed, except where cooling towers might be built. Exelon would need to consult with IHPA at the CP or COL stage. Exelon has committed to develop procedures to manage cultural resources in the event of an inadvertent discovery.	SMALL
Environmental Justice	No unusual resource dependencies in the area.	SMALL
Nonradiological Health Impacts	Emission controls and remote location of the ESP site would keep nonradiological health impacts small. Adherence to Federal and State Regulations assumed to protect occupational workers.	SMALL
Radiological Health Impacts	Exposures would be below annual occupational and public dose limits.	SMALL

4.13 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

18 CFR Part 35. Code of Federal Regulations, Title 18, *Conservation of Power and Water Resources*, Part 35, "Filing of Rate Schedules and Tariffs."

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

29 CFR Part 1926. Code of Federal Regulations, Title 29, *Occupational Safety and Health Administration*. Part 1926, "Safety and Health Regulations for Construction."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 204. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 204, "Noise Emission Standards for Construction Equipment."

35 Illinois Administrative Code [IAC] Subtitle H, 1987. "Noise." Accessed on the Internet April 27, 2004, at http://www.ipcb.state.il.us/Archive/dscgi/ds.py/View/Collection-13.

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5.0 Station Operation Impacts at the Proposed Site

This chapter examines environmental issues associated with operation of the proposed new nuclear unit at the early site permit (ESP) site to be located adjacent to the Clinton Power Station (CPS), for an initial 40-year period as described by Exelon Generation Company, LLC (Exelon). As part of this application, Exelon submitted an Environmental Report (ER) that discussed the environmental impacts of station operation (Exelon 2003b). This chapter is divided into 13 sections. Sections 5.1 through 5.11 discuss the potential operational impacts on land use, meteorology and air quality, water, terrestrial and aquatic ecosystems, socioeconomics, historic and cultural resources, environmental justice, nonradiological and radiological health effects, postulated accidents, and applicable measures and controls that would limit the adverse impacts of station operation during the 40-year operating period. In accordance with Title 10 of the Code of Federal Regulations (CFR), Part 51, impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned to each analysis. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such. The staff's determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades, as discussed throughout this chapter, are implemented. Failure to implement these upgrades might result in a change in significance level. Possible mitigation of adverse impacts is also presented, where appropriate. Negligible impacts and beneficial impacts are categorized as SMALL impacts. A summary of these impacts is presented in Section 5.12. The references cited in this chapter are listed in Section 5.13.

5.1 Land-Use Impacts

Sections 5.1.1 and 5.1.2 contain information regarding land-use impacts associated with operation of a new nuclear unit at the Exelon site. Section 5.1.1 contains a discussion of land-use impacts at the site and in the vicinity of the site. Section 5.1.2 contains a discussion of land-use impacts in transmission line rights-of-way and offsite areas.

5.1.1 The Site and Vicinity

Based on the information provided by Exelon and the staff's independent review, the staff concludes that the operation of the proposed unit at the ESP site may result in the need for more local housing in the vicinity, which could have SMALL land-use impacts associated with land conversion to residential use. Such impacts are not certain and would result from changes in socioeconomic conditions, as described in Section 5.5.

5.1.2 Transmission Line Rights-of Way and Offsite Areas

In the event that upgraded transmission lines are constructed in the existing transmission line rights-of-way, the staff finds that only SMALL impacts to land use would occur as a result of normal transmission maintenance activities such as right-of-way vegetation clearing, line maintenance, and other normal access needs. The full extent of potential land-use impacts in the transmission line rights-of-way can be estimated only after following the Federal Energy Regulatory Commission (FERC) process for connecting new large generation to the grid. This process is detailed more specifically in Section 3.3.

5.2 Meteorological and Air Quality Impacts

Sections 2.3.1 and 2.3.2 contain a discussion of the meteorological characteristics and air quality of the Exelon ESP site. The primary impacts of operation of a new nuclear unit on local meteorology and air quality would be from releases to the environment of heat and moisture from the primary cooling system (cooling towers), operation of auxiliary equipment (generators and boilers), and emissions from workers' vehicles. The potential impacts of releases from operation of the cooling system are discussed in Section 5.2.1. Section 5.2.2 covers potential air quality impacts from nonradioactive effluent releases at the ESP site, and Section 5.2.3 covers the potential air quality impacts of transmission line rights-of-way during plant operation.

5.2.1 Cooling Tower Impacts

The proposed cooling system for a new nuclear unit at the Exelon ESP site is a wet cooling tower with a hybrid wet/dry cooling system as an alternative. The most apparent impacts of wet cooling towers are the land-use and aesthetic impacts associated with visible plumes. The air quality impacts of wet cooling towers are associated with the drift from the cooling towers and possible interactions between the moist plumes and other pollutants. Existing wet cooling towers at nuclear plants have drift eliminators to reduce drift. The use of hybrid wet/dry cooling towers at a new nuclear unit could reduce potential impacts of wet cooling towers and reduce the amount of water vapor and drift of the plume.

Drift comprises small water droplets that are carried out of the cooling tower. These droplets evaporate, leaving particles that contain residual salts and chemicals from the cooling water. Drift from mechanical draft cooling towers is deposited near the cooling tower, and drift from natural draft towers is deposited farther downwind. Based on a review of the measurements of deposition of drift from nuclear power plants in NUREG-1437, the staff found that "...measurements indicate that, beyond about 1.5 km (1 mile) from the nuclear plant cooling tower, salt deposition is not significantly above background levels" (NRC 1996).

There are no major air pollution sources near the Exelon ESP site. Diesel generators and boilers at the CPS operate for limited periods; generators and boilers that would be associated with a new nuclear unit would also be operated for limited periods. Interactions between pollutants emitted from these sources and the plumes from the cooling towers for a new nuclear unit would be intermittent and would not have a significant impact on air quality.

Based on the above considerations and the assumption that cooling towers associated with a new nuclear unit would be similar to cooling towers at existing nuclear plant sites, the staff concludes that cooling tower impacts on air quality would be SMALL and that additional mitigation of air quality impacts would not be warranted. The CPS does not use wet cooling towers, and there are no other cooling towers in the immediate vicinity of the ESP site. Therefore, the staff concludes that there are no cumulative impacts of cooling towers on air quality.

5.2.2 Meteorological and Air Quality Impacts

A new nuclear unit at the ESP site would include additional standby diesel generators and auxiliary power systems for emergency power and auxiliary steam purposes. These systems would be used on an infrequent basis and pollutants discharged (e.g., particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides) would be in accordance with State and Federal regulatory requirements. Exelon (2003b) provides bounding values for these pollutants. Because these systems would be used on an infrequent basis (i.e., typically a few hours per month) and there would be no significant industrial activities within 16 km (10 mi) of the Exelon ESP site, the staff concludes that the environmental impact of pollutants from these sources would be SMALL and that additional mitigation would not be warranted.

5.2.3 Transmission Line Impacts

Impacts of existing transmission lines on air quality are addressed in the *Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants,* NUREG-1437 (NRC 1996).[a] Small amounts of ozone and smaller amounts of oxides of nitrogen are produced by transmission lines. The small amounts of these gases were found to be insignificant for 745-kV lines (the largest lines in operation) and for a prototype 1200-kV line. In addition, it was determined that potential mitigation measures would be very costly and would not be warranted. The largest lines currently used by the Illinois Power Company (IPC) transmission system are 345-kV lines (Exelon 2003b), well within the range of lines considered in NUREG-1437.

(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.

Therefore, the staff concludes that the potential impacts of transmission lines on air quality are SMALL and that mitigation measures beyond those normally taken in construction and operation of transmission lines would not be warranted.

5.3 Water-Related Impacts

Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting, objectives. The objectives of water management at Clinton Lake and Salt Creek downstream of Clinton Lake include recreation, visual aesthetics, a fishery, and a variety of beneficial consumptive uses of water, such as industrial uses (e.g., cooling water for power generation). The responsibility for regulating water use and water quality is delegated to the Illinois Environmental Protection Agency (IEPA) through both Federal laws and laws of the State of Illinois. Water resource management is subject to considerable uncertainty because of limited ability to reliably predict the future supply of and demand for water that results from natural climate variability. The ability to manipulate the water supply to balance periods of excess water supply with periods of excess water demand is limited by the available water infrastructure. While the water supply is regularly being replenished by precipitation, conflicts over water resources typically grow along with population.

Both Exelon and the staff conducted independent analyses of the changes in Clinton Lake's water supply that would result from operating a new nuclear unit at the Exelon ESP site. These calculations employed different approaches and relied on different data sources. For a more complete description of Exelon's analysis, refer to Sections 5.2.2 and 5.3.2 of the ER (2003b). See Section 2.6 for the staff's description of the hydrologic conditions in the vicinity of the site.

5.3.1 Hydrological Alterations

The reduced volume of water in Clinton Lake, due to the water loss associated with the cooling towers, would result in shorter times for the water to travel from the discharge back to the intake. By reducing the travel time, the average temperature in the lake would increase, thereby contributing to additional induced evaporation in the lake. Based on the relatively one-dimensional flow pattern between the discharge and the intake, the staff concludes that the increase in lake temperatures would advance farther from the discharge towards the intake. However, the impacts of the increased velocities would not be expected to have other impacts in the lake.

The reduced volume of water in Clinton Lake would decrease the lake's pool elevations and increase the frequency and duration that the releases from Clinton Lake would be at the minimum release level. Exelon's and the staff's independent assessments of this change in the pool elevation and downstream releases are described in the following section.

5.3.2 Water-Use Impacts

The existing CPS unit is one the largest users of water in the region and a new nuclear unit at the ESP site would further add to this use. Most of the CPS water usage is water drawn from Clinton Lake for condenser cooling. This usage is non-consumptive as it is entirely returned to the lake. While the existing facility's once-through cooling results in a large non-consumptive use, the facility's consumptive use is dominantly the result of induced evaporation of water from Clinton Lake caused by the increase in the lake's temperature from the once-through cooling discharge. A new nuclear unit would not result in a significant increase in the non-consumptive water use. However, wet cooling towers would result in a significant increase in the consumptive water use.

The impacts on water use are related to the water budget. The consumptive use of water by a new unit would directly reduce the water supply. Additionally, by reducing the lake volume, a new unit would indirectly increase the induced evaporation in Clinton Lake, thereby further reducing the water supply. The reduction in the water supply would result in decreases in the lake's pool elevation and an increase in the frequency and duration that releases from the lake would be the minimum release values.

The water budget for Clinton Lake is limited to a relatively small number of inputs and outputs. The fixed weir design of the Clinton Lake dam does not allow active management of the lake pool levels or downstream releases. Water in excess of the weir height freely spills over the weir and down the spillway. Once the lake pool elevation drops below the weir height, downstream flows are maintained at the release minimums with a submerged pipe and gate with a limited flow capacity. The inputs to the Clinton Lake water budget would include direct precipitation to the lake and surface and subsurface discharges from the contributing watershed. The outputs would include spills over the dam's weir, releases from the dam's release gate, natural evaporation, induced evaporation, and consumptive loss of water from the new nuclear unit's cooling towers. If the sum of the inflows were to exceed the sum of the outflows, the storage in the lake would increase. If the outflows exceed the inflows, the storage in the lake would decrease.

In response to the NRC's request for additional information (NRC 2004a), Exelon described a numerical calculation of the lake water surface elevation changes for a 24-year period of record from June 1, 1978, to April 31, 2002 (Exelon 2004). Exelon provided information on the predicted pool elevation if an ESP facility had been operating during this period. Exelon used a water budget approach, wherein the change in lake storage is the result of an imbalance between inflows and outflows. Inflows were considered from direct precipitation onto the lake and upstream drainage. Outflows were assumed to be the sum of natural evaporation, induced evaporation due to the existing CPS Unit 1, and direct evaporation from an ESP unit operating with wet cooling towers.

Both the staff's and Exelon's water budget models of Clinton Lake are based on a simplified representation of the conservation of mass. The principle of conservation of mass can be restated specifically for water as "the change in storage of water at any time is equal to the water inflow less the water outflow." In both water budget models, changes in lake storage over time would be equal to the differences between the inflows and the outflows. Inflows would include the drainage from the basin upstream of the lake and the precipitation occurring directly on the lake. Outflows would be the natural and induced evaporations and releases from the dam. Groundwater could either flow from the aquifer into Clinton Lake or from Clinton Lake into the aquifer. Based on groundwater elevation measurements, the only time Clinton Lake would be expected to recharge the adjacent aquifer would be after the lake was refilled following an extended period of very low lake elevations. The change in storage would be reflected by a change in pool elevation.

The staff and Exelon made different assumptions to estimate the inflow to Clinton Lake. Because of the absence of tributary flow measurements, there is no direct way to estimate the total inflow into Clinton Lake from its tributaries. The outflow from Clinton Lake's dam was estimated by Exelon from the U.S. Geological Survey gauge downstream from the dam at Rowell, Illinois, after correcting for the additional contributing area downstream between the dam and the Rowell gauge. Evaporation estimates were based on calculations with Exelon's lake temperature model, discussed in Section 5.3.2 of the ER (Exelon 2003b).

Because historical pool elevation records were not available, the only information available to calibrate the inflow estimates was discharge recorded at the Rowell gauge. For the tributary inflows, Exelon estimated monthly average runoff yield coefficients (ratio of runoff to rainfall), which were multiplied by the recorded rainfall during the period of record to generate a runoff record. By considering only rainfall (excluding snowfall) the approach resulted in conservative annual water yield. However, these estimates would not necessarily provide conservative estimates in warm dry years. Therefore, the staff applied a different approach, estimating inflows by using stream flow data from an adjacent unregulated, undiverted watershed.

The staff found an adjacent streamflow gauge on Kikapoo Creek at Waynesville, IL. The drainage of Kikapoo Creek is adjacent to that of the North Fork of the Salt Creek and is located to the northwest. The Kikapoo Creek gauge at Waynesville is approximately 24.7 km (15.3 mi) from the Clinton Dam. This gauge, which is minimally affected by streamflow regulation, is comparable in size of its contributing area (588 km^2 [227 mi^2]) to that of the drainage area (748.9 km^2 [289.2 mi^2]) that contributes flow to Clinton Lake. To estimate inflows into Clinton Lake, the staff scaled the stream flow observed at Kikapoo Creek at Waynesville by the ratio of contributing area at Clinton Dam to the contributing area at the Waynesville gauge. The time period used for estimating inflow was January 28, 1948, to September 30, 2001.

The staff and Exelon also made different assumptions as to the consumptive use of water due to the induced evaporation caused by the existing CPS unit. Exelon based its evaluation on the monthly induced evaporation estimates derived in the Updated Final Safety Analysis Report. The staff used 80 percent of the bounding value of an equivalent wet tower evaporation rate for the CPS unit at its current rated power. This assumes that 20 percent of the heat would be dissipated by heat transfer processes other than evaporation such as long-wave back radiation and conduction. The staff's estimate of induced evaporation due to the existing CPS unit is significantly greater than the applicant's and is considered very conservative.

The results of the staff's independent analysis show that the additional consumptive water loss of a new nuclear unit's wet cooling tower would result in longer and more frequent periods of minimum releases from Clinton Dam. Based upon 100% unit operation and the 51-year period between 1948 and 1999, the estimated percentage of time that minimum flows would have been released from the dam (i.e., when water surface elevations were below 690 ft) increased from 43% (CPS only) to 68% (CPS and ESP). By comparison, if no units were operating, minimum flows would have been released 23% of the time. The pool elevation would also be lowered due to the consumptive water loss caused by a new nuclear unit. The percentage of time with pool elevations below 680 and 677.5 ft would increase from 0% (no units or the CPS unit) to 9% and 5%, respectively, if the CPS and a new nuclear unit were operating. Both of these impacts would be greater in years with lower-than-normal precipitation.

The results of the staff analysis were that the frequency and magnitude of low water conditions are more frequent and deeper than those predicted by the applicant. However, the lack of pool elevation data made it impossible for the staff to perform an adequate calibration and verification of the approach. The analysis must be revisited at the construction permit (CP) or combined license (COL) application. The applicant has, however, committed to collect the pool elevation data that would be required to calibrate and verify the model results. Therefore, based on the Exelon ER and the staff's independent review, the staff concludes that during normal water years the water-use impacts would be SMALL, and mitigation would not be warranted. During low water years, however, the impact to the water level could be MODERATE until normal water conditions return. In such cases, Exelon would need to coordinate with IEPA on appropriate measures, including temporary unit shutdown.

5.3.3 Water Quality Impacts

Because a specific design has not been selected, the ultimate water treatment systems for a new nuclear unit at the Clinton ESP site have not been specified. Currently, raw cooling water from Clinton Lake for condenser cooling and service water needs is not treated. Makeup water for the new unit and the ultimate heat sink (UHS) systems would require treatment with biocides, antiscalants, and dispersants. Makeup of ultrapure water systems, such as condensate and primary cooling, would employ technologies such as reverse osmosis and ultrafiltration.

As discussed above, the consumptive water use from a new nuclear unit would reduce the volume of water in the lake available to absorb the heat rejected by the CPS. As a result, the temperature of the water in Lake Clinton would increase. This increase in temperature, combined with the increased velocity caused by the reduced volume, would tend to push the thermal plume farther toward the intake. However, reliable estimation of this impact would require sufficient data to adequately calibrate a multidimensional numerical model. Such data are currently unavailable. Exelon has committed to collect such data before a CP or COL application is submitted.

The responsibility for regulating water quality is delegated to IEPA through both Federal laws and laws of the State of Illinois. The water quality of effluents from a new nuclear unit would be regulated by its National Pollutant Discharge Elimination System (NPDES) permit. Based on the review of the current NPDES permit, Exelon's ER, the environmental monitoring report, and its independent review, the staff concludes that, with the exception of water temperature, which remains undetermined, the impact to water quality would be SMALL, and mitigation would not be warranted.

5.4 Ecological Impacts

This section describes the potential impacts to ecological resources from operation of a new nuclear unit at the Exelon ESP site, in addition to transmission line rights-of-way and offsite facilities. The impacts are discussed for terrestrial ecosystems, aquatic ecosystems, and threatened and endangered species.

5.4.1 Terrestrial Impacts

Exelon has not determined the cooling system configuration and design parameters for a new nuclear unit. This would have to be evaluated by the staff at the CP or COL stage. The new nuclear unit could use a wet, dry, or hybrid wet/dry system for plant cooling. For a wet system, mechanical or natural draft cooling towers would be possible, whereas a dry system would employ dry towers. Depending on the type of cooling system(s) that would be used to dissipate heat from the new nuclear unit, the rejected heat would be manifested in the form of vapor (wet system) and/or thermal (dry system) plumes from one or more locations within the cooling tower footprint. With vapor plumes, associated impacts due to salt drift, fogging, and icing would be possible. Because dry towers do not expose cooling water directly to the air, there would be no evaporative loss, and hence no vapor plumes, salt drift, fogging, or icing. Dry thermal plumes are not normally expected to result in significant environmental impacts (Exelon 2003b). For wet cooling processes, the resulting vapor plumes could impact crops and ornamental vegetation and native plants, and water losses could affect shoreline habitat. In addition, bird collisions and wildlife disturbance due to noise are possible with wet or dry cooling towers. Each of these topics is discussed below.

Transmission systems associated with nuclear power plants have the potential to impact terrestrial ecological resources through right-of-way management practices, bird collisions with power lines, and electromagnetic fields. Exelon currently anticipates that four new 345-kV transmission lines (two parallel, double-circuit lines running north to the Brokaw Substation near Bloomington and two running south to the Oreana Substation) would be required to accommodate the bounding case of an output of 2200 MW(e) from a new nuclear unit (see Section 3.3) (Exelon 2003b). However, if a new unit is constructed, the actual need for and nature of any transmission system improvements would be determined definitively at the CP or COL stage by the transmission and distribution system owner and operator (currently Illinois Power) under FERC Order No. 2003 (18 CFR Part 35), *Standardization of Generator Interconnection Agreements and Procedures* (FERC 2004). The magnitude of the environmental impacts, given any transmission system improvements, would be established definitively by the transmission and distribution system owner and operator at that time. The impacts normally associated with transmission line operation and maintenance (right-of-way management [including cutting and herbicide application and associated impacts to floodplains and wetlands], bird collisions with power lines, and electromagnetic fields) are discussed below in light of Exelon's anticipated changes to the existing transmission system.

5.4.1.1 Impacts on Crops, Ornamental Vegetation, and Native Plants

Impacts on crops, ornamental vegetation, and native plants might result from cooling tower salt drift, icing, fogging, or increased humidity. The heat dissipation system at the CPS is once-through. Because it has no cooling towers, there is no history of salt drift at the CPS that can be used to help evaluate this issue for a new nuclear unit. It is assumed that one or more new cooling towers at the ESP site would produce salt concentrations similar to those at other nuclear power plants that employ cooling towers. Impacts on crops, ornamental vegetation, and native plants were evaluated for existing nuclear plants in the GEIS for License Renewal (NRC 1996) and were found to be of small significance. This determination included existing nuclear plants with more than one cooling tower. There are no important terrestrial plant species or habitats (defined in NRC 2000b) onsite, or in the immediate site vicinity, except for four minor (less than 0.4 ha [1 ac]) herbaceous wetlands that consist of open water in association with constructed sediment basins (Exelon 2003b). Consequently, based on the evaluation in the GEIS for License Renewal (NRC 1996), a lack of important terrestrial plant species and habitats, and agricultural land use onsite and in the immediate vicinity, the staff concludes that the potential impacts on crops, ornamental vegetation, and native plants from addition of one or more cooling towers for a new nuclear unit at the ESP site would be minimal and that mitigation would not be warranted.

5.4.1.2 Noise

For both natural and mechanical draft cooling towers, the anticipated noise level from cooling tower operation is anticipated to be 55 decibels at 305 m (1000 ft) (Exelon 2003b). Noise levels from dry cooling tower operation would be less than 65 decibels (Dominion 2002). Noise levels from these three types of cooling towers are well below the 80-to-85-decibel threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating any of these types of cooling towers would not be likely to disturb wildlife beyond the ESP site. Consequently, the potential impacts to wildlife posed by the noise resulting from the addition of one or more cooling towers at the ESP site would be minimal and mitigation would not be warranted.

5.4.1.3 Avian Collisions

Although the Exelon ESP site is located in central Illinois at a considerable distance from the Mississippi River, it lies in proximity to one of the principal routes of the Mississippi flyway.[a] The CPS has a once-through cooling system. Because it has no cooling towers, there is no history of bird collisions at the CPS that can be used to help evaluate this issue for a new nuclear unit. However, the evaluation presented in the GEIS for License Renewal (NRC 1996) concludes that bird collisions with cooling towers are of small significance at all operating nuclear power plants, including those with more than one cooling tower. Consequently, the number of bird collisions, if any, associated with the addition of one or more cooling towers for a new nuclear unit at the ESP site would be negligible and mitigation would not be warranted.

There are no known reports by transmission-line-operation and right-of-way maintenance personnel of dead birds resulting from collisions with the existing transmission line rights-of-way. However, there is currently no monitoring plan in place that would facilitate detection and

(a) North American Migration Flyways, accessed on the Internet at http://www.birdnature.com/mississippi.html, on May 7, 2004.

reporting of dead birds under transmission lines. The conclusion presented in the GEIS for License Renewal (NRC 1996) is that bird collisions with transmission lines are of small significance at operating nuclear power plants, including those with rights-of-way with variable numbers of power lines.

Thus, although expansion of the existing transmission line rights-of-way could be required for a new nuclear unit at the Exelon ESP site, this would likely present few new opportunities for bird collisions beyond those currently in existence. Further, the additional number of bird collisions, if any, would not be expected to cause a noticeable reduction in local bird populations. Consequently, the incremental number of bird collisions posed by the possible expansion of the two existing transmission line rights-of-way for a new nuclear unit at the ESP site would be negligible and mitigation would not be warranted.

5.4.1.4 Shoreline Habitat

Addition of a new nuclear unit at the ESP site would reduce water volume in Clinton Lake, due to evaporative water loss from wet cooling tower operation. Additionally, by reducing the lake volume, a new unit would increase lake water temperature and evaporation above that caused by the discharge of once-through cooling water from the existing CPS. This would further reduce the lake volume. The reduction in water volume would decrease pool elevation and increase the amount of lakebed exposed along Clinton Lake. This would alter the amount and distribution of soil water which could alter the composition of shoreline vegetation. Existing vegetation could eventually be replaced with more drought hardy or exotic opportunistic species, which could affect wildlife use of shoreline habitat.

The staff analyzed the Clinton Lake water budget for the CPS and the CPS plus a new nuclear unit for a 51-year period between 1948 and 1999 (see Section 5.3). The estimated percentage of time minimum flows (0.14 m^3/sec [5 cfs]) would have to be released from the dam (i.e. water surface elevations below 210 m [690 ft]) increased from 43 percent (CPS only) to 68 percent (CPS plus new nuclear unit). The percentage of time with pool elevations below 207 m (680 ft) and 206 m (677.5 ft) would increase from 0 percent (CPS only) to 9 percent and 5 percent, respectively, if the CPS and new nuclear unit were operating. These represent substantial reductions in surface water elevation, and these would be expected to be greater in years with lower than normal precipitation.

Consequently, the additional water loss of a new nuclear unit's wet cooling tower(s) would result in longer, more extensive, and more frequent periods of lakebed exposure. However, because Clinton Lake bathymetry data are lacking, it is unknown where these drawdowns would expose the most lakebed along the lake perimeter. Without bathymetry data, it is also unknown how aerially extensive shoreline exposure would be. However, the upper arms of the lake, near the ingress of Salt Creek and North Fork Salt Creek, would probably be two of the areas most affected, because they are generally shallower than other parts of the lake. Lakebed exposure would likely be most severe during late summer and during drought years. Nonetheless, because it is unknown where and how much lakebed would be affected, potential impacts to shoreline vegetation and wildlife could range from minimal to substantial. This issue will be evaluated in greater detail at the CP or COL stage.

5.4.1.5 Transmission Line Rights-of-Way

Exelon anticipates adding two new 345-kV transmission lines to the existing transmission line rights-of-way to accommodate the target generating capacity for a new nuclear unit at the ESP site (approximately 2200 MW(e) [Exelon 2003b]), as indicated in the introduction to Section 5.4.1. Exelon anticipates that the new lines would be sited within the CPS rights-of-way to the greatest extent possible, and that no new rights-of-way would be needed. However, Exelon projects that widening the transmission line rights-of-way from 40 m (130 ft) to 76 m (250 ft) would be required to add the lines for a new nuclear unit (Exelon 2003b).

Approximately 88 percent of the area of the transmission line rights-of-way cover agricultural land. As part of the existing right-of-way agreements, it is assumed that farmers would continue to cultivate this land. Therefore, 88 percent of the expanded rights-of-way would also cross agricultural land. It is anticipated that existing access would be adequate and that no new permanent roads would be needed for transmission line right-of-way maintenance (Exelon 2003b).

Routine inspections of the existing transmission line rights-of-way for vegetation control are conducted by helicopter three times per year. Routine vegetation control, which consists of clearing vegetation that encroaches on the line exclusion area, is performed every 4 years unless required sooner. No vegetation over 3 m (10 ft) tall is allowed within the transmission line exclusion area. Tree species with the potential for resprouting may be controlled with an environmentally acceptable selective basal spray herbicide. The same vegetation management practices currently in effect for the rights-of-way would be applied to the expanded rights-of-way for a new nuclear unit. Thus, vegetation management would simply occur along the same rights-of-way but over nearly twice the area. Transmission line right-of-way management was evaluated previously in the GEIS for License Renewal (NRC 1996), and the impacts were found to be of small significance at operating nuclear power plants, including those using transmission line rights-of-way of variable widths. Consequently, the incremental impacts of right-of-way management performed over twice the size of the existing rights-of-way for a new nuclear unit would be minimal and mitigation would not be warranted.

5.4.1.6 Impacts of Electromagnetic Fields on Flora and Fauna (Plants, Agricultural Crops, Honeybees, Wildlife, Livestock)

As discussed in the GEIS for License Renewal (NRC 1996), a careful review of the biological and physical studies of electromagnetic fields (EMFs) has not revealed consistent evidence linking harmful effects with field exposures. EMFs are unlike other agents that have a toxic effect (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be forced and long-term effects, if real, are subtle. Therefore, the staff concludes that the impacts of EMFs on terrestrial flora and fauna are of small significance at operating nuclear power plants, including those with transmission line rights-of-way with variable numbers of transmission lines (NRC 1996). Consequently, the incremental EMF impacts posed by possible addition of four new transmission lines in the two existing rights-of-way for a new nuclear unit at the ESP site would be minimal and mitigation would not be warranted.

5.4.1.7 Floodplains and Wetlands on Transmission Line Rights-of-Way

The effects of transmission line right-of-way management on floodplains and wetlands was evaluated previously in the GEIS for License Renewal (NRC 1996), and the impacts were found to be of small significance at operating nuclear power plants, including those with transmission line rights-of-way of variable widths. The same vegetation management practices currently in effect for the rights-of-way would be applied to the expanded rights-of-way for a new nuclear unit. Vegetation management would simply occur along the same rights-of-way with double the floodplain/wetland interface. Consequently, the incremental effects of transmission line right-of-way management on floodplains and wetlands posed by doubling the size of the existing rights-of-way for the new nuclear unit would be negligible and mitigation would not be warranted.

5.4.1.8 State-Listed Species

There would be no operational impacts to State-listed threatened or endangered terrestrial plant species because none is known to occur on or within 16 km (10 mi) of the Exelon ESP site (IDNR 2004).

There are also no State-listed threatened or endangered terrestrial animal species known to occur on or within 16 km (10 mi) of the ESP site (IDNR 2004). However, according to the local Audubon Society and other birding sources in Illinois, there have been documented sightings of several State-listed threatened or endangered bird species in the vicinity (see Section 2.7.1.2 for a species list) (Exelon 2003b). Individuals of these species that frequent the vicinity of the ESP site would be expected to be minimally exposed, if at all, to the potential effects of the operations described above. Consequently, it is expected that operation impacts to State-listed terrestrial animal species would be negligible. Exelon has committed to contact the Illinois Department of Natural Resources (IDNR) prior to commencement of construction activities to ensure that these assumptions remain valid.

5.4.1.9 Summary of Terrestrial Ecosystems Impacts

The potential impacts of operating one or more cooling towers on the Exelon ESP site for a new nuclear unit on crops and ornamental vegetation and native plants, bird collisions, wildlife due to noise, and vegetation and wildlife due to alteration of shoreline habitat are considered negligible. The potential impacts of possibly doubling the size of the existing transmission line rights-of-way and operating two new transmission lines within them, on power line right-of-way management (cutting and herbicide application), on floodplains and wetlands, on bird collisions, and on wildlife due to EMFs are considered negligible. In addition, there would be no operation impacts to State-listed threatened or endangered terrestrial species.

After reviewing the proposed new nuclear unit for the ESP site, including the associated heat dissipation system, transmission lines, and associated right-of-way maintenance, the staff concludes that the impacts from operation of a new nuclear unit would be SMALL and that mitigation would not be warranted.

5.4.2 Aquatic Impacts

Section 2.7.2 contains a discussion of the aquatic ecology of the Exelon ESP site. Impacts of a nuclear unit on aquatic organisms in Clinton Lake and/or Salt Creek may arise through water intake, consumption, and discharge. The location, design, and operation of a new intake structure would be regulated by the IEPA to prevent impingement and entrainment of aquatic organisms. The IEPA also regulates thermal limits for heated water discharge, which can affect organisms indirectly by impacting water quality and directly when water is heated or cooled to a temperature outside an organism's tolerance range. Exelon plans to maintain the cooling water discharge from a new nuclear unit within the existing NPDES limits for the CPS. Exelon's and the staff's independent assessment of the potential for impacts to the local aquatic ecology from operation are discussed in Sections 5.4.2.1 and 5.4.2.2, and then summarized in Section 5.4.2.3.

5.4.2.1 Water Intake and Consumption

For aquatic resources, the primary concerns of water intake and consumption are the amount of water drawn from the cooling water source (i.e., Clinton Lake), the design and location of the cooling water intake structure, and the potential for organisms to be impinged on the intake screens or entrained into the cooling-water system. Impingement takes place when organisms are trapped against intake screens by the force of the water passing through the cooling-water intake structure (FR 2001). Impingement can result in starvation and exhaustion, asphyxiation (water velocity forces may prevent proper gill movement or organisms may be removed from the water for prolonged periods of time), and descaling (FR 2001). Entrainment occurs when organisms are drawn through the cooling water intake structure into the cooling system. Organisms that become entrained are normally relatively small benthic, planktonic, and nektonic organisms, including early life stages of fish and shellfish, and often serve as food for larger organisms (FR 2001). As entrained organisms pass through a plant's cooling system, they are subject to mechanical, thermal, and/or toxic stress.

The U.S. Environmental Protection Agency (EPA) has promulgated regulations that implement Section 316(b) of the Federal Water Pollution Control Act of 1972 for new and existing electric power producing facilities (66 FR 65255; 69 FR 41576). The regulations apply to facilities that employ a cooling water intake structure and are designated to withdraw 50 million gallons per day or more of water from waters of the United States for cooling purposes. The new nuclear unit would be subject to these regulations. The regulations establish performance standards that are designed to reduce impingement mortality by 80 to 95 percent and entrainment by 60 to 90 percent. The new regulations state that if the facility employs a closed-cycle cooling system, the facility is deemed to have met the performance standards to reduce impingement mortality and entrainment. Exelon has not yet finalized a detailed design of the cooling water system. However, the applicant proposes a PPE that includes a cooling system that employs mechanical draft, natural draft, or a wet/dry hybrid cooling systems, all of which are considered closed-cycle cooling systems. Therefore, the staff believes that the new nuclear unit would meet the performance standards specified in the new EPA regulations implementing Section 316(b).

The responsibility for making the determination that the cooling water intake structure reflects the best available technology for minimizing adverse impacts rests with the EPA or its designee, e.g., IEPA, which would make decisions implementing Section 316(b) on a case-by-case, site-specific basis. Exelon would work with the IEPA to design the intake system to meet the new standards of best available technology.

The specific components and design of the cooling water system at a new nuclear unit will not be determined before the COL phase. However, Exelon's ER (Exelon 2003b) provides general descriptions of a nuclear unit's cooling system operational modes, component descriptions, normal heat sink and UHS, and cooling system instrumentation.

The primary water demand for a new nuclear unit would be for condenser cooling. Exelon discusses using either a wet tower closed-loop cooling system or a hybrid wet/dry closed-loop cooling system. The plant parameter envelope (PPE) provides bounds for a wet tower cooling system but no similar values for the hybrid wet/dry cooling system. The staff has assumed that water used for the hybrid wet/dry cooling system is bounded by the wet cooling system values. Therefore, the following discussion is limited to the wet tower system. The hybrid wet/dry cooling system will not be addressed further in this environmental impact statement (EIS).

Based on the expected intake velocity and flow rate, the new intake structure would be approximately 34 m x 46 m (110 ft x 150 ft) in shore-to-lake dimensions. Preliminary plans call for water drawn from Clinton Lake to pass through bar racks or a similar device that are designed to keep large debris (e.g., tree branches) from entering the cooling water system. The water would then pass through traveling screens that allow water to pass but remove small debris (e.g., leaves) by the rotation of the screens and with the help of a water spray. The debris removed from the screens would be held in trash collection baskets so it could be inspected before disposal. The velocity of the water approaching the traveling screens would be limited to a maximum of 0.15 m/s (0.50 fps) at the normal lake-level elevation of 210 m (690 ft) above mean sea level (MSL) (Exelon 2003b).

Exelon plans to maintain a discharge rate within the current NPDES permit limits for the CPS. The current CPS relies on once-through cooling. The expectation of the original environmental assessment for the CPS was that Clinton Lake would be able to support two once-through cooling units. In its ER, however, Exelon proposed a closed-cycle cooling tower for a new nuclear unit, which requires less water to be drawn from Clinton Lake than does a once-through cooling system.

The relatively low overall water use estimated for the intake for a new nuclear unit would minimize the chance for impingement and entrainment, and compliance with the EPA ruling for new intake structures would ensure that aquatic organisms are protected. The adjacent CPS intake structure would be considered an "existing" structure under a separate EPA ruling for existing facilities and would also be required to meet performance standards that protect aquatic organisms based on the facility's source water (e.g., lake or reservoir).

On July 9, 2004, the EPA published a final rule in the *Federal Register* (69 FR 41576) addressing cooling water intake structures at existing power plants whose flow levels exceed a minimum threshold value of 190,000 m^3/d (50 mgd). The rule is Phase II in EPA's development of regulations under Section 316(b) of the Federal Water Pollution Control Act of 1972 (also referred to as the CWA) and establishes national requirements applicable to the location, design, construction, and capacity of cooling water intake structures at existing facilities that exceed the threshold value for water withdrawals. The national requirements, implemented through NPDES (or equivalent State) permits, minimize the adverse environmental impacts associated with the continued use of the intake systems. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES (or equivalent State) permit. Licensees may be required as part of the permit renewal to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigation measures as a result of this regulation. The new performance standards are designed to significantly reduce impingement and entrainment losses due to water withdrawals associated with cooling water intake structures used for power production. Any required site-specific mitigation would result in less impact from entrainment during the license renewal term.

Information on recent entrainment studies, if any, was not available for the CPS. A discussion of entrainment in the CPS Final Environmental Statement (IPC 1974) indicated that the recreational fish species in Clinton Lake (e.g., sunfish, bass, crappie, walleye, and catfish) are nest builders, and that the eggs and small juveniles are closely associated with nest sites located in the shallow, littoral zones of the lake or in the two creeks that feed the lake (Lutterbie 2002). The intakes for the CPS and a new nuclear unit are located in a relatively deep portion of this shallow lake (at approximately 6.4 m [21 ft] depth), where these species are less likely to spawn. Combined with the EPA requirements to meet best available technology for new and existing cooling water intake structures and the fish-stocking programs managed by the IDNR, the location of the intakes decreases the likelihood of significant entrainment impacts to important aquatic species from the operation of an intake for a new unit, either on its own or in combination with the CPS cooling water intake. However, a full review of anticipated impacts to important aquatic species cannot be performed without a specific cooling water intake design.

There would be a reduced volume of water in Clinton Lake, due to water loss associated with the cooling towers of a new nuclear unit. This would result in shorter times for the water to recirculate from the discharge back to the intake (see also Section 5.3.1). This reduction in travel time would increase average temperature in the lake, thereby contributing to additional induced evaporation in the lake. The reduced volume of water in Clinton Lake would decrease the pool elevations and would increase the amount of shoreline exposed. The increased water use and evaporative loss from operation of a new nuclear unit at the ESP site could also increase the amount of time additional shoreline is exposed. Depending on the season and the duration and amount of shoreline exposure, it is possible that shoreline vegetation and aquatic organisms could be affected. However, because the mechanism for drawdown would be evaporation and/or discharge of 0.14 m^3/s (5 cfs) to Salt Creek, the drawdown would likely be slow enough to allow most aquatic organisms to adjust to the lower water levels. In severe cases, it is possible that some shallow-water fish spawning areas could be exposed, but this is unlikely to have a lasting impact on the Clinton Lake fish community structure. Other potential impacts associated with an increase in average lake temperature are a decrease in the amount of cool-water summer refugia for fish and an alteration in the timing of fish spawning events. These issues would be evaluated in detail at the CP or COL stage.

A fish-impingement study was conducted during the first year of CPS operation, from April 1987 to May 1988 (Pallo 1988). Eight fish species were collected during 84 sampling days. Gizzard shad (*Dorosoma cepedianum*) composed over 99 percent of the total estimated count and the biomass of impingement collections. Other species observed in descending order of estimated annual abundance were white crappie (*Pomoxis annularis*, n = 2338), freshwater drum (*Aplodinotus grunniens*, n = 758), black bullhead (*Ameiurus melas*, n = 148), bluegill (*Lepomis macrochirus*, n = 82), hybrid striped bass (*Morone saxatilis X M. chrysops*, n = 26), channel catfish (*Ictalurus punctatus*, n = 17), and largemouth bass (*Micropterus salmoides*, n = 16). It was estimated that over 43-million gizzard shad, mostly young-of-the-year, were impinged during the study. This number, though high, must be taken in context of the gizzard shad's fecundity. Females may contain between 22,400 and 543,000 eggs each (Jenkins and Burkhead 1993). This prolific forage fish species typically experiences a naturally high young-of-the-year mortality rate and commonly demonstrates mass mortality in winter when water temperatures approach 4°C (39.2°F). Most of the fish were collected in winter (December through March) when water temperatures declined and then held steady between 4° to 6°C (39.2° to 42.8°F) (Pallo 1988). Fortunately, the species has the ability to compensate for high juvenile mortality by producing a large amount of young. Abundance of gizzard shad has been high since operation of the CPS began, indicating that there are no apparent adverse impacts to the population as a result of current cooling water intake withdrawals. In fact, fish are smaller on average than gizzard shad in many other Illinois lakes, possibly indicating that overabundance of the fish is creating strong competition among shad for food and other resources.[a] The almost exclusive impingement of the abundant gizzard shad, combined with the EPA requirements to meet best available technology for new and existing cooling water intake structures and the recreational fish-stocking programs managed by IDNR, decreases the likelihood of significant impingement impacts to important fish species from the operation of an intake for a new nuclear unit, either on its own or in combination with the CPS cooling water intake operation. However, a full review of anticipated impacts to important fish resources due to impingement cannot be performed without a specific cooling water intake design.

5.4.2.2 Water Discharge

For aquatic resources, the primary concerns related to water discharge are the effects of heated effluents on fish and other aquatic organisms (NRC 1996). Heated effluent temperatures may be high enough to kill some organisms, especially in the area nearest the effluent discharge structure. The amount of suitable habitat available to important aquatic species (i.e., within the species' tolerance range of temperature and dissolved oxygen) may be reduced during warm summer months. In addition to heat effects, there may be impacts to important aquatic species if they are exposed to a sudden decrease in temperature when artificial heating ceases. For example, the condition known as cold shock may occur if power plants are shut down suddenly in winter (NRC 1996).

(a) Personal communication on March 2, 2004, with Mike Garthaus (Illinois Department of National Resources).

The NPDES permit program, authorized by the CWA, controls water pollution, including heated effluents, by regulating point sources that discharge pollutants into waters of the United States. The CPS currently discharges waste water to Clinton Lake under NPDES permit IL0036919 issued by the IEPA (IEPA 2000). Future waste water discharges from the new nuclear unit would be in compliance with a similar approved NPDES permit with discharge limits established by the IEPA. The IEPA is required to take into consideration the cumulative impacts of multiple discharges to the same waterbody, and discharges from the CPS and other area facilities would be included in the review and development of permit requirements for any new nuclear unit. Additionally, all NPDES permits must be renewed every 5 years, allowing IEPA to ensure that the permits provide the appropriate level of protection to the environment.

A new nuclear unit, under all of the cooling alternatives, would add its discharge to the existing CPS discharge flume. The only modification would require making a new unit's discharge pipe connect to the portion of the existing flume that was originally provided for the circulating water discharge of the CPS Unit 2, which was never constructed (Exelon 2003b). Exelon has expressed a goal of maintaining the combined CPS and new unit discharge flows and temperatures within the conditions of the current NPDES permit for the CPS (Exelon 2003b; IEPA 2000).

If a new nuclear unit were to operate alone (no concurrent discharge from the CPS), lake temperature increases would likely be proportional to the increase in flow and temperature that has been observed for the CPS facility.

The average lake temperature, determined by monitoring during the CPS pre-operational period (1985 and 1986), was 13.3°C (55.9°F) (IPC 1992). The average lake temperature monitored over 5 years after CPS operation (1987 through 1991) was 21.1°C (70.0°F) (IPC 1992). Thus, the CPS has increased lake temperatures approximately 7.8°C (14°F) over pre-operational conditions (IPC 1992). Temperature differences between pre-operational and CPS operational periods were most noticeable at the discharge sampling station and at the 1- and 2-m (3- and 7-ft) depth strata (IPC 1992). Water temperature increases would be most critical near the discharge and during the summer months, when recirculating water volumes, ambient air temperatures, and water temperatures are high. Exelon states in its ER that "if a cooling method is selected that has a consumption rate that exceeds the available water for drought conditions, it may be necessary for periods of time to reduce or curtail plant operation to protect the minimum lake level and integrity of the ultimate heat sink" (Exelon 2003b). This may also be necessary to keep temperatures below the limits allowed by the NPDES permit at the discharge and by the Illinois Pollution Control Board at the Salt Creek monitoring station, 30.5 m (100 ft) downstream of the Clinton Lake Dam.

Water temperature is an important factor in the maintenance of a healthy aquatic environment. Temperature regulates the metabolism and composition of aquatic communities. Elevated temperatures increase metabolism, respiration, and oxygen demand for aquatic organisms (IPC 1992). During warm weather, an upper, heated layer of water may form at the lake surface. In most lakes, this is a result of the absorption of solar energy. In Clinton Lake, this thermal stratification is caused by the combination of solar energy and the dispersion of heat from the CPS discharge. The heated upper layer floats over a cooler, deeper, more dense layer of water. During sustained thermal stratification, mixing between layers is inhibited and the deep waters may not have any direct contact with the atmosphere. As biota living in the deep waters respire, the amount of oxygen is depleted. As a result, there may be periods when only the upper layers are able to support a diversity of aerobic aquatic life. Between 1978 and 1991, the IPC monitored temperature in Clinton Lake at five sites. Stratification occurred each year, but not at every site sampled. In general, the deeper sites were more likely to exhibit complete stratification, and stratification was most likely to occur between May and September (IPC 1992).

IPC analyzed the potential impacts of high lake temperatures on fish in the lake before CPS operation (IPCB 1993). The thermal tolerance limits of six fish species were compared to the 43.7°C (110.7°F) maximum and the 37.2°C (99°F) 90-day limit allowed under the NPDES permit. The six species were gizzard shad, common carp, channel catfish, bluegill, largemouth bass, and white crappie. An EPA protocol was used to assess impacts on reproduction, growth, and survival for each species, using preferred thermal limits and habitats for each species drawn from the existing literature. Minimal impacts were predicted for the reproduction, growth, and survival of gizzard shad, common carp, and bluegill. Minimal impacts were likewise predicted for the survival and growth of channel catfish and largemouth bass, but reproduction in these species was predicted to be limited during the spawning season. Substantial impacts were predicted for white crappie. Even under severe ambient summer conditions, the species was not predicted to survive. Since operation of the CPS began, the white crappie population has indeed experienced a decline. However, the black crappie population has increased proportionally over the same time period and now comprises greater than 80 percent of the crappie population in the lake (Lutterbie 2002).[a] The IDNR does manage and stock a number of recreational sport fish species in the lake on an annual basis, including hybrid striped bass, striped bass, smallmouth bass, walleye, and white crappie (IDNR 2003a). The stocking program ensures that the number and variety of recreational species is maintained from year to year.

Dissolved oxygen (DO) levels are also important to the protection and maintenance of a well-balanced aquatic community. Concentrations of DO vary inversely with temperature and may vary widely between day and night as plants photosynthesize (DO increases) and respire (DO

(a) Personal communication on March 2, 2004, with Mike Garthaus (Illinois Department of Natural Resources).

decreases). There has been a significant decrease in the average DO concentration in Clinton Lake since operation began, from 10.2 mg/L to 7.8 mg/L (IPC 1992). In general, a DO concentration of 5 mg/L is sufficient to support a healthy aquatic community (EPA 1986). During the CPS operational period, 4 percent of the DO samples monitored were below 5 mg/L, compared to less than 1 percent during the pre-operational period. The DO reached its lowest levels during August and September and generally decreased with increasing water depth. However, the majority of the lake had DO levels above 5 mg/L at any given time (IPC 1992).

It is not uncommon for lakes in Illinois to have depleted DO in bottom waters during the summer. Fish generally avoid areas that exhibit a water temperature or DO concentration outside their preferred range by swimming to another region of the lake. However, there has been at least one occasion when striped bass inhabiting cooler waters in the deep portions of the lake (e.g., submerged gravel pits located near the Clinton Lake Marina) have died as a result of low oxygen levels associated with thermal stratification during the summer.[a] These instances are rare, however, and under current CPS operating conditions, the balance of indigenous and stocked recreational fish populations in the lake is being maintained.[a] The small increase in average lake temperature during combined operations of the CPS and a new nuclear unit, so long as it remains within the NPDES limits currently in place, are not expected to adversely affect important aquatic organisms or upset the balance of the aquatic community in Clinton Lake or its tributaries (i.e., Salt Creek and the North Fork of Salt Creek).

The effects of heated discharges on other organisms is generally limited to localized areas, usually in the vicinity of the discharge. In this area, localized reductions in coldwater species or increases in warmwater species are possible, but the effects are limited to small areas and have not been found to alter large geographic distributions (NRC 1996). Because the heated effluent discharge of a new nuclear unit would be combined with that from the CPS, the localized area impacted would likely increase somewhat as increased water temperatures advanced farther from the discharge toward the intake.

Impacts to Salt Creek, downstream from the Clinton Dam, have also been considered under the current permitted NPDES limits. It is expected that water temperatures immediately downstream of the Clinton Dam would increase slightly with the addition of heated effluent discharge from a new nuclear unit to that of the CPS (Exelon 2003b). They currently range between 1.1° and 4.4°C (2° and 8°F) higher than those at the Rowell gauging station located 19.3 km (12 mi) downstream of the Clinton Dam (Exelon 2003b). However, the influence of the additional heated effluent would likely diminish over distance and be undetectable at the Rowell gauging station (Exelon 2003b). Temperature data collected from pre-dam to post-CPS operation indicate that Salt Creek temperatures at Rowell have not been influenced by increased temperatures in Clinton Lake (Exelon 2003b). Based on CPS post-operational monitoring data, the Illinois Pollution Control Board found in 1993 that no abnormal temperature changes have occurred in Salt Creek below the dam, that normal seasonal fluctuations are maintained in the creek, and that water temperatures in Salt Creek have not exceeded 2.8°C (5°F) above background temperature for more than 1 percent of the time in a given calendar year. Therefore, it is expected that impacts resulting from discharge of heated effluent on the distribution of aquatic organisms would be minimal.

Another factor related to thermal discharges that may affect aquatic biota is cold shock. Loss of heat input to the discharge flume during cold winter months results in a large drop in lake temperature in the vicinity of the discharge flume. Many fish species congregate in the warm lake waters surrounding the discharge during winter, as fishermen can attest (IDNR 2003b). Nuclear plants must cease operation to refuel on a periodic basis. This is often planned for winter time when demand for electricity is relatively low. A planned station shutdown is generally conducted over a lengthy period of time so that heated discharge is gradually reduced and fish have time to acclimate to the change in water temperature. If water temperature drops too rapidly, fish may be overly stressed and die. Whenever possible, the removal of heat from the discharge stream should be very gradual, especially in winter. It is generally accepted that a 2°C per hour (3.6°F per hour) change in temperature is adequate for most fish species and individuals to acclimate without adverse effect (Oliver and Fidler 2001).

Two fish-kill events caused by cold shock have been recorded for the CPS in winter since operation began, the first in January 2001 and the second in February 2004 (Petro 2001; Bement 2004). While there are no requirements to monitor Clinton Lake for fish kills, there are procedures set forth in the CPS Environmental Protection Plan that dictate when the NRC and other agencies must be notified in the event of an unusual or important environmental event, such as a fish kill. Upon discovery, the NRC must be notified within 24 hours, along with other agencies with responsibility for protecting the aquatic environment (i.e., IDNR and IEPA). IDNR, in accordance with the CPS Lake Management Agreement, has the responsibility to patrol the lake and conduct initial assessments of any fish kills (Petro 2001). A followup report must be submitted to the NRC within 30 days of the occurrence of a nonroutine event that shall: (a) describe, analyze, and evaluate the event, including the extent and magnitude of the impact and plant operating characteristics, (b) describe the probable cause of the event, (c) indicate the action taken to correct the reported event, (d) indicate the corrective action taken to preclude repetition of the event and to prevent similar occurrences involving similar components or systems, and (e) indicate the agencies notified and their preliminary responses (IPC 1987). A similar Environmental Protection Plan and requirements for the disclosure, investigation, and analysis of nonroutine environmental impacts could be part of an operating license for a new nuclear unit at the Exelon ESP site. This could be included as part of a COL.

In both cases, the IDNR investigated the fish kill and performed shoreline surveys to identify and quantify the numbers of fish killed. The majority of fish observed are not usually considered sport fish: bigmouth buffalo (*Ictiobus cyprinellus*), gizzard shad (*Dorosoma cepedianum*), freshwater drum (*Aplodinotus grunniens*), quillback (*Carpoides cyprinus*), and carp (*Cyprinus carpio*). The loss of these fish was localized and likely to be temporary in nature (Petro 2001; Bement 2004). Some of the sport fish that were lost in the event are stocked on an annual basis by IDNR to provide recreational fishing opportunities for anglers. As these sport fish will be replaced during future stocking events, the overall abundance will not be reduced.

Overall, the number of fish lost was considered small in relation to the total abundance of these fish species throughout Clinton Lake and throughout the surrounding region (Petro 2001; Bement 2004). Their loss is not expected to have any long-term adverse effect on the future fish population structure. A species-specific evaluation of the number of fish lost compared to the number of fish estimated to inhabit Clinton Lake (carrying capacity) would provide a more accurate assessment of the relative impact of these losses to the Clinton Lake fish population, but these data are unavailable.

The possibility of a cold shock event is less likely when two sources are producing heated effluent and discharging it to the lake at the same location because it is unlikely both plants would be shut down simultaneously. However, some cold shock could still occur with sudden shutdown of the CPS, because blowdown from a closed-cycle new nuclear unit would not produce as much heated effluent as the CPS.

One of the plant operational activities that would require consideration under the NPDES permit is chemical treatment of the cooling water and of the water processed through the reactor-coolant cleanup system. This might entail the periodic use of scale inhibitors, corrosion inhibitors (chloride), and sulfuric acid for pH adjustment (Exelon 2003b). Biological inhibitors such as biocides, dispersants, and molluskicides might also be required on a periodic basis to reduce biofouling of the cooling towers and the shell side of the primary heat exchangers (Exelon 2003b). If a wet cooling system were selected for a new nuclear unit, it might also be necessary to incorporate a de-icing compound in the cooling water during colder months (Exelon 2003b). If proven necessary, potable water used throughout the plant might be treated with an antibacterial inhibitor such as chlorine and monitored on a monthly basis (Exelon 2003b). It is expected that the discharge limits set forth by IEPA for these chemical additives would be sufficient to protect aquatic biota.

5.4.2.3 Summary of Aquatic Impacts

In summary, the NPDES permit issued by IEPA for a new nuclear unit would govern the operational impacts to the aquatic environment whether a new nuclear unit operates alone or jointly with the CPS under a cumulative effect scenario. It is expected that operation under the NPDES permit would result in the maintenance of a balanced, indigenous population of fish, shellfish, and other aquatic organisms, both in Clinton Lake and in Salt Creek downstream of

Clinton Dam. Because a new nuclear unit would adhere to the NPDES-permitted conditions for maximum temperatures and other water quality conditions at the second drop structure in the discharge flume, to the Illinois Pollution Control Board thermal requirements for Salt Creek, and to maintenance of a minimum 0.14 m^3/s (5 cfs) flow to Salt Creek below the dam, it is expected that the operational impacts of a new nuclear unit operation would be minimal. Based on the Exelon ER and the staff's independent review, the staff concludes that during normal water years the aquatic ecosystem impacts would be SMALL, and mitigation would not be warranted. During low-water years, however, the impact to the water level, and thus to the water temperature and available aquatic habitat, could be MODERATE until normal water conditions return. In such cases, Exelon would need to coordinate with IEPA on appropriate measures, including temporary unit shutdown.

5.4.3 Threatened or Endangered Species

This section describes the potential impacts to Federally listed and proposed threatened or endangered species and associated designated and proposed critical habitat from operation of a new nuclear unit on the Exelon ESP site, transmission lines, and maintenance of associated rights-of-ways and offsite facilities. The biology of these species is presented in Sections 2.7.1 and 2.7.2.

The staff prepared a biological assessment documenting the impacts of operation of a new nuclear unit on the Federally listed threatened and endangered terrestrial species described in the U.S. Fish and Wildlife Service (FWS) correspondence (FWS 2004a and b). The staff's impact determinations from the biological assessment are reiterated in this section.

There are two Federally listed species, the threatened bald eagle (*Haliaeetus leucocephalus*) and the endangered Indiana bat (*Myotis sodalis*), that may occur in the vicinity of the ESP site and transmission corridors (FWS 2004a, b).

Bald Eagle - Threatened

Bald eagles are not known to nest but are known to winter along large rivers, lakes, and reservoirs in DeWitt County and have been observed in the vicinity of the Exelon ESP site (Exelon 2003b). However, there are no known night roost sites in DeWitt County (FWS 2004a, b). Further, no concentrations of foraging eagles have been reported on or in the vicinity of the ESP site (Exelon 2003b; FWS 2004a, b; IDNR 2004). No critical habitat is designated for the bald eagle (FWS 2004a, b).

Bald eagles may be affected by an operating nuclear unit via collisions with cooling towers and transmission lines. Generic impacts of cooling towers on bird collisions were evaluated in

Section 5.4.1 and were found to be minimal. The bald eagle is an infrequent visitor to the project area and typically roosts at night when visibility is poorest and the possibility for collisions with cooling towers is greatest. This further minimizes the potential for bald eagle collisions with cooling towers.

Generic impacts of transmission lines on bird collisions were also evaluated in Section 5.4.1 and were found to be minimal. Again, because the bald eagle is an infrequent visitor to the project area, the potential for collisions with transmission lines is further minimized.

Indiana Bat - Endangered

Because the Indiana bat potentially occurs throughout Illinois where forest habitat is present (FWS 2004a, b), it could occur on and in the vicinity of the Exelon ESP site, although there are no records of its occurrence within 16 km (10 mi) (IDNR 2004). If present, Indiana bats would most likely occur in association with small streams with well-developed riparian woods, as well as with mature floodplain and upland forests. It roosts and rears its young beneath the loose bark of large dead or dying trees, and tends to return to the same roosting area year after year (FWS 2004a, b). Indiana bats winter in caves and abandoned mines (FWS 2004a, b).

To be impacted by operation of a new nuclear unit, suitable Indiana bat summer habitat would have to occur within a transmission line right-of-way. Indiana bats could thus be affected by right-of-way management (i.e., cutting and herbicide application) and EMFs. Generic impacts of right-of-way management and EMFs were evaluated in Section 5.4.1 and were found to be minimal. Further, it is very unlikely that suitable summer habitat would occur in a transmission line right-of-way, because right-of-way maintenance practices preclude the development of riparian woods, mature floodplain and upland forests, and large trees. This further minimizes potential impacts to Indiana bats from transmission line right-of-way management and EMFs.

The only critical habitat designated for the Indiana bat is the Blackball Mine in LaSalle County, Illinois (41 FR 41914). Consequently, there would be no operational impacts to Indiana bat critical habitat because none occurs in the vicinity of the Exelon ESP site.

Federally Listed or Proposed Aquatic Animals

No impacts to Federally listed or proposed threatened or endangered aquatic animal species or associated proposed or designated critical habitat are anticipated, because none is known to occur on or within 16 km (10 mi) of the Exelon ESP site (Exelon 2003b; FWS 2003a, b; FWS 2004a, b; IDNR 1999) or in the vicinity of the transmission line corridor (FWS 2004b).

Federally Listed or Proposed Terrestrial and Aquatic Plants

No impacts to Federally listed or proposed threatened or endangered terrestrial or aquatic plant species are anticipated, because none is known to occur on or within 16 km (10 mi) of the Exelon ESP site (IDNR 2004; FWS 2004a, b) or in the vicinity of the transmission line corridor (FWS 2004b).

Conclusions

In summary, there would be no operational impacts to Federally listed terrestrial or aquatic plant species and no operational impacts to Federally listed aquatic animal species. Operational impacts to Federally listed terrestrial animal species, the bald eagle and Indiana bat, are expected to be negligible. There would also be no operational impacts to critical habitat for Federally listed terrestrial or aquatic animal species. Exelon has committed to contact the FWS before beginning construction activities to ascertain whether these assumptions remain valid or whether further evaluation is needed.

Based on its review of a new nuclear unit at the Exelon ESP site and associated transmission line rights-of-way, the staff concludes that the impacts of operation on threatened and endangered species would be SMALL, and mitigation would not be warranted.

5.5 Socioeconomic Impacts

This section describes the socioeconomic impacts of operating a new nuclear unit at the Exelon ESP site and of the activities and demands of the operating workforce on the surrounding region. Socioeconomic impacts include potential impacts on individual communities, the surrounding region, and minority and low-income populations.

5.5.1 Physical Impacts

This section assesses the potential physical impacts on the nearby communities caused by operation of a new nuclear unit at the Exelon ESP site, including noise, odors, exhausts, thermal emissions, and visual intrusions. As stated in its ER, Exelon plans to manage these physical impacts to comply with applicable Federal, State, and local environmental regulations and, therefore, operation of a new nuclear unit would not significantly affect the ESP site and the vicinity (Exelon 2003b). The staff's evaluations are discussed in the following sections.

5.5.1.1 Workers and the Local Public

A new nuclear unit at the Exelon ESP site would be co-located and operated on the site of the CPS, 210 m (700 ft) south of the CPS and adjacent to the CPS's 1981-ha (4895-ac) cooling reservoir, Clinton Lake. Except for the structures at the CPS, there are no industrial, commercial, or institutional structures on the site. Industrial is the only type of land use on the site (Exelon 2003b). Main access to the Exelon ESP site is provided by Illinois State Route (SR) 54.

The terrain around and on the plant site is undulating and wooded. The region surrounding Clinton Lake and the Exelon ESP site is farmland, interspersed with occasional forest and brushwood. Most of the existing CPS site structures are screened from public view, except for visitors near Weldon off SR 10 and near the visitors center off SR 54. It is expected that a new nuclear unit would have similar visual limitations.

There are no residential areas located within the Exelon ESP site boundary. The nearest residence to the site is (1.2 km) (0.73 mi) away. The nearest towns are DeWitt (population 188) and Weldon (population 440) (USCB 2000a). The City of Clinton is 10 km (6 mi) west of the site. The population in the vicinity of the Exelon ESP site is about 2940 (Exelon 2003b).

The existing CPS produces noise from the operation of pumps, transformers, turbines, generators, and switchyard equipment. It is expected that this would continue with the installation of a new nuclear unit at the ESP site. Most equipment would be located inside structures that would tend to reduce the outdoor noise level. Building walls would reduce outside noise levels as much as 15 decibels. Further reduction would be achieved as the noise travels to the site's property line.

The many pieces of large industrial equipment needed for operations at a nuclear unit (freight trucks, forklifts, etc.) would also be a source of noise and air pollution. It is expected that standard noise suppression devices on trucks and other equipment would be sufficient to keep offsite noise levels well within acceptable levels. In addition, activities requiring the use of heavy equipment would be limited on weekends. Finally, Exelon states it would adhere to applicable air pollution regulations as they relate to the operation of fuel-burning equipment.

Exelon is evaluating several cooling options, including a proposed wet cooling system that would utilize mechanical or natural draft cooling towers. Natural and mechanical draft cooling towers emit broadband noise; therefore, the noise associated with the cooling towers is largely indistinguishable and unobtrusive. It is expected that the anticipated noise levels from either of the cooling tower options would not be significantly greater than background levels. It is anticipated that the heat dissipation system would have a noise level of up to 55 decibels at a distance of 300 m (1000 ft) from the system (Exelon 2003b). This level is below the typical outside noise criterion, 65 decibels, for residential areas (24 CFR Part 51).

Exelon states that a Hearing Conservation Program would be developed to control and protect onsite workers from excessive noise levels, which are defined as an 8-hour exposure of 85 decibels or more. The program would comply with the requirements specified in 29 CFR 1910.95 (Exelon 2003b). In addition, noise levels at a new nuclear unit would be governed in accordance with the following regulations:

- Occupational Safety and Health Administration (OSHA) noise-exposure limit to workers and workers' annoyance from the noise

- Consideration of acceptable noise levels for offices, control rooms, etc. (29 CFR Part 1910)

- Federal (40 CFR Part 204) noise-pollution control regulations

- State (35 Illinois Administrative Code Subtitle H) or local noise-pollution control regulations.

There are few rural families close to the site that might be affected by an increase in traffic noise generated by station employees' cars, delivery trucks, and offsite shipments. Traffic from the operation workforce driving to and from the site would increase the level of vehicular noise for those residents living along routes that access a new nuclear unit.

Traffic on the roads is controlled by speed limits. The access roads to the ESP site should be paved. Most vehicle trips are anticipated to occur during normal weekday business hours. Given that these are rural roads, lightly traveled and with appropriate speed limits, it is anticipated that even with the added traffic, noise levels would be below the noise criteria for residential areas (24 CFR Part 51).

A new nuclear unit could have standby diesel generators for auxiliary power. The generators would be required to have air-emission permits, which would ensure their compliance with applicable Federal and State air-pollution requirements. Also, it is expected that these generators would see limited use and, if used, would be used for only short periods of time (Exelon 2003b).

In summary, it is expected that offsite noise impacts would be minor because of the noise-control devices on the vehicles, the adherence to applicable State and Federal criteria, the distance of nearby residences to the site, and the fact that operations activities entailing significant noise would be limited to normal weekday business hours. Exelon has stated it would adhere to applicable air-pollution control regulations as they relate to the operation of fuel-burning equipment. In addition, central Illinois is in attainment[a] or is an unclassified[b] area for the criteria pollutants. Therefore, based on the information provided by Exelon and the NRC staff's independent review, the staff concludes that the physical impacts of station operation on the workers and the local public would be SMALL, and mitigation would not be warranted.

5.5.1.2 Buildings

DeWitt and Weldon are the two closest small towns to the Exelon ESP site and are located 5 and 8 km (3 and 5 mi), respectively, from the site. No physical impacts from operation of a new nuclear unit would affect these two rural communities, which include small businesses, houses, and farms.

Therefore, based on the staff's independent verification during a site visit the week of March 1, 2004, the staff concludes that the physical impacts of station operation on offsite buildings would be SMALL, and mitigation would not be warranted. No physical impacts to structures, including residences near the site or vicinity, are anticipated from operation of a new nuclear unit on the ESP site.

5.5.1.3 Roads

The roads and highways in the vicinity of the site would experience an increase of approximately 580 additional vehicle trips per day, in addition to the 550 vehicle trips per day associated with the existing CPS operating workforce. The roads and highways are two-lane, well-maintained, rural, and lightly traveled. Given that they are expected to handle an even heavier construction-labor workforce without undue congestion, it is expected they could also withstand the increase in vehicular traffic of the permanent operating workforce.

Based on the information provided by Exelon and the staff's independent verification during a site visit the week of March 1, 2004, the staff concludes that the physical impacts of station operation on roads in the vicinity of the site would be SMALL and mitigation would not be warranted.

(a) "Attainment" means that an area meets applicable air-pollution standards.
(b) "Unclassified" means that an area cannot be classified as meeting or not meeting the applicable air-pollution standards.

5.5.1.4 Aesthetics

A new nuclear unit would marginally change the view existing from the current CPS operating facility. The CPS has a power-block structure approximately 60 m (200 ft) tall, and a new nuclear unit at the ESP site would have a power block structure that could be up to 71.3 m (234 ft) tall. The heat dissipation system could have a height of up to 168 m (550 ft). An off-gas structure might also be required and would range in height between that of the power block structure and the height of the heat dissipation system. An additional visible plume might result from the heat dissipation system. Occasionally during cold weather, vapor/moisture plumes from the towers might be visible from some offsite locations, depending on wind direction and other meteorological parameters (Exelon 2003b). A new nuclear unit on the Exelon ESP site would not substantially alter an already visually disturbed CPS site. The CPS and a new nuclear unit would be visible from several vantage points around the site and outside the site boundary. However, the Exelon ESP site is far removed from most of the permanent population, with the closest residence approximately 1.2 km (0.73 mi) to the southwest and the closest town, DeWitt, which is approximately 5 km (3 mi) to the east. Recreational users of Clinton Lake would be able to observe the operation of the new unit only by the visible moisture plumes from the heat dissipation units that may appear under certain meteorological conditions. Users of the lake would be able to see the CPS and new nuclear unit from certain parts of the lake.

There is a concern about the impact of the facility's cooling system on lake levels during times of severe drought. The consumptive water loss to the atmosphere from the cooling tower, added to the existing consumptive loss of the CPS once-through cooling system during times of drought, could lower the water levels of the lake significantly.

In summary, a new nuclear unit at the Exelon ESP site would have visual impacts similar to those of the existing CPS. As the area is sparsely populated, the facility would have a minor (small) impact on aesthetic quality for nearby residences and on recreational users of Clinton Lake. However, the impacts could also be moderate due to the consumptive use of water for cooling and impacts on Clinton Lake during times of severe drought. Therefore, based on the information provided by Exelon and the staff's independent verification during a site visit the week of March 1, 2004, the staff concludes that the physical impacts of station operation on aesthetics would be SMALL and mitigation would not be warranted. During times of severe drought the impacts would be MODERATE, and mitigation would not be generally warranted due to the temporary nature of the potential impact.

5.5.2 Demography

Population within an 80-km (50-mi) radius of the region is 764,366 and projected to grow to 942,556 by 2060, for an average annual growth rate over the 60-year period of 0.31 percent (see Table 2-4). The economy in the region is considered recovering from the economic recession of 2001.

There are an estimated 550 permanent operating personnel employed at the CPS site. Approximately 580 additional permanent workers would be required for the operation of a new nuclear unit (Exelon 2003a). Exelon expects that most of the new operating workforce will come from within the region (Exelon 2003b). But even if the 580 additional employees and their families were to come from outside the region, the potential increases in population of the most impacted counties would not be significant. For example, the 580 additional employees would translate into an increase in population of about 2320, assuming each new employee represents a family of four. Given that the geographic distribution of new employees would be the same as for the existing employees of the CPS (see Section 2.8.1), about 190 new employees would settle in DeWitt County, 140 in Macon County, and 120 in McLean County. The remaining approximately 130 employees would be scattered throughout the other counties within the 80-km (50-mi) radius of the Exelon ESP site.

The addition of the new employees and their families would equate to the following percentage increases in population (using 2000 Census data; see Table 2-6): DeWitt County 4.5 percent, Macon County 0.49 percent, and McLean County 0.32 percent. Overall, the potential increases in population do not represent a large percentage increase in the total population for the most impacted counties.

Some new jobs might result from employment of the new operating personnel through the multiplier effect attributable to the operations workforce. But when these increases are compared to the total population base in the region, it is expected that they would be minimal as well. And many of these new jobs would be filled by workers already living within the region.

In summary, the number of new employees and their families would represent a very small increase to the counties' total population. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the impacts of station operation on increases in population would be SMALL and mitigation would not be warranted.

5.5.3 Impacts to the Community

This section evaluates the social, economic, infrastructure, and community impacts to the surrounding region as a result of operation of a new nuclear unit. The evaluation assesses impacts of operation and of those demands placed by the workforce on the surrounding region. Operation of a new nuclear unit could last up to 60 years (a potential 40-year initial operating license, plus 20 years additional operation under license renewal) and employ up to an additional 580 workers (Exelon 2003b). This is in addition to the 550 permanent operations personnel currently employed at the CPS site.

5.5.3.1 Economy

The impacts of station operation on the local and regional economy are dependent on the region's current and projected economy and population. Some insight can be obtained on the projected economy and population by consulting county comprehensive plans and data from the U.S. Census Bureau. The economic impacts, given the potential 60-year period of station operation, are qualitatively discussed below.

Exelon states that it is expected that most new operating personnel would come from inside the region (Exelon 2003b). The employment of the operations workforce for such an extended period of time would have economic and social impacts on the surrounding region. DeWitt County would be the most impacted, and Piatt County might be the second most impacted in percentage terms (the relationship of the net economic benefits of a new nuclear unit to the total economy of the county). Further impacts become diffuse as a result of interacting with the larger economic base of the surrounding counties and cities. Impacts would affect traffic, taxes, housing, and public services, among others, all of which are discussed separately below. The magnitude of the impacts hinge on (1) the percentage of the workforce that would come from within the region of interest (80 km [50 mi]) and thus commute to the site and (2) those workers who might relocate to the area and whether they would relocate to DeWitt and Piatt Counties or elsewhere in the region.

The economic impacts to the region would be beneficial. The new jobs, as with the construction workforce, would also create new jobs in the region through the multiplier effect. Any multiplier effect resulting from the operating personnel expenditures in the region would most likely mean that some residents would obtain new or higher paying jobs as a result of the increased economic activity.

In summary, the magnitude of the economic impacts would be diffused in the larger economic bases of Macon, McLean, and Champaign Counties. DeWitt County would be the site of a new nuclear unit and would benefit more, as a result, than Piatt and Logan Counties. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the impacts of station operation on the economy would be beneficial and SMALL everywhere in the region except DeWitt County, where the impacts could be MODERATE, and that mitigation would not be warranted.

5.5.3.2 Taxes

There will be several types of taxes generated by the increase in the permanent operations workforce at a new nuclear unit at the Exelon ESP site. These include income taxes on corporate profits and on wages and salaries paid, sales and use taxes on purchases, and property taxes on owned real property. Each is briefly discussed below. Taxes collected are viewed as a benefit to the State and the local jurisdictions in the region.

Personal and Corporate Income Taxes

As discussed in Section 4.5.3.3, Illinois has a personal and corporate income tax. Employees of a new nuclear unit would pay taxes on their wages and salaries to Illinois if their residence is in Illinois. Exelon would also pay Illinois a corporate income tax on the profits received from the facility. While the exact amount of tax payable to Illinois is not known, it could be substantial over the potential 60-year life of the operating facility. Although the amount of taxes collected over the potential lifetime of the project could be large in absolute amounts, it is small when compared to the total amount of taxes Illinois collects in any given year or over the 60-year period.

Sales and Use Taxes

Illinois and the counties surrounding the Exelon ESP site would experience an increase in the amount of sales and use taxes collected as a result of the operation of a new nuclear unit. Additional sales and use taxes would be generated by retail expenditures (restaurants, hotels, merchant sales, and food) of the operating workers.

At this point, it is difficult to assess which counties and local jurisdictions would be most impacted by the expenditures and resultant sales and use taxes collected. In absolute terms, the amount of taxes collected over a potential 60-year operating period could be large, but small when compared to the total amount of taxes collected by Illinois and the governmental jurisdictions within the region. The exception could be Clinton, which is close to the Exelon ESP site and would be a convenient shopping point for the workforce at a new nuclear unit. In addition, approximately 33 percent of the current CPS employees live in DeWitt County. Should this pattern be replicated with the operating workforce of a new nuclear unit, it is probable that Clinton could receive a large increase in taxes collected. Because towns of significant size are 30 km (20 mi) or more from the site, it would be more likely that workers would seek services and make purchases at locations closer to the Exelon ESP site.

Property Taxes

A main economic impact related to the operation of an additional unit would be associated with payment of property taxes. The value of an additional unit would exceed that of the CPS, which has depreciated with time and deregulation (see discussion in Section 2.8). It is not possible to estimate the actual amount of taxes on the new facility that would be paid to DeWitt County and to other jurisdictions in the county, except that with deregulation it would probably be based on the market value of power produced, as opposed to the traditional assessed value of the plant. DeWitt County, Clinton Community School District No. 15, and the other taxing districts listed in Section 2.8 would be the beneficiaries of these taxes.

The full potential effects of electric utility deregulation in Illinois are not known at this time. Before deregulation, the property taxes paid by the CPS represented more than 70 percent of the total property taxes received by DeWitt County. During the transition period, as a result of deregulation, they still represent more than 50 percent of the total property taxes collected by the County (see Table 2-13). It is expected that the addition of a new nuclear unit would represent a significant source of property tax revenue for the County, even with deregulation.

The second source of property taxes would be on the housing owned by the permanent employees at a new nuclear unit. The operating workforce would consist of up to 580 employees. Exelon expects that, while some of the workforce might relocate from outside the region, a significant number of them would already be located in the region. Exelon bases its conclusion on the fact that a significant number of employees at the CPS already lived within the region before operations at that facility began and did not move to the vicinity but remained in the region (Exelon 2003b).

If Exelon's assumptions are true, there would not be a substantial shift or increase in property taxes paid within the region and vicinity. Some potential employees might move up to more expensive housing because of better paying jobs, but this would be a minor economic perturbation within the regional economy.

However, if Exelon's assumptions do not hold, two things could happen. If the available workers with the requisite skills could not be found within the region, they would be recruited from outside and move into the region. Some new workers could construct new housing or increase the demand for existing housing, which could put an upward trend on housing prices, increasing values and property taxes paid. Nevertheless, if this were to occur in the larger cities in the region, the increase in property taxes paid, though important and large when aggregated over time, would be insignificant when compared to the total taxes collected by these jurisdictions.

On the other hand, in the smaller jurisdictions, such as DeWitt, Piatt, and Logan Counties, the effects could be more significant. Approximately 33 percent of CPS employees live in DeWitt County. If 33 percent of the permanent employees for a new nuclear unit decided to move to and live in DeWitt County, it would account for about 190 families. However, at the present time, there is no housing of the right type available in DeWitt County to accommodate this increase. New housing construction would have to be undertaken to meet the demand. Because of the increased demand for housing, it could be expected that prices of existing housing would rise (thus increasing property values and property taxes, as well) and constructed new housing would be added to the tax rolls. Also, DeWitt County (and the other surrounding counties to a lesser extent) would benefit from increased property values and the addition of new houses to the tax rolls.

At this time, it is not possible to know whether Exelon's assumptions about the new permanent operating workforce coming from within the region will hold up or not, nor of the magnitude of property taxes that might be collected on new or existing residential housing as a result of the additional operations workforce.

Summary of the Impact of Taxes

The staff evaluated the effect of taxes from income on wages and salaries of Exelon employees, and sales, use, and property taxes of these employees, as well as taxes on Exelon's corporate profits. Most of these represent beneficial sources of income for the State, some of which would benefit the counties in the region. Property tax paid by Exelon would directly benefit DeWitt County, as would property taxes from employees living in the county. Sales and use taxes could beneficially impact the City of Clinton, due to its proximity to a new nuclear unit. Personal and corporate income taxes would be paid to the State of Illinois. Although the amount of taxes collected over the potential lifetime of the project could be large in absolute amounts, it is small when compared to the total amount of taxes Illinois collects in any given year or would collect over the 60-year life of operation of a new nuclear unit. Based on a review of the overall impacts on the region, the beneficial impacts would be SMALL to LARGE (DeWitt County). Therefore, the adverse impact level would be SMALL, and mitigation would not be warranted.

5.5.3.3 Transportation

The roads and highways within the vicinity of the Exelon ESP site would experience an increase in use of approximately 580 additional vehicle trips during the peak hours of the workday. This is in addition to the 550 existing vehicles of the CPS workers, bringing the total vehicle trips from the combined CPS and new nuclear unit to 1130, assuming one employee per vehicle. The majority of the impacts would be the congestion at shift changes.

Most of the roadways within DeWitt, Logan, and Piatt Counties are rural and, as the staff observed during the site visit (March 1 to 5, 2004), lightly traveled and well-maintained. While population growth could put pressure on the local transportation system, it probably would not overwhelm the current transportation system in these counties. Upon leaving the ESP site, workers are expected to travel and disperse in all directions (Exelon 2003b). In addition, as discussed in Section 2.8, business route U.S. 51 through Clinton has had a center turn-lane constructed, which has greatly alleviated congestion through Clinton.

In summary, the rural roads are well maintained and lightly traveled. The addition of the workforce to operate a new nuclear unit would cause congestion only at shift changes. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the impacts of station operation on the transportation system would be SMALL and that mitigation would not be warranted.

5.5.3.4 Recreation

There are four issues with respect to recreation at Clinton Lake. First is the impact of a new nuclear unit, in conjunction with the existing CPS, on Clinton Lake's water quality and temperature and, in turn, their impact on recreation. Second is the impact on recreation because of the potential increase in the use of the lake as a result of hiring the operations workforce. Third is the potential consumptive loss of water in Clinton Lake during a severe drought as a result of a new nuclear unit's cooling system. Fourth is the potential health impacts a new nuclear unit's cooling system might have on users of the lake (see Section 5.8.1). Changes in the recreational use of Clinton Lake could have economic impacts to the surrounding area.

Clinton Lake is cited in Draft Illinois 2004 Section 303(d) (IEPA 2004), which identifies it as an impaired waterbody (Exelon 2003b). Impaired water quality (including both metals and sediments) can impact recreational use of the lake. The causes of impaired use include a Confidence Level 3 (high) excess algal growth, and a Confidence Level 2 (moderate) metals level. Algal growth is related to nutrient levels in the water column that originate from the dominant agricultural land use and crop production. Other sources may also contribute to the availability of nutrients in the water column, such as recreational boating, which may increase sediment resuspension and shoreline erosion. Power plant operation is not considered a significant source of nutrients to Clinton Lake (Exelon 2003b). Metals concentrations in the water column and sediment have a number of sources, including natural geologic formations, agricultural practices, and industrial sources. Industrial sources, such as the CPS, are also a potential source of metals.

For both impairments (sediments and metals), storm water management and erosion-control practices for sediment control are the best control options. Nutrients and metals attach to the sediments and are effectively controlled with control of sediments in storm water. Industrial pollution-control practices, strategic materials selection, and corrosion control are also expected to be effective in reducing metals contributions from industrial sources.

The second issue is the impact an increase in the operations workforce for a new nuclear unit might have on Clinton Lake and other nearby facilities, such as Weldon Springs, due to increased crowding. If the workforce to be hired was already in the region and did not relocate to DeWitt County and the City of Clinton, there would be minimal impact on the recreation taking place at Clinton Lake and nearby facilities. However, if the workforce was recruited from outside the region or if there was a relocation of existing operating personnel to Clinton and DeWitt County, there could be increased demand for the recreational services provided by the lake and other facilities. Currently, 33 percent of the CPS workforce resides in Clinton or DeWitt County. Given an expected operating workforce at a new nuclear unit of 580 individuals with 33 percent moving to Clinton or DeWitt County, there could be 190 new families (or 760 individuals, assuming four individuals per family) moving into these areas. This could result in increased crowding, a decline in overall recreational enjoyment, and potentially a decrease in water quality which, in turn, impacts the recreational experiences at these facilities.

The third issue is potential impairment of recreation on the lake due to lower water levels during periods of severe drought. The consumptive water loss to the atmosphere from the cooling tower of a new nuclear unit could lower the water levels of the lake significantly during times of drought. This could impact both boating (lower water levels) and fishing (lower water levels and elevated temperatures) at the lake. One mitigating factor at Clinton Lake is that the steep banks might mean less land exposed during drops in the pool elevation. Another is that a drought severe enough to impact lake levels and water quality is a rare event.

In summary, severe drought in conjunction with the consumptive use of water for cooling at both the CPS and a new nuclear unit could impact lake pool elevations and temperature, which in turn could impact boating and fishing. A drought severe enough to impact lake levels and water quality is a rare event. Mitigative actions might include cutting back on the unit's power production or shutting down one or both units. The impacts of the operating workforce on Clinton Lake and other nearby recreational facilities hinge on whether the operating workforce would come primarily from within the region (with most staying at their existing places of residence and commuting to a new nuclear unit) or would relocate to DeWitt County and Clinton to be nearer work. If the latter, then the recreational experience at Clinton Lake could deteriorate, which would cause those recreationists using the lake to look elsewhere, lessening the demand on the lake for recreation – a form of mitigative action. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that potential impacts of station operation on recreation would be SMALL to MODERATE. Mitigation would be warranted only when a drought occurs and could be undertaken by changing the way in which the units are operated.

5.5.3.5 Housing

An accurate estimate of the number of housing units that would be available in the region in the year a new nuclear unit would begin operation is not possible. If Exelon's assumptions hold and the operational workforce of 580 already resided in the region and did not relocate closer to the new nuclear unit, then housing supply within the region would be more than adequate to meet the needs of a small number of operating employees relocating from outside the region.

Otherwise, it all depends on where the potential new growth takes place, as discussed in Section 5.5.3.3. Again, while there is no way of accurately estimating the number of available housing units at the commencement of operations, Section 2.8.2 reviews the current availability of housing in the region. Table 2-15 shows that the availability of housing units for sale in the region could easily accommodate the expected permanent workforce of 580 new employees. In 2000, there were 13,183 vacant housing units in Champaign, DeWitt, Logan, Macon, McLean, and Piatt Counties. The counties in the vicinity of the Exelon ESP site and within the region are addressing the needs of the projected increases in population through their county comprehensive plans. As such, an adequate number of housing units likely would be available, especially in the larger towns.

Currently, in smaller towns around the Exelon ESP site, the housing market is much tighter. In 2000, there were 820 vacant housing units and, of those, 155 were for sale in Clinton, Farmer City, Monticello, and Lincoln Counties. Clinton had 37 houses for sale on the market in 2000 (see Table 2-16) and DeWitt County had 97 (USCB 2000b). While in absolute numbers there would be enough housing to accommodate 190 new families, not all units would necessarily be the type of housing purchased by higher income families, as most likely would be representative of the permanent operating workforce at the Exelon ESP.

With respect to housing prices, DeWitt County does not have a growth moratorium. Given that the incomes of the new workforce would be expected to be higher than the overall average incomes in DeWitt, Piatt, and Logan Counties, the prices that they would be willing to pay for housing would be on the high end of the price range within those counties. Therefore, it is expected that the impact on housing prices of workers relocating to these counties, especially to DeWitt County, would be impacted, and new construction would most likely have to be undertaken to meet demand. However, the abundance of existing housing within the surrounding region could mitigate against effects on residential housing prices as a result of the increase in the operations workforce.

In summary, county comprehensive plans could address the issue of new housing, but there has been a history in the counties closer to the Exelon ESP site of not building "spec" housing (see Section 2.8.2.1). Therefore, advanced existing and new construction to handle potential population increases might not occur in a timely manner. One potential reason for the lack of "spec" building is that Piatt, Logan, and DeWitt Counties have had negative population growth during the 1990s (see Table 2-6). Based on the information provided by Exelon and the staff's independent review, the staff concludes that potential impacts of a new nuclear unit on housing would be SMALL to MODERATE in DeWitt County and potentially in Piatt and Logan Counties. Market forces, represented by increased housing demand, would result in more housing being built, which, over time, would mitigate any housing shortages.

5.5.3.6 Public Services

This section describes the impacts of a new nuclear unit at the Exelon ESP site on local and regional water supplies and waste water treatment; on police, fire, and medical facilities; and on social services.

Water Supply and Waste Water Treatment

In the vicinity of the CPS in DeWitt County, drinking water is primarily obtained from groundwater via wells. Only a small number of residents have private well systems. The Clinton Sanitary District Sewage Treatment Plant serves the waste water needs of the City of Clinton. In the region, rural communities generally have private wells for water and septic systems for sanitary wastes. Larger communities obtain water from groundwater extraction wells and are served by public waste water treatment systems. A survey was performed for water and waste water facilities in the region, and the facilities have excess capacity to accommodate potential population increases (Exelon 2003b). Within the last decade, Clinton has upgraded its waste water system and now has excess capacity. An independent analysis conducted by the NRC staff confirmed Exelon's conclusion (see Tables 2-17 and 2-18).

Public water supply and waste water treatment are not a constraint to growth in the vicinity of the Exelon site, assuming that growth increases hold to the historical norm. Should there be a disproportionate increase in the populations of Clinton, Monticello, or Farmer City as a result of relocation of the operations workforce within the region or the importation of workers into Clinton and DeWitt Counties, there could be some capacity constraints. One restraint to this happening is the small number of vacant housing units available in these small towns.

Police, Fire, and Medical Facilities

Section 4.5.3.6 discusses the availability of police, fire, and medical facilities in the region. Exelon concludes that the projected capacity of these public services is adequate and is expected to expand modestly to meet the demands of a slight population growth (Exelon 2003b). The fact that annual population growth projections are less than 0.5 percent a year within the region tends to support its conclusion (see Table 2-6). Exelon plans to employ its own security force for a new nuclear unit on the ESP site (Exelon 2003b).

If 190 workers were to locate to Clinton and/or DeWitt County, there could be some pressure on fire-protection providers. The degree of pressure would be dependent on where these workers locate, whether in developed areas such as Clinton, where fire services are already provided, or in the county, where the services might not be available but could be provided given a demonstrated need. The increased property taxes coming from a new nuclear unit could help fund such services. Medical facilities within the larger communities are within commuting distance of the smaller communities.

Social Services

This section focuses on the potential impacts of station operation on the social and related services provided to disadvantaged segments of the population in DeWitt County. This section is distinguished from issues surrounding environmental justice, which is discussed in more depth in Section 5.7.

Station operation would be viewed as beneficial economically to the disadvantaged population served by the Department of Human Resources in DeWitt County. Station operation might enable the disadvantaged to improve their social and economic position by moving up to higher paying jobs created by the multiplier effect of station-operation jobs. Based on where the current operations workforce for the CPS lives and given that new employees would follow similar location patterns, many of these benefits could accrue to DeWitt County, where, because of the smaller economic base, they might have a more noticeable impact.

Summary of Public Services

In summary, a survey was performed for water and waste water facilities in the region, and the facilities have excess capacity to accommodate potential population increases. The projected capacity of police, fire, and medical services in the region is currently adequate and is expected to expand modestly to meet the demands of a slight population growth. The increases in tax revenue could help with the infrastructure and resource requirements for any potential increase in demand for services (police, fire, etc.). Station operation would be beneficial economically to the disadvantaged population served by the Department of Human Resources in DeWitt County, enabling them to improve their social and economic status, thereby potentially cutting back on the amount of social services required. Therefore, based on the information provided by Exelon and the staff's independent evaluation, the staff concludes that the potential impact on the demand for public services as a result of a new nuclear unit would be SMALL and that mitigation would not be warranted.

5.5.3.7 Education

Exelon undertook a survey of class size of some schools within the region and concluded that there is sufficient capacity for a small increase in school population. When NRC staff interviewed the superintendents of the Clinton and Monticello School Districts, overcapacity in the number of students per class room was not an issue,[a] which, at least locally around a new nuclear unit, would tend to support Exelon's conclusions that there is a sufficient capacity in the education system to handle a small increase in population. Exelon assumes that the majority of the operations workforce would come from within the region, where educational requirements are already being met. Thus, the school systems in these areas would not experience any major influx of students because of the operation of a new nuclear unit (Exelon 2003b).

Even if some of the operating workforce were to come from outside the region, the majority of the new workers would likely move to the more populous areas in the surrounding communities, having access to the more developed public services. Workers with school-aged children would be interested in communities with good school districts, for example. There are a number of private schools located in the region, which would further increase educational options for incoming workers and their families.

Should workers relocate to Clinton and DeWitt County to be closer to a new nuclear unit, the local school district could accommodate an increase in the student population. Should there be small adverse impacts to local school districts due to the influx of plant workers into a community, these would likely be at least partially offset by increased sales, property, and income tax revenues paid by facility personnel, which in turn could be used to build additional classrooms or schools to accommodate the increased student population.

(a) Personal interviews conducted on March 3, 2004, in the City of Clinton with Roger A. Little, Superintendent, Clinton Unit School District 15, and on March 5, 2004, in the City of Monticello with Lawrence J. McNabb, 2004, Superintendent, Monticello Community School District 25.

The majority of the operations workers are expected to come from within the region, with little anticipated in-migration of operations workers from outside. Should workers come from outside the region, they might commute to the site from the larger cities in the region. Should they relocate to Clinton and DeWitt County to be closer to the site, it would appear that the local school district could accommodate an increase in the student population. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impact of the operation of a new nuclear unit on educational facilities would be SMALL and that mitigation would not be warranted.

5.6 Historic and Cultural Resource Impacts

The National Environmental Policy Act of 1969, as amended (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966, as amended (NHPA), as amended through 1992, also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (such resources are referred to as "Historic Properties" in NHPA). As outlined in 36 CFR 800.8, "Coordination with the National Environmental Policy Act of 1969," the NRC is coordinating compliance with Section 106 of the NHPA in meeting the requirements of NEPA.

The NRC has determined that evaluating suitability of a potential ESP site within the existing CPS for construction, operation, and decommissioning of a new nuclear unit is an undertaking that could possibly affect either known or potential historic properties that may be located at the site. Therefore, in accordance with the provisions of NHPA and NEPA, the NRC is required to make a reasonable and good faith effort to identify historic properties in the areas of potential effect and, if present, determine if any significant impacts are likely to occur. Identification is to occur in consultation with the State Historic Preservation Officer, American Indian tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, if no historic properties (i.e., places eligible for listing on the National Register of Historic Places) are present or affected, the NRC is required to notify the State Historic Preservation Officer before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve adverse effects of the undertaking.

For specific historic and cultural information on the Exelon ESP site, see Section 2.9.

Most significant impacts to cultural resources would occur during the construction phase. Additional impacts during station operations are not considered likely. Any new ground-disturbing activities that might occur during operation would follow Exelon procedures, which would result in the identification of any protective measures that needed to be taken (Exelon 2003a). Therefore, the staff concludes that the impacts from operations would be SMALL. Mitigation might be warranted in the event of an inadvertent discovery.

5.7 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). Section 2.8.4 discusses the locations of minority and low-income populations around the Exelon ESP site and within the 80-km (50-mi) radius.

The staff identified the pathways through which the environmental impacts associated with construction of a new nuclear unit at the Exelon ESP site could affect human populations. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. During its March 2004 site audit, the staff interviewed local government officials and the staff of social welfare agencies concerning potentially disproportionate impacts to minority and low-income populations. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately impacted by operation of a new unit that would result in those populations being adversely affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations.

In summary, no disproportionately high or adverse health or environmental effects impacting minority or low-income populations were found. Therefore, based on the information provided by Exelon and the staff's independent review, the staff concludes that the offsite impacts of station operation of a new nuclear unit at the Exelon ESP site to minority and low-income populations would be SMALL, and mitigation would not be warranted.

5.8 Nonradiological Health Impacts

This section addresses the health impacts of operating a new nuclear unit at the Exelon ESP site from nonradiological parameters. Health impacts to the public from the cooling system, noise generated by operations, and EMFs are discussed. Health impacts from the same sources are also evaluated for workers at a new nuclear unit. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Thermophilic Microorganisms

In its ER, Exelon notes that lake temperature appears to be the most significant water quality change from CPS operations (Exelon 2003b). Lake temperatures from the plant intake to the discharge appear to be about 2.8°C (5°F) warmer on average. Lake cooling is the primary cooling process used by the CPS. Heated non-contact cooling water is cooled by contact with the soil and air as the water passes down the 5.5-km (3.4-mi) discharge flume and around the Clinton Lake cooling loop back to the plant intake.

The new nuclear unit would use either wet cooling systems (i.e., mechanical or natural draft cooling towers), dry cooling systems, or a combination of hybrid wet/dry cooling systems. The impact of this type of cooling process would not be significant for water temperature in Clinton Lake when compared to the open-cycle cooling process (i.e., cooling lake) used for the CPS. Exelon estimated that the average annual lake temperature would increase about 0.2°C (0.3°F) using a wet cooling process (Exelon 2003b). Changes in lake temperature can increase the number of thermophilic microorganisms. Thermophilic microorganisms include enteric pathogens such as *Salmonella sp., Pseudomonas aeriginosa,* and *thermophilic fungi,* bacteria such as *Legionella sp.,* and free-living amoeba such as *Naegleria fowleri* and *Acanthomoeba.* These microorganisms could be causative agents of potentially serious human infections. However, the small temperature increase estimated as a result of operating the new nuclear unit would not significantly increase the abundance of these organisms and the staff concludes that the impacts on human health would be SMALL and that no mitigation would be warranted.

5.8.2 Noise

In the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) (NRC 1996), the staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from plant operation include cooling towers, transformers, and loud speakers with intermittent contributions from auxiliary equipment. These noise sources are generally sufficiently distant from the plant boundaries that the noise generated by the plant is attenuated to near-ambient levels before reaching critical receptors outside the plant boundary.

The existing unit at the CPS has an open-cycle cooling system that uses water from Clinton Lake. This system does not contribute significantly to noise at the plant site or plant boundary. Exelon's ER (Exelon 2003b) specifies that a new nuclear unit at the ESP site would be cooled by wet or hybrid wet/dry cooling towers. If the ESP was approved and cooling towers were used at the site, the towers would be a major noise source on the site.

The ER does not directly specify the sound intensity for cooling towers. However, the PPE specifies that cooling tower noise will be less than 55 decibels at 300 m (1000 ft). In general, the decrease in sound intensity with distance from the source is inversely proportional to the square of the distance. At its closest point of approach, the site fence line is approximately 90 m (300 ft) from the area where cooling towers would be located; the exclusion area boundary is about 520 m (1700 ft) from the cooling tower location, and the closest residence is about 730 m (2400 ft). Using these distances, the inverse square relationship, and the PPE cooling tower noise specification, the corresponding sound intensities at the closest points on the fence line, exclusion area boundary, and nearest residence are estimated to be approximately 65, 50, and 47 decibels, respectively. For context, Tipler (1982) lists the sound intensity of a quiet office as 50 decibels, normal conversation as 60 decibels, busy traffic as 70 decibels, and a noisy office with machines or an average factory as 80 decibels. Construction noise (at 3 m [10 ft]) is listed as 110 decibels, and the pain threshold is 120 decibels.

According to NUREG-1437 (NRC 1996), noise levels below 60 to 65 decibels are considered to be of small significance. More recently, the impacts of noise were considered in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (NUREG-0586, Supplement 1) (NRC 2002a). The criterion for assessing the level of significance was not expressed in terms of sound levels but based on the effect of noise on human activities and on threatened or endangered species. The criterion in NUREG-0586, Supplement 1, is stated as follows:

> The noise impacts ... are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts ... are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened or endangered species is affected.

Given the postulated noise levels for cooling towers, the staff concludes that the noise impacts would be SMALL and that mitigation would not be warranted.

5.8.3 Acute Effects of Electromagnetic Fields

EMFs are produced by electrical devices including transmission lines. Two issues related to the health effects of EMFs are addressed in some detail in NUREG-1437 (NRC 1996) relative to renewal of nuclear power plant operating licenses. Those issues are acute effects (shock hazard) and chronic effects (effects of long-term exposure).

Acute effects can result from direct contact with transmission lines. Transmission line construction practices minimize public access to the lines. Acute effects can also be caused by induced currents. The 1981 revision of National Electric Safety Code added criteria related to construction of transmission lines to minimize potential impacts associated with induced currents.

Section 3.7.5 of the ER (Exelon 2003b) discusses grounding measures that would be taken to minimize the acute effects of induced currents in structures near transmission lines. Section 3.7.2 of the ER ends with the statement that transmission system design, construction, and operation would comply with the relevant local, state, and industry standards, including the National Electric Safety Code and various American National Standards Institute of Electrical and Electronics Engineers standards. This includes standards for ground clearances, EMFs, and other factors.

Given these considerations, the staff concludes that the impacts associated with transmission line rights-of-way for a new nuclear unit at the Exelon ESP site would be SMALL and that no mitigation would be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Research on the potential for chronic effects from 60-Hz EMFs from transmission lines was reviewed in NUREG-1437 (NRC 1996). At that time, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. A NIEHS report (1999) contains the following conclusion:

> The NIEHS concludes that extremely low frequency-electromagnetic field (ELF-EMF) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the staff to consider the potential impact as significant to the public.

5.8.5 Occupational Health

In general, human health risks for a new nuclear unit are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) to workers engaged in activities such as maintenance, testing, and plant modifications. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks for new nuclear unit operation. The staff assumes strict adherence to NRC, OSHA, and State safety standards, practices, and procedures during new nuclear unit operation.

Occupational health impacts from thermophilic microorganisms would be the same as those discussed in Section 5.8.1. Health impacts to workers from noise and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations and would be SMALL.

5.8.6 Summary of Nonradiological Health Impacts

The staff evaluated health impacts to the public and the workers. It is expected that health risks to workers would be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts to the public and workers from thermophilic microoganisms, noise generated by unit operations, and acute and chronic impacts of EMFs would be minimal. Based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential impacts of nonradiological effects resulting from the operation of a new nuclear unit would be SMALL, and mitigation would not be warranted.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of a new nuclear unit on the Exelon ESP site, including a discussion of the estimated radiation dose to a member of the public and to the biota inhabiting the area around the ESP site. Estimated doses to workers are also discussed. Radiological impacts were determined using the PPE approach where the bounding direct radiation and liquid and gaseous radiological effluents were used in the evaluation (see discussion in Section 3.2.3).

5.9.1 Exposure Pathways

The public and biota would be exposed to increased ambient background radiation from a nuclear unit via the liquid effluent, gaseous effluent, and direct radiation pathways. Exelon estimated the potential exposures to the public and biota by evaluating exposure pathways typical of those surrounding a nuclear unit at the ESP site. They considered pathways that could cause the highest calculated radiological dose based on the use of the environment by the residents located around a new nuclear unit (Exelon 2003b). For example, factors such as the location of homes in the area, consumption of milk from dairy cows in the area, and consumption of vegetables grown in area gardens were considered.

For the liquid effluent release pathway, the ER considered the following exposure pathways in evaluating the dose to the maximally exposed individual: (1) ingestion of aquatic food (i.e., fish), (2) direct radiation exposure from shoreline activities, and (3) direct radiation exposure from swimming and boating activities (see Figure 5-1). The irrigation and drinking water exposure pathways were not considered, as water from Clinton Lake and Salt Creek is not used for either irrigation or public drinking water. Population dose estimates for the public within 80 km (50 mi) of a new nuclear unit were not calculated for the liquid effluent pathway because Clinton Lake and Salt Creek are not a source of public drinking water and no commercial fishing is allowed on them. Liquid effluents were assumed to be released into Clinton Lake at the end of the 5.5-km (3.4-mi) discharge flume.

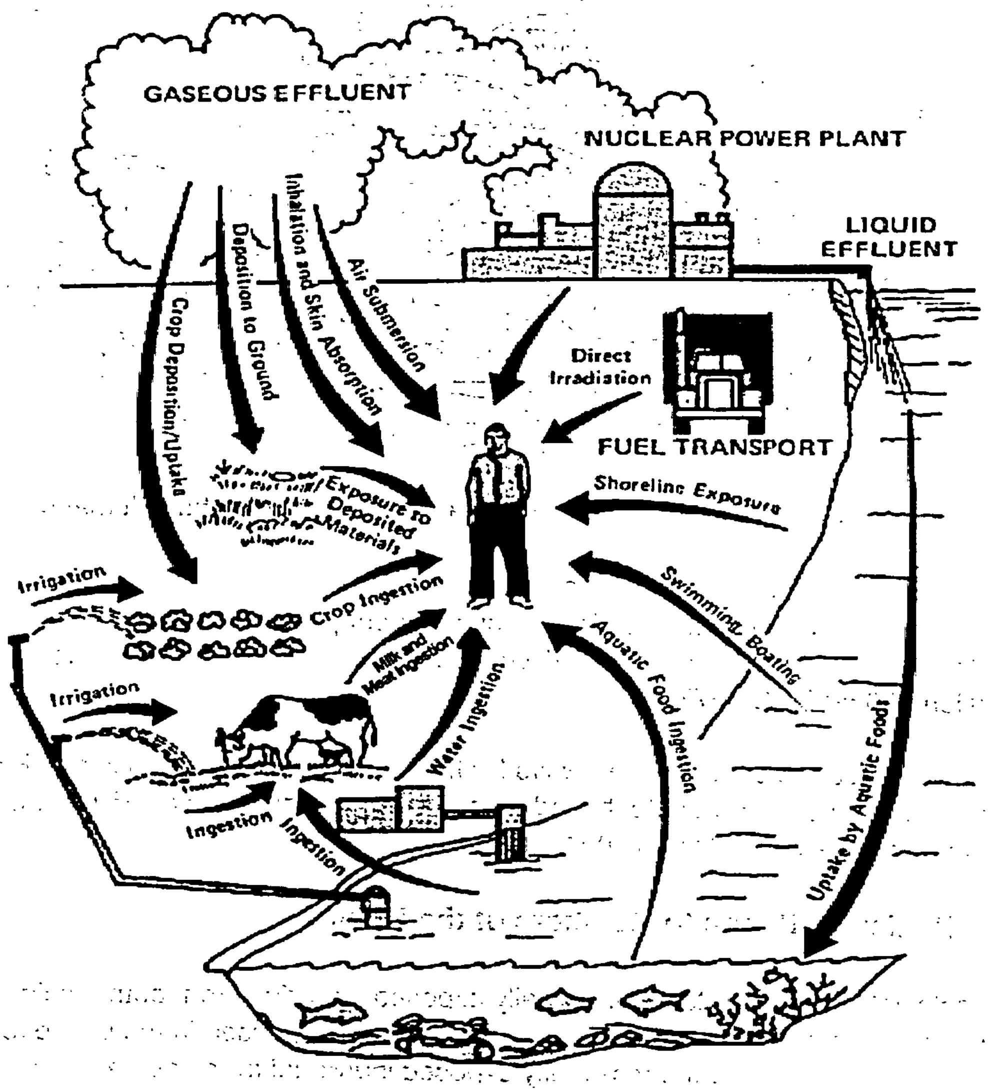
For the gaseous effluent release pathway, Exelon considers the following exposure pathways in evaluating the dose to the maximally exposed individual and to the population: (1) external exposure to the airborne plume (i.e., air submersion), (2) external exposure to contaminated ground, (3) inhalation of airborne activity (i.e., gaseous effluents), and (4) ingestion of contaminated agricultural products (see Figure 5-1).

Exelon (2003b) states that direct radiation from the condensate storage tank and skyshine from N-16 in the CPS turbine building would be the dominant source of direct radiation exposure to the public from the Exelon ESP site. Exelon assumes that contained sources of radiation at a new nuclear unit would be shielded and would not contribute to the external dose of the maximally exposed individual or the population.

Exposure pathways considered in evaluating dose to the biota are shown in Figure 5-2 and included

- Ingestion of aquatic foods
- Ingestion of water
- External exposure from water immersion or surface effect

Figure 5-1. Exposure Pathways to Humans



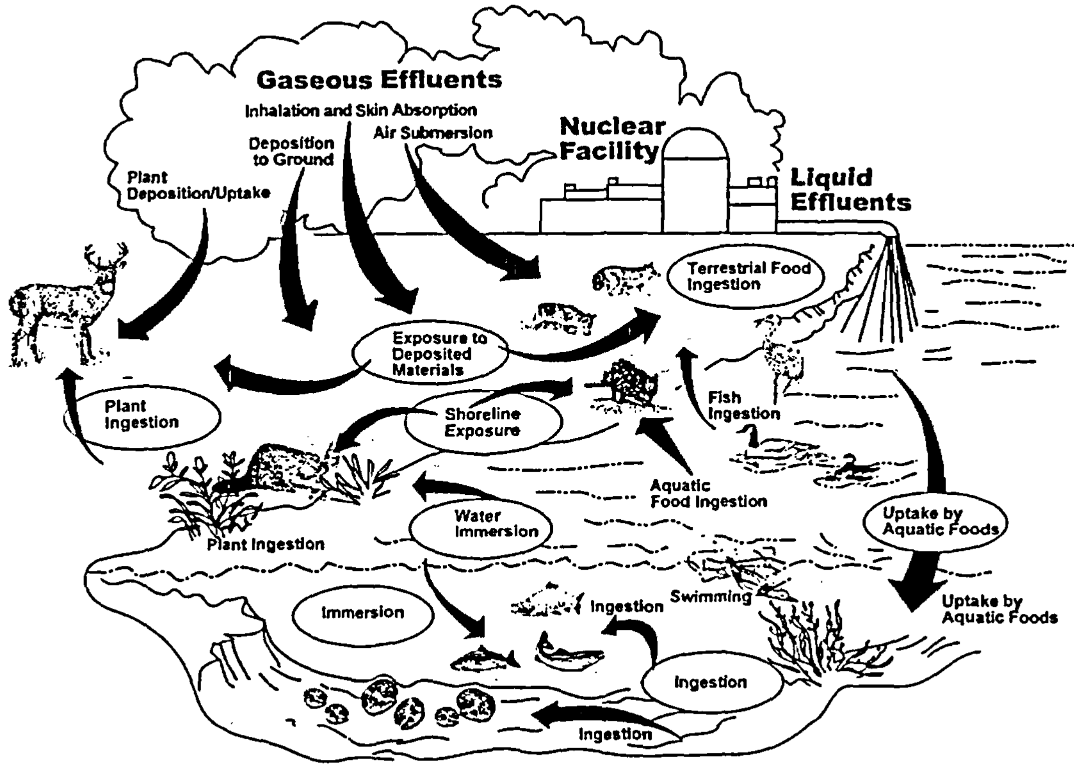


Figure 5-2. Exposure Pathways to Biota Other than Humans

- Inhalation of airborne radionuclides
- External exposure to immersion in gaseous effluent plumes, and
- Surface exposure from deposition of iodine and particulates from gaseous effluents (Exelon 2003a; NRC 1977).

The staff reviewed the exposure pathways for the public and biota identified by Exelon (2003a) and found them to be appropriate, based on a documentation review and interviews with Exelon staff during the site visit in March 2004.

5.9.2 Radiation Doses to Members of the Public

Exelon calculated the dose to the maximally exposed individual from both the liquid and gaseous effluent release pathways (Exelon 2003b). As discussed in the previous sections, direct radiation exposure to the maximally exposed individual from sources of radiation at a new nuclear unit would be negligible.

5.9.2.1 Liquid Effluent Pathway

Liquid pathway doses were calculated using the LADTAP II computer program (Strenge et al. 1986) for the following activities: eating fish caught near the discharge point, swimming and boating activities near the discharge point, and using the shoreline for recreational purposes near the discharge point. The liquid effluent releases used in the estimate of dose to the maximally exposed individual are found in Table 3.5-1 of the ER (Exelon 2003b). Other parameters used as inputs to the LADTAP II program include effluent discharge rate, dilution factor for discharge, lake volume, and liquid pathway consumption and usage factors (i.e., fish consumption, shoreline usage, swimming exposure, and boating). See Tables 5.4-1 and 5.4-2 of the ER (Exelon 2003b).

Exelon calculated liquid pathway doses to the maximally exposed individual. The maximum annual dose to the total body for an adult was 0.0095 mSv (0.95 mrem). The maximum annual dose to the thyroid for an infant was 0.0003 mSv (0.03 mrem). The maximum annual dose to the liver for a child was 0.0133 mSv (1.33 mrem).

The staff recognizes the LADTAP II computer program as an appropriate method for calculating dose to the maximally exposed individual for liquid effluent releases. The staff performed an independent evaluation of liquid pathway doses using input parameters from the ER and found similar results. All input parameters used in Exelon calculations were judged by the staff to be appropriate. Results of the staff's independent evaluation are found in Appendix H.

5.9.2.2 Gaseous Effluent Pathway

Gaseous pathway doses to the maximally exposed individual were calculated by Exelon using the GASPAR II computer program (Strenge et al. 1987) at the following locations: the nearest residence, nearest garden, nearest meat animal, nearest milk cow, nearest milk goat, and the exclusion area boundary. The GASPAR II computer program was also used to calculate annual population doses. The following activities were considered in the dose calculations: (1) direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground, (2) inhalation of gases and particulates, (3) ingestion of milk and meat from cattle eating contaminated grass, and (4) ingestion of foods contaminated by gases and particulates. The gaseous effluent releases used in the estimate of dose to the maximally exposed individual and population are found in Table 3.5-3 of the ER (Exelon 2003b). Other parameters used as inputs to the GASPAR II program, including population data, milk production rates, vegetable production rates, meat production rates, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors, are found Tables 5.4-3 and 5.4-4 of the ER (Exelon 2003b) or were obtained by the staff during the March 2004 site visit.

Gaseous pathway doses to the maximally exposed individual calculated by Exelon are found in Table 5-1. Table 5-2 shows the annual whole body and thyroid doses to the population from various pathways calculated by Exelon.

The staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the maximally exposed individual and population from gaseous effluent releases. The staff performed an independent evaluation of gaseous pathway doses and found similar results. All input parameters used in the Exelon calculations were judged to be appropriate by the staff. Results of the staff's independent evaluation are found in Appendix H.

5.9.3 Impacts to Members of the Public

This section describes the staff's evaluation of the estimated impacts from radiological releases and direct radiation of a new nuclear unit at the Exelon ESP site. The evaluation addresses dose from operations to the maximally exposed individual located at the ESP site and the population dose (collective dose to the population within 80 km [50 mi]) around the ESP site.

5.9.3.1 Maximally Exposed Individual

Exelon (Exelon 2003b) states that total body and organ dose estimates to the maximally exposed individual from liquid and gaseous effluents for a new nuclear unit would be within the design objectives of 10 CFR Part 50, Appendix I. Doses to total body and maximum organ at Clinton Lake from liquid effluents were well within the respective 0.03-mSv/yr (3-mrem/yr) and 0.1-mSv/yr (10-mrem/yr) Appendix I design objectives. Doses at the exclusion area boundary from gaseous effluents were well within the Appendix I design objectives of 0.1 mGy/yr (10 mrad/yr) air dose from gamma radiation, 0.2 mGy/yr (20 mrad/yr) air dose from beta radiation, 0.05 mSv/yr (5 mrem/yr) to the total body, and 0.15 mSv/yr (15 mrem/yr) to the skin.

In addition, dose to the thyroid was within the 0.15-mSv/yr (15-rem/yr) Appendix I design objective. A comparison of dose estimates for a new nuclear unit to the Appendix I design objectives is found in Table 5-3.

Gaseous and liquid effluents from the CPS contribute a small fraction of the Appendix I design objectives (i.e., less than 1 percent) (AmerGen 2002). Therefore, the cumulative effects of both the current operating unit and a new nuclear unit would be within Appendix I design objectives.

If Exelon applies for a CP or a COL, the staff will verify whether liquid and gaseous effluent releases for the actual reactor design are bounded by the PPE bounding release values used by Exelon in its ESP application. Additional evaluations will be performed if bounding release values are exceeded.

Table 5-1. Doses to the Maximally Exposed Individual from Gaseous Effluent Pathway[(a)]

Location	Pathway	Total Body Dose (mSv/yr)[(b)]	Thyroid Dose (mSv/yr)[(b)]	Skin Dose (mSv/yr)[(b)]
Exclusion area boundary (1.0 km [0.64 mi] NNE)	Plume	8.75 x 10^{-3}	-	2.94 x 10^{-2}
Nearest residence (1.2 km [0.73 mi] SW)	Plume	3.9 x 10^{-3}	-	1.4 x 10^{-2}
Nearest residence (1.2 km [0.73 mi] SW)	Inhalation			
	Adult	1.2 x 10^{-3}	4.8 x 10^{-3}	-
	Teen	1.2 x 10^{-3}	6.0 x 10^{-3}	-
	Child	1.1 x 10^{-3}	7.0 x 10^{-3}	-
	Infant	6.3 x 10^{-4}	6.0 x 10^{-3}	-
Nearest garden (1.5 km [0.93 mi] N)	Vegetable			
	Adult	2.7 x 10^{-3}	2.6 x 10^{-2}	-
	Teen	3.6 x 10^{-3}	3.6 x 10^{-2}	-
	Child	6.8 x 10^{-3}	7.0 x 10^{-2}	-
Nearest meat animal (1.5 km [0.93 mi] N)	Meat			
	Adult	6.1 x 10^{-4}	-	-
	Teen	4.5 x 10^{-4}	-	-
	Child	7.3 x 10^{-4}	-	-
Nearest milk cow (8.1 km [5 mi] N)[(c)]	Cow Milk			
	Adult	9.7 x 10^{-5}	1.5 x 10^{-3}	-
	Teen	1.4 x 10^{-4}	2.4 x 10^{-3}	-
	Child	2.7 x 10^{-4}	4.7 x 10^{-3}	-
	Infant	5.0 x 10^{-4}	1.1 x 10^{-2}	-
Nearest milk goat (7.1 km [4.4 mi] SE)[(d)]	Goat Milk			
	Adult	1.5 x 10-4	1.7 x 10-3	-
	Teen	2.0 x 10-4	2.7 x 10-3	-
	Child	3.4 x 10-4	5.4 x 10-3	-
	Infant	5.9 x 10-4	1.3 x 10-2	

(a) Source was the Exelon ER (2003b), Tables 5.4-6 and 5.4-9. No infant doses were calculated for the vegetable or meat pathway as infants do not consume these foods.
(b) Multiply mSv/yr times 100 to obtain mrem/yr.
(c) This distance and direction from the ESP site represents the location of the nearest cow producing milk for human consumption.
(d) This distance and direction from the ESP site represents the location of the nearest milk goat. In Table 2.7-53 of the ER (Exelon 2003b), the largest atmospheric dispersion factor for the nearest milk goat is listed at a distance of 8 km (5 mi) north of the ESP site. This atmospheric dispersion factor is 15 percent greater than the atmospheric dispersion factor used in Exelon's calculation; however, it would not result in a significant increase in the dose to the maximally exposed individual.

Exelon (Exelon 2003b) states that dose estimates from combined liquid and gaseous effluents to the maximally exposed individual at the site boundary from a new nuclear unit are well within the regulatory standards of 40 CFR Part 190. As stated earlier, exposure from direct radiation sources at a new nuclear unit would be negligible. Table 5-4 compares calculated Exelon doses to the dose standards from 40 CFR Part 190, i.e., 0.25 mSv/yr (25 mrem/yr) to the total body, 0.75 mSv/yr (75 mrem/yr) to the thyroid, and 0.25 mSv/yr (25 mrem/yr) to any other organ.

Table 5-2. Annual Doses to Population from Gaseous Effluent Pathway[a]

Pathway	Calculated Dose to Total Body (person-Sv/yr)	Calculated Dose to Thyroid (worst case organ) (person-Sv/yr)
Plume	4.03×10^{-3}	4.03×10^{-3}
Ground	1.45×10^{-3}	1.45×10^{-3}
Inhalation	4.8×10^{-3}	1.53×10^{-2}
Vegetable ingestion	1.08×10^{-3}	1.09×10^{-3}
Cow milk ingestion	3.92×10^{-3}	3.35×10^{-2}
Meat ingestion	2.98×10^{-3}	4.2×10^{-3}
Total	1.83×10^{-2}	5.95×10^{-2}

(a) Source was Exelon (2003b), Table 5.4-11.
(b) Multiply person-Sv/yr times 100 to obtain person-rem/yr.

Table 5-3. Comparison of Maximally Exposed Individual Dose Estimates from Liquid and Gaseous Effluents to 10 CFR 50, Appendix I, Design Objectives

Pathway/Type of Dose	Exelon (2003b)	Appendix I Design Objectives[a]
Liquid Effluents		
Total body dose	0.0095 mSv/yr (adult)	0.03 mSv/yr
Maximum organ dose	0.0133 mSv/yr (teen liver)	0.1 mSv/yr
Gaseous Effluents (Noble gases only)		
Gamma air dose	0.0135 mGy/yr	0.1 mGy/yr
Beta air dose	0.0289 mGy/yr	0.2 mGy/yr
Total body dose	0.00875 mSv/yr	0.05 mSv/yr
Skin dose	0.0294 mSv/yr	0.15 mSv/yr
Gaseous effluents (Radioiodines and particulates)		
Organ dose	0.0944 mSv/yr (thyroid)	0.15 mSv/yr

(a) Multiply mSv/yr or mGy/yr times 100 to obtain mrem/yr or mrad/yr.

Doses to the maximally exposed individual from the CPS are smaller than the dose estimates for a new nuclear unit. Section 2.5 states that the maximum annual dose to a member of the public from gaseous and liquid effluents at the CPS is typically less than 3×10^{-5} mSv (less than 0.003 mrem). Section 4.9 states that direct radiation exposures from the CPS do not vary significantly from background radiation levels at the site boundary. Therefore, the combined dose to the maximally exposed individual from the CPS and a new nuclear unit would be well within the 40 CFR Part 190 standards, 10 CFR Part 20 standards, and 10 CFR Part 50, Appendix I, design objectives.

Table 5-4. Comparison of Maximally Exposed Individual Dose Estimates from Liquid and Gaseous Effluents to 40 CFR Part 190 Standards

Dose	Exelon (2003b) Estimate (mSv/yr)[a]	40 CFR Part 190 Standards (mSv/yr)[b]
Whole body dose equivalent	0.0321	0.25
Thyroid dose	0.0947	0.75
Dose to another organ	0.0133 (teen liver) - liquid 0.0371 (bone) - gaseous	0.25

(a) Sum of dose from liquid and gaseous effluent releases.
(b) Multiply mSv/yr times 100 to obtain mrem/yr.

5.9.3.2 Population Dose

Exelon estimates the collective total body dose within an 80-km (50-mi) radius of the Exelon ESP site to be 0.0183 person Sv/yr (1.83 person-rem/yr) (Exelon 2003b). The estimated collective dose to the same population from natural background radiation is estimated to be 2300 person-Sv/yr (230,000 person-rem/yr) (Exelon 2003b). The dose from natural background radiation was calculated by multiplying the projected 80-km (50-mi) population data for 2010 of approximately 800,000 people by the annual background dose rate of 2.85 mSv/yr (285 mrem/yr) (Exelon 2003b).

Collective dose was estimated using the GASPAR II computer code and was attributed to the gaseous effluent pathway. Collective dose from the liquid effluent pathway was not calculated since Clinton Lake and Salt Creek are not a source of public drinking water or irrigation water, and no commercial fishing is allowed (Exelon 2003b). The staff performed an independent evaluation of population doses and found similar results (see Appendix H).

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). This coefficient was multiplied by the estimated collective whole body population dose of 0.0183 person-Sv/yr (1.83 person-rem/yr) to calculate that the population living within 80 km (50 mi) of the Exelon ESP site would incur a total of approximately 0.0013 fatal cancers, nonfatal cancers, and severe hereditary effects annually. The risks from the cumulative radiation exposure from the CPS and the proposed ESP plant would be only slightly higher. This risk is very small compared to the estimated 170 fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published, "Cancer in Populations Living Near Nuclear Facilities," in 1990 (NCI 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990).

5.9.3.3 Summary of Radiological Impacts to Members of the Public

The staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from a new nuclear unit at the Exelon ESP site. Based on the information provided by Exelon and on its own independent evaluation, the staff concludes there would be no observable health impacts to the public from normal operation of a new nuclear unit, and the health impacts would be SMALL.

5.9.4 Occupational Doses to Workers

Limited information was available on occupational dose estimates from the advanced reactor designs. Dominion (2002) reported annual occupational dose estimates of 1.5 person-Sv (150 person-rem) for the advanced pressurized water reactor (AP1000), the International Reactor Innovative and Secure (IRIS), and gas turbine modular helium (GT-MHR) reactor designs. NUREG-0713 (NRC 2002b) reported an average annual collective dose per operating reactor of 1.72 person-Sv/yr (172 person-rem/yr) for the time period of 1992-2001. The estimated occupational doses for the advanced reactor designs were slightly less than the annual occupational doses for current light water reactors (LWRs). Exelon (2004) concluded that occupational exposures for the new nuclear unit would likely be bounded by occupational exposures from currently operating LWRs based on the following: (1) advanced LWR designs have or will incorporate radiation protection features that are improved over the designs provided in currently operating LWRs and (2) gas-cooled reactor design-basis source terms and expected operating characteristics exhibit lower radiation levels during normal operation and for abnormal operating occurrences than currently operating LWRs. This relationship will need to be verified by the staff at the CP or COL stage when a specific design has been chosen.

5.9.5 Impacts to Biota Other than Members of the Public

Exelon estimated doses to surrogate biota species, including fish, invertebrates, algae, muskrat, raccoon, heron, and duck. Fish, invertebrates, and algae are referred to as aquatic species. Muskrats, raccoons, herons, and ducks are referred to as terrestrial species. Important biota species for the Exelon ESP site and the corresponding surrogate species are as follows: (1) spike (freshwater mussel) - invertebrate, (2) channel catfish, hybrid striped bass, largemouth bass, and walleye - fish, (3) whitetail deer, turkey, rabbit, squirrel, and raccoon - raccoon and muskrat, (4) duck, teal, coot, and Canada goose - duck, and (5) sandpiper and heron - heron (Exelon 2003b). Surrogate species are well-defined and provide an acceptable method for judging doses to the biota. Exposure pathways considered in evaluating dose to the biota were discussed in Section 5.9.1 and shown in Figure 5-2.

5.9.5.1 Liquid Effluent Pathway

Exelon (2003b) used the LADTAP II computer code to calculate doses to the biota from the liquid effluent pathway. In estimating the concentration of radioactive effluents in Clinton Lake, Exelon (2003b) used a partially mixed impoundment model. Liquid pathway doses were higher for biota compared to man because of considerations for bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, and increased time spent in water and shoreline compared to man. The liquid effluent releases used in estimating biota dose are found in Table 3.5-1 of the ER (Exelon 2003b). Input parameters into the LADTAP II computer code assumed no credit for dilution or transit time from the outflow. Parameters for surrogate species are found in Tables 5.4-15, 5.4-16, and 5.4-17 of the ER (Exelon 2003b) and were taken from Strenge et al. (1986) and NRC (1977). These parameters include food intake, body mass, effective body radius, shoreline exposure, and swimming exposure. Total body dose estimates to the surrogate species from the liquid pathway are shown in Table 5-5.

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). The exposure pathways include inhalation of airborne radionuclides, external exposure due to immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents. The dose calculated to the maximally exposed individual from gaseous effluent releases in Table 5-1 would also be applicable to terrestrial surrogate species with one modification. The one

Table 5-5. Comparison of Biota Doses from the Exelon ESP Site to 40 CFR Part 190[a]

Biota	Liquid Effluents - Internal Dose (mGy/yr)[b]	Liquid Effluents - External Dose (mGy/yr)[b]	Gaseous Effluents - Internal Dose (mGy/yr)[b]	Gaseous Effluents - External Dose (mGy/yr)[b]	Total Body Biota Dose All Pathways (mGy/yr)[b]	40 CFR Part 190 Total Body Dose Limit (mSv/yr)[a]
Fish	2.43×10^{-2}	3.82×10^{-2}	-	-	6.25×10^{-2}	2.5×10^{-1}
Invertebrate	6.11×10^{-2}	7.63×10^{-2}	-	-	1.37×10^{-1}	2.5×10^{-1}
Algae	2.78×10^{-1}	7.18×10^{-5}	-	-	2.78×10^{-1}	2.5×10^{-1}
Muskrat	1.34×10^{-1}	2.55×10^{-2}	1.66×10^{-3}	1.06×10^{-2}	1.72×10^{-1}	2.5×10^{-1}
Raccoon	4.57×10^{-2}	1.91×10^{-2}	1.66×10^{-3}	1.44×10^{-2}	8.09×10^{-2}	2.5×10^{-1}
Heron	6.63×10^{-1}	2.55×10^{-2}	8.3×10^{-4}	6.27×10^{-3}	6.96×10^{-1}	2.5×10^{-1}
Duck	1.2×10^{-1}	3.82×10^{-2}	1.66×10^{-3}	1.16×10^{-2}	1.72×10^{-1}	2.5×10^{-1}

(a) Data taken from Table 5.4-18 of Exelon (2003b).
(b) Multiply mGy/yr or mSv/yr times 100 to obtain mrad/yr or mrem/yr.

modification defined in Exelon (2003b) was increasing the ground deposition factors by a factor of two as terrestrial animals would be closer to the ground than the maximally exposed individual. The gaseous effluent releases used in estimating dose are found in Table 3.5-3 of the ER (Exelon 2003b). The ER used doses at the exclusion area boundary (1.03 km [0.64 mi]) NNE of the ESP site) in estimating terrestrial species doses. Total body dose estimates to the surrogate species from the gaseous pathway are shown in Table 5-5.

5.9.5.3 Impact of Estimated Biota Doses

Table 5-5 also compares the annual total body dose estimates to surrogate biota species from a new nuclear unit to the annual whole body dose standard in 40 CFR Part 190. Although the 40 CFR Part 190 standards apply to members of the public in unrestricted areas and not to biota, they are provided here for comparative purposes. Dose estimates to the biota from the CPS would not be significant when compared to those of a new nuclear unit because the current operating plant has not had any liquid effluent releases in the past 9 years. Radiation doses to the biota are expressed in units of absorbed dose (mGy [mrad]) because dose equivalent (mSv [mrem]) only applies to human radiation doses. Exelon assumed that mSv (mrem) and mGy (mrad) are approximately equivalent for comparison of biota doses to the 40 CFR Part 190 standards. Annual dose to algae and heron-surrogate species exceeded the dose standard in 40 CFR Part 190. The biota dose estimates of a new nuclear unit are conservative because they do not consider dilution or decay of liquid effluents during transit. Actual doses to the biota are likely to be much less.

The International Council on Radiation Protection (ICRP 1977; ICRP 1990) states that if humans are adequately protected, other living things are also likely to be sufficiently protected.

The International Atomic Energy Agency (IAEA), (ORNL 1995) and the National Council on Radiation Protection and Measurements (NCRP 1991) found that appreciable effects in aquatic populations would not be expected at doses lower than 10 mGy/d (1000 mrad/d). IAEA (ORNL 1995) also concluded that chronic dose rates of 1 mGy/d (100 mrad/d) or less do not appear to cause observable changes in terrestrial animal populations. Table 5-6 compares the estimated total body dose to the biota from a new nuclear unit to the IAEA chronic dose rate values for aquatic organisms and terrestrial animals. The cumulative effects of the CPS and a new nuclear unit result in dose rates less than those of the NCRP and IAEA studies.

The staff performed an independent evaluation of doses to biota and found similar results. Results of the staff's independent evaluation are found in Appendix H.

Based on the information provided by Exelon and its own independent evaluation, the staff concludes that the radiological impact on biota from the routine operation of a new nuclear unit at the proposed ESP site would be SMALL, and mitigation would not be warranted.

5.9.6 Radiological Monitoring

Exelon would establish a radiological environmental monitoring program (REMP) for the Exelon ESP site to monitor the radiological environment around the site during pre-construction and construction phases and during operation of a new nuclear unit (Exelon 2003b). The purpose of the REMP is to sample, measure, analyze, and monitor the radiological impact of proposed reactor operations on the environment.

The program would be implemented in accordance with 10 CFR 20.1501 and 10 CFR Part 50, Appendix A, General Design Criterion 64. The program would consist of two phases

Table 5-6. Comparison of Biota Doses from a New Nuclear Unit at the Exelon ESP Site to IAEA Studies[a]

Biota	Total Body Dose - Exelon ESP Unit (mGy/d)[b]	Chronic Dose Rate Values from IAEA Studies mGy/d [b]
Fish	1.71×10^{-4}	10
Invertebrate	3.76×10^{-4}	10
Algae	7.62×10^{-4}	10
Muskrat	4.71×10^{-4}	1
Raccoon	2.22×10^{-4}	1
Heron	1.91×10^{-3}	1
Duck	4.70×10^{-4}	1

(a) Total dose from liquid and gaseous effluents in Table 5-5.
(b) Multiply mGy/d times 100 to obtain mrad/d.

(pre-operational and operational). The pre-operational program would evaluate radiation exposure rates and concentrations in the environment that contribute to construction worker dose. The pre-operational program would be developed from baseline data already established for the CPS (Exelon 2003b). The operational and pre-operational phases would be essentially the same. To the greatest extent practical, the REMP for the ESP program would utilize the sampling locations used by the CPS. Additional sampling locations might be added as necessary.

The REMP would include the following six environmental elements: direct radiation, atmosphere, aquatic, terrestrial environments, groundwater, and surface water. Analyses performed on environmental samples collected would include gross alpha and beta analysis, gamma spectroscopy analysis, tritium analysis, strontium analysis, and gamma dose (using thermoluminescent dosimetry only).

In an annual Radiological Environmental Operating Report (e.g., AmerGen 2002) for the entire site, including both the CPS and a new nuclear unit, data will be compared with those for previous years. In addition, an inter-laboratory comparison program currently exists and an independent laboratory will continue to verify the program results. A quality assurance program will be implemented for the program.

The staff reviewed Exelon's proposed REMP and finds it adequate.

5.10 Environmental Impacts of Postulated Accidents

The staff considered the radiological consequences on the environment of potential accidents at a new nuclear unit at the Exelon ESP site. Consequence estimates are based on the General Electric advanced boiling water reactor (ABWR) standard reactor design, which has been certified by the NRC, and the surrogate Westinghouse AP1000. The term "accident," as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially in excess of permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2.

Numerous features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, which comprise the first line of defense, are intended to prevent the release of radioactive materials from the plant. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas is as low as is reasonably achievable (ALARA) are specified in 10 CFR Part 50, Appendix I. There are additional measures that are designed to mitigate the consequences of failures in the first line of defense. These include the NRC's reactor site criteria in 10 CFR Part 100, which require the site to have certain characteristics that reduce the risk to the public and the potential impacts of an accident, and emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47, 10 CFR Part 50, Appendix E, and NUREG-0654/FEMA-REP-1 (NRC 1980). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

This section discusses (1) the types of radioactive materials, (2) the paths to the environment, (3) the relationship between radiation dose and health effects, and (4) the environmental impacts of reactor accidents, both design basis accidents (DBAs) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. The majority of the material in the fuel is in the form of nonvolatile solids. However, there is a significant amount of material that is in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and, therefore, have a lower tendency to escape from the fuel than the noble gases and iodines.

Radiation exposure to individuals is determined by their proximity to radioactive material, the duration of their exposure, and the extent to which they are shielded from the radiation. Pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in the water, (2) inhalation of radioactive material, and (3) ingestion of food or water containing material initially deposited on the ground and in water.

The risks of health effects from radiation exposure are either too small to be observed or are nonexistent below 0.1 Sv (10 rem) (HPS 2004). Incidence of cancer in the exposed general population may begin to develop after a lapse of 2 to 15 years (latent period) after exposure and then level off over a period of about 30 years (plateau period). In the case of radiation exposure of fetuses, cancer may begin to develop as early as at birth (no latent period) to the age of 10.

Physiological effects are clinically detectable should individuals receive radiation exposure resulting in a dose greater than about 0.25 Sv (25 rem) over a short period of time (hours). Doses of about 2.5 to 5.0 Sv (250 to 500 rem) received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.10.1 Design Basis Accidents

Exelon evaluated the potential consequences of postulated accidents to demonstrate that a new nuclear unit could be constructed and operated at the Exelon ESP site without undue risk to the health and safety of the public. These evaluations used a set of surrogate design basis accidents (DBAs) that are representative of the range of reactor designs being considered for the ESP site and site-specific meteorological data. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences.

The DBA review focuses on two LWR designs – the ABWR and the surrogate AP1000. The bases for analyses of postulated accidents for these designs are well established because they have been considered as part of the NRC's advanced reactor design certification process. Accidents for the other reactor designs listed in the application are not as well defined as those for the ABWR and AP1000; acceptable assumptions and methodologies for the evaluation of postulated accidents have not been fully established. Because the source terms for accident analyses are generically proportional to the power level, for the purpose of this site-suitability evaluation, the potential consequences of accidents for the other reactor designs are expected to be bounded by those for the ABWR and the surrogate AP1000 designs. For example, preliminary information on source terms for the IRIS and ACR-700 reactor designs indicates that the source terms for the surrogate AP1000 loss-of-coolant accident (LOCA) will bound the worst case accident releases for these advanced reactor designs. Similarly, the ABWR source term will bound the source term for the Economic Simplified Boiling Water Reactor (ESBWR) design. The advanced gas reactor designs (GT-MHR and pebble bed modular reactor) postulate relatively small releases to the environment compared to water reactor technologies (Exelon 2003b).

Should an application that references an ESP at the Exelon site be made to build and operate one of the designs other than the ABWR or surrogate AP1000, Exelon would be required to show - and the staff would verify - that the radiological consequences of DBAs for the proposed reactor(s) are bounded by the consequences of DBAs evaluated in this EIS.

Potential consequences of DBAs are evaluated following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions. The source terms for the ABWR reactor design are based on TID-14844 (AEC 1962) guidance, and guidance on methods for evaluating potential accidents for the ABWR are set forth in NUREG-0800 (NRC 1987), Regulatory Guide 1.3 (NRC 1974a), and Regulatory Guide 1.25 (NRC 1974b). The source terms for the surrogate AP1000 reactor and methods for evaluating potential accidents are based on guidance in Regulatory Guide 1.183 (NRC 2000a).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as χ/Q. Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983).

Table 5-7 lists χ/Q values pertinent to the evaluation of the suitability of the Exelon ESP site. The first column lists the time periods and boundaries for which χ/Q and dose estimates are needed. For the exclusion area boundary, the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term, i.e., 2 hours, and for the low population zone, they are calculated for the course of the accident, i.e., 30 days (720 hours) composed of four time periods. The second column lists the χ/Q values presented in Exelon's ER Section 2.7.6 using the site meteorological information discussed in ER Section 2.7.4 and the exclusion area boundary and low population zone distances (Exelon 2003b). No credit was taken for building wake.

Exelon calculated the χ/Q values listed in Table 5-7 (1) using a set of meteorological data for the ESP site that covered 32 months, and (2) assuming the release point was located at the center of the proposed ESP facility footprint. The staff evaluated possible changes in the χ/Q values (1) based on 36 months (2000 - 2002) of meteorological data, and (2) assuming that the release point would be 220 m (722 ft) closer to the exclusion area boundary and low population zone in each downwind sector. These changes in the χ/Q values were small and would not significantly change the calculated doses.

Small χ/Q values are associated with greater dilution capability. Thus, if the design χ/Q values for a specific reactor design identified as part of a CP or COL application are greater than or equal to the site χ/Q values, atmospheric dispersion at the site is sufficient such that the doses

Table 5-7. Atmospheric Dispersion Factors for Exelon ESP Site Design Basis Accident Calculations

Time Period and Boundary	χ/Q (s/m³)
0 to 2 hr, Exclusion Area Boundary	3.56×10^{-5}
0 to 8 hr, Low Population Zone	3.40×10^{-6}
8 to 24 hr, Low Population Zone	2.85×10^{-6}
1 to 4 d, Low Population Zone	1.85×10^{-6}
4 to 30 d, Low Population Zone	1.00×10^{-6}

predicted for postulated DBAs for the design will be below regulatory limits if the source terms are bounded by the PPE.

The staff concludes that the atmospheric dispersion characteristics of the Exelon ESP site are acceptable with respect to the potential environmental consequences of postulated DBAs for reactor designs with design χ/Q values falling within the bounds set by the site χ/Q values. At the CP or COL stage, the staff will need to verify that the χ/Q values for reactor designs considered are bounded by the site χ/Q values. Additional evaluation will be needed if reactor design χ/Q values are not bounded by those of the site χ/Q values.

Tables 5-8 and 5-9 list the set of surrogate DBAs considered by Exelon and present its estimate of the environmental consequences of each accident in terms of total effective dose equivalent (TEDE). TEDE is the sum of the committed effective dose equivalent (CEDE) from inhalation and the deep dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988) were used to calculate the CEDE. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993) were used to calculate the deep dose equivalent. Equivalent TEDE values were estimated for the ABWR by multiplying the thyroid dose by a factor 0.03 (the organ weighing factor for the thyroid in the TEDE methodology) and adding the product to the whole body dose. The review criteria used in the staff's safety review of DBA doses are included in Tables 5-8 and 5-9 to illustrate how small the calculated environmental consequences (TEDE doses) are.

In addition to the evaluation of consequences of the DBAs for the ABWR and surrogate AP1000 designs described above, Exelon evaluated the consequences of postulated LOCAs

Table 5-8. Design Basis Accident Doses for an ABWR

		TEDE (Sv)[a]		
Accident	**Standard Review Plan Section[b]**	**Exclusion Area Boundary**	**Low Population Zone**	**Review Criterion**
Main steam line break	15.6.4			
Pre-existing iodine spike		6.8×10^{-4}	6.5×10^{-5}	2.5×10^{-1} (c)
Accident-initiated iodine spike		3.4×10^{-5}	3.3×10^{-6}	2.5×10^{-2} (d)
Loss-of-coolant accident	15.6.5	2.3×10^{-3}	7.6×10^{-3}	2.5×10^{-1} (c)
Failure of small lines carrying primary coolant outside containment	15.6.2	3.0×10^{-5}	5.7×10^{-6}	2.5×10^{-2} (d)
Fuel handling	15.7.4	8.0×10^{-4}	9.8×10^{-5}	6.25×10^{-2} (d)

(a) To convert Sv to rem, multiply by 100.
(b) NUREG-0800 (NRC 1987).
(c) 10 CFR 50.34(a)(1) and 10 CFR 100.21 criteria.
(d) Standard Review Plan criterion.

Table 5-9. Design Basis Accident Doses for an AP1000 Reactor

Accident	Standard Review Plan Section[b]	TEDE in Sv[a] EAB[c]	LPZ[d]	Review Criterion
Main steam line break	15.1.5			
Pre-existing iodine spike		4.2×10^{-4}	1.3×10^{-4}	2.5×10^{-1} [e]
Accident-initiated iodine spike		4.7×10^{-4}	5.0×10^{-4}	2.5×10^{-2} [f]
Steam generator rupture	15.6.3			
Pre-existing iodine spike		1.8×10^{-3}	8.8×10^{-5}	2.5×10^{-1} [e]
Accident-initiated iodine spike		8.9×10^{-4}	6.6×10^{-5}	2.5×10^{-2} [f]
Loss-of-coolant accident	15.6.5	1.5×10^{-2}	2.6×10^{-3}	2.5×10^{-1} [e]
Rod ejection	15.4.8	1.8×10^{-3}	4.5×10^{-4}	6.25×10^{-2} [f]
Reactor coolant pump rotor seizure (locked rotor)	15.3.3	1.5×10^{-3}	1.5×10^{-4}	2.5×10^{-2} [f]
Failure of small lines carrying primary coolant outside containment	15.6.2	7.7×10^{-4}	7.6×10^{-5}	2.5×10^{-2} [f]
Fuel handling	15.7.4	1.4×10^{-3}	1.5×10^{-4}	6.25×10^{-2} [f]

(a) To convert Sv to rem, multiply by 100.
(b) NUREG-0800 (NRC 1987).
(c) Exclusion area boundary.
(d) Low population zone.
(e) 10 CFR 50.34(a)(1) and 10 CFR 100.21 criteria.
(f) Standard Review Plan criterion.

for the ESBWR and Advanced Canada Deuterium Uranium Reactor (ACR-700) reactor designs. Table 5-10 lists the estimated TEDE for each design. The review criteria used in the staff's safety review of DBA doses are included in Table 5-10 to illustrate how small the calculated environmental consequences (TEDE doses) are.

In all cases, the calculated TEDE values are small - considerably smaller than the TEDE doses used as safety review criteria. Therefore, the staff concludes that the Exelon ESP site is suitable for operation of new advanced LWRs. The environmental impacts of DBAs have not

Table 5-10. Potential Consequences of Postulated Loss-of-Coolant Accidents for the ESBWR and ACR-700 Reactor Designs

Reactor Design	TEDE (Sv)[a] Exclusion Area Boundary	Low Population Zone	Review Criterion[b]
ESBWR	3.1×10^{-3}	4.7×10^{-3}	2.5×10^{-1}
ACR-700	3.8×10^{-3}	4.2×10^{-3}	2.5×10^{-1}

(a) To convert Sv to rem, multiply by 100.
(b) 10 CFR 50.34(a)(1) criterion.

been explicitly evaluated for gas-cooled reactors; however, the staff expects that releases to the environment under accident conditions would be small for such designs. At the COL stage, the applicant and the staff will need to verify that the doses for postulated DBAs for the actual reactor design remain bounded by environmental impacts from the surrogate reactor designs.

Summary of Design Basis Accident Impacts

Although Exelon chose to use the PPE approach in its ESP application, the applicant based its evaluation of the environmental impacts of DBAs on characteristics of the ABWR and the surrogate AP1000 reactor designs with the explicit assumption that these impacts would bound the impacts of other advanced LWR designs (Exelon 2003b). The NRC staff reviewed the analysis in the ER, which is based on analyses performed for design certification of these reactor designs. The results of the Exelon analyses indicate that the environmental risks associated with DBAs, if an advanced LWR were to be located at the Exelon ESP site, would be small compared to the TEDE doses used as safety review criteria. On this basis, the staff concludes that the consequences of DBAs at the Exelon ESP site are of SMALL significance for advanced LWRs and that the Exelon ESP site is suitable for operation of advanced LWRs. The environmental impacts of DBAs for gas-cooled reactors have not been explicitly evaluated and will need to be evaluated at the CP or COL stage. For this evaluation to bound the reactor design selected at the CP or COL stage, Exelon and the staff will need to verify that the environmental impacts of a DBA at the Exelon ESP site remain bounded by the environmental impacts for the surrogate designs considered in this EIS.

5.10.2 Severe Accidents

In its ER, Exelon bases its evaluation of the potential environmental consequences of severe accidents on the evaluation of potential consequences of severe accidents for the current-generation reactors presented in NUREG-1437 (NRC 1996). Three pathways were considered: (1) the atmospheric pathway, in which radioactive material is released to the air, (2) the surface water pathway, in which airborne radioactive material falls out on open bodies of water, and (3) the groundwater pathway, in which groundwater is contaminated by a basemat melt-through with subsequent contamination of surface water by the groundwater.

In response to an NRC request for additional information, dated May 11, 2004 (NRC 2004a), Exelon performed a site-specific analysis of the potential environmental consequences of postulated severe accidents at the Exelon ESP site. Because the PPE does not include source terms for severe accidents, Exelon used the source terms for the ABWR and surrogate AP1000 reactors as PPE values. Exelon used the MACCS2 computer code (Chanin et al. 1990; Jow et al. 1990) for the analysis. Input to the MACCS2 code and summarized results of the analysis were submitted to the NRC in a letter dated July 23, 2004 (Exelon 2004b).

The MACCS computer code was developed to evaluate the potential offsite consequences of the sites covered by NUREG-1150 (NRC 1990). MACCS2 (Chanin and Young 1997) is the current version of MACCS. The MACCS and MACCS2 codes evaluate the consequences of atmospheric releases of material following a severe accident. The pathways modeled include exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and resuspended from the ground, and ingestion of contaminated food and surface water. The primary enhancements in MACCS2 are that MACCS2 has (1) a more flexible emergency-response model, (2) an expanded library of radionuclides, and (3) a semidynamic food-chain model (Chanin and Young 1997).

Three types of severe accident consequences were assessed: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS2 estimates both early cancer fatalities and latent fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure (Jow et al. 1990). Latent fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates are based on the population distribution within an 80-km (50-mi) radius of the site. Economic costs of a severe accident include the costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination following a severe accident.

Risk is the product of the frequency and the consequences of an accident. For example, the probability of a severe accident without loss of containment for an ABWR is estimated to be 1.34×10^{-7} per reactor year (Ryr^{-1}), and the cumulative population dose associated with a severe accident without loss of containment at the Exelon ESP site is calculated to be 8.18×10^{1} person-Sv (8.18×10^{3} person-rem). The population dose risk for this class of accidents is the product of 1.34×10^{-7} Ryr^{-1} and 8.18×10^{1} person-Sv, or 1.10×10^{-5} person-Sv Ryr^{-1} (1.10×10^{-3} person-rem Ryr^{-1}). The following sections discuss the estimated risks associated with each pathway.

The risks presented in the tables that follow are risks per year of reactor operation. Exelon has indicated that the ESP site could hold two reactors of the surrogate AP1000 design. The consequences of a severe accident would be the same regardless of whether one or two surrogate AP1000 reactors were built. However, if two of the surrogate AP1000 reactors were built, the risks would apply to each reactor, and the total risk for new reactors at the site would be twice the risk for a single reactor. Even if the risk values were doubled, the risks would still be significantly smaller than the risks associated with current-generation reactors.

Air Pathway. The MACCS2 code directly estimates consequences associated with releases to the air pathway. The results of the MACCS2 runs are presented in Tables 5-11 and 5-12. The core damage frequencies given in these tables are for internally initiated accident sequences while the plant is at power. Internally initiated accident sequences include sequences that are initiated by human error, equipment failures, loss of offsite power, etc. Based on insights from the review of the advanced LWR probabilistic risk assessments, the core damage frequencies for externally initiated events and during shutdown would be comparable to or lower than those for internally initiated events.

Tables 5-11 and 5-12 show that the probabilistically weighted consequences, i.e., risks, of severe accidents for an ABWR or surrogate AP1000 reactor located on the Exelon ESP site are small for all risk categories considered. For perspective, Tables 5-13 and 5-14 compare the health risks from severe accidents for the ABWR and the surrogate AP1000 reactors at the Exelon ESP site with the risks for current-generation reactors at various sites.

In Table 5-13, the health risks estimated for the ABWR and surrogate AP1000 reactors at the Exelon ESP site are compared with health-risk estimates for the five reactors considered in NUREG-1150 (NRC 1990). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG-1150, only risks associated with internally initiated events are presented in Table 5-13. The health risks shown for the ABWR and surrogate AP1000 reactors at the Exelon ESP site are significantly lower than the risks associated with current generation reactors presented in NUREG-1150.

In addition, the last two columns of Table 5-13 provide average individual fatality risk estimates *for comparison to the Commission's safety goals. The Commission has set safety goals for* average individual early fatality and latent cancer fatality risks from reactor accidents in the Safety Goal Policy Statement (NRC 1986). The Policy Statement expressed the Commission's policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows:

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health

- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

The following quantitative health objectives are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.

- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all "other accidents to which members of the U.S. population are generally exposed," such as fatal automobile accidents, is about $5x10^{(-4)}$ per year. One-tenth of one percent of this figure implies that the individual risk of prompt fatality from a reactor accident should be less than $5x10^{(-7)}$ per reactor year.

- "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the U.S. which is about 1 in 500 or $2x10^{(-3)}$ per year. One-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant because of its operation should be limited to $2x10^{(-6)}$ per reactor year.

The average individual early fatality risk is calculated using the population distribution within 1.6 km (1 mi) of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 16 km (10 mi) of the plant. For the plants considered in NUREG-1150, these risks were well below the Commission's safety goals. Risks calculated for the ABWR and the surrogate AP1000 designs at the Exelon ESP site are lower than the risks associated with the current generation reactors considered in NUREG-1150 and are well below the Commission's safety goals.

The staff compared the core damage frequencies and population dose risk estimates for the ABWR and surrogate AP1000 reactors at the Exelon ESP site with statistics summarizing the results of contemporary severe accident analyses performed for 28 current generation operating reactors at 23 sites. The results of these analyses are included in the final site-specific Supplements 1 through 20 to the GEIS for License Renewal, NUREG-1437 (NRC 1996), and in the ERs included with license renewal applications for those plants for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150 (NRC 1990), and 23 of the analyses used MACCS2, which was released in 1997. Table 5-14 shows that the core damage frequencies estimated for the

ABWR and surrogate AP1000 reactors are significantly lower than those of current-generation reactors. Similarly, the population doses estimated for the advanced reactors at the Exelon ESP site are well below the mean and median values for current- generation reactors undergoing license renewal.

The staff compared the risk estimates given in Tables 5-11 and 5-12, the comparisons of air pathway risks in Tables 5-13 and 5-14, and the comparison of average individual early fatality and average individual latent cancer fatality risks in Table 5-13 with the Commission's safety goals. Preliminary information on the IRIS and the ACR-700 reactor designs indicates that the surrogate AP1000 will likely bound the risk for these advanced reactor designs. Similarly, the ESBWR risk is expected to be bounded by the risk for the ABWR. On this basis, the staff concludes that the Exelon ESP site is suitable for operation of advanced LWRs.

If, as stated in the ER, the releases from the gas-cooled reactor designs are bounded by the releases from the advanced LWR designs, the site would be suitable for these gas-cooled reactors. The PPE does not contain specific parameters related to severe accidents for gas-cooled reactors. The consequences of severe accidents have not been explicitly evaluated for gas-cooled reactors and will need to be evaluated at the CP or COL stage. For the evaluation in this EIS to bound the reactor design selected at the CP or COL stage, Exelon and the staff will need to verify that the environmental impacts of the air pathway releases for severe accidents at the Exelon ESP site remain bounded by the environmental impacts from the surrogate designs.

Surface-Water Pathways. Surface-water pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water. The surface-water pathways of interest include external radiation from submersion in water and activities near the water, ingestion of water, and ingestion of fish and other aquatic creatures. Of these pathways, the MACCS2 code evaluates only the ingestion of contaminated water. The risks associated with this surface-water pathway calculated for the Exelon ESP site are included in the last columns of Tables 5-11 and 5-12. These dose estimates are extremely conservative because no drinking water is withdrawn from surface waters in the vicinity of the ESP site (Exelon 2003b). For each accident class, the population dose risk from ingestion of water is a small fraction of the dose risk from the air pathway.

Clinton Lake is used for recreational activities including swimming and fishing. Doses from these surface-water pathways are not modeled in MACCS or MACCS2. NUREG-1437 (NRC 1996) considered typical population exposure risk for the aquatic food pathway for plants located on small rivers. For these plants, the population dose from the food pathway was well below the population dose from the air pathway. The CPS site, which is co-located with the ESP site, is classified as being on a small river. Analysis of water-related exposure pathways at the Fermi reactor (NRC 1981) suggests that population exposures from swimming are significantly lower than exposures from the aquatic ingestion pathway.

Exelon owns Clinton Lake, which is the major surface-water body in the vicinity of the Exelon ESP site. Clinton Lake is managed by the IDNR. In the event of a large release of radioactive material, population exposures through the surface-water pathways could be minimized by controlling access to the lake.

After considering the water-ingestion dose estimates, the NUREG-1437 evaluations, and Exelon and the State of Illinois control over Clinton Lake access, the staff concludes that the Exelon ESP site is suitable for operation of an ABWR or a surrogate AP1000 reactor; in a similar fashion to the air pathway, the environmental impacts of the surface-water pathway for other advanced LWRs are expected to be bounded by the ABWR and the surrogate AP1000. The environmental impacts of severe accidents for gas-cooled reactors have not been evaluated. The PPE does not contain specific parameters related to severe accidents for gas-cooled reactors, and the consequences of severe accidents for gas-cooled reactors will need to be evaluated at the CP or COL stage. For this evaluation to bound the reactor design selected at the CP or COL stage, Exelon and the staff will need to verify that the environmental impacts of the surface-water pathway releases for severe accidents at the Exelon ESP site remain bounded by the environmental impacts from the surrogate designs.

Groundwater Pathway. Neither MACCS nor MACCS2 evaluates the environmental risks associated with severe accident releases of radioactive material to groundwater. However, this pathway has been addressed in NUREG-1437 in the context of renewal of licenses for current-generation reactors (NRC 1996). NUREG-1437 assumes a 1×10^{-4} Ryr^{-1} probability of occurrence of a severe accident with a basemat melt-through leading to potential groundwater contamination, and the staff concluded that groundwater generally contributes a small fraction of the risk attributable to the atmospheric pathway. Although the staff assumed that the probability of occurrence of a release via the groundwater pathway is significantly larger than a release via the atmospheric pathway for either the ABWR or the surrogate AP1000, the groundwater pathway is more tortuous and affords more time for implementing protective actions and, therefore, results in a lower risk to the public. As a result, the staff concludes that the risks associated with releases to groundwater are sufficiently small that they would not have a significant effect on determination of suitability of the Exelon ESP site.

Summary of Severe Accident Impacts. Although Exelon chose the PPE approach in the overall ESP application, it based its evaluation of the environmental impacts of severe accidents on characteristics of the ABWR and surrogate AP1000 reactor designs with the explicit assumption that these impacts would bound the impacts of other potential designs (Exelon 2003b). The

Table 5-11. Mean Environmental Risks from ABWR Severe Accidents at the Exelon ESP Site

Release Category Description (Accident Class)		Environmental Risk						
		Core Damage Frequency (Ryr^{-1})	Population Dose (person-Sv Ryr^{-1})[a]	Fatalities (Ryr^{-1})		Cost[d] (\$ Ryr^{-1})	Land Requiring Decontamination[e] (ha Ryr^{-1})	Population Dose from Water Ingestion (person-Sv Ryr^{-1})[a]
				Early[b]	Latent[c]			
0	No loss of containment	1.34×10^{-7}	1.10×10^{-5}	0	4.76×10^{-7}	3.58×10^{-1}	2.71×10^{-6}	1.20×10^{-8}
1	Transients followed by failure of high-pressure coolant makeup and failure to depressurize in timely fashion	2.08×10^{-8}	1.59×10^{-6}	0	7.88×10^{-8}	6.45×10^{-2}	2.58×10^{-7}	2.08×10^{-9}
2	Short-term station blackout with reactor core isolation cooling (RCIC) failure, onsite power recovery in 8 hr	1.00×10^{-10}	3.80×10^{-10}	0	1.63×10^{-10}	3.82×10^{-5}	1.71×10^{-11}	1.93×10^{-12}
3	Station blackout with RCIC available for about 8 hr	1.00×10^{-10}	2.33×10^{-7}	0	1.08×10^{-8}	2.07×10^{-2}	5.05×10^{-7}	8.55×10^{-10}
4	Station blackout (more than 8 hr) with RCIC failure	1.00×10^{-10}	1.52×10^{-7}	0	6.77×10^{-9}	1.36×10^{-2}	3.54×10^{-7}	6.19×10^{-10}
5	Transients followed by failure of high-pressure coolant makeup, successful depressurization of reactor, failure of low-pressure coolant makeup	1.00×10^{-10}	6.32×10^{-8}	0	2.43×10^{-9}	1.32×10^{-2}	1.50×10^{-7}	2.05×10^{-10}
6	Transient, loss-of-coolant accident (LOCA), and anticipated transient without scram (ATWS) events with successful coolant makeup, but potential prior failure of containment	1.00×10^{-10}	7.81×10^{-7}	6.83×10^{-15}	3.51×10^{-8}	6.53×10^{-1}	1.35×10^{-5}	3.00×10^{-8}
7	Small/medium LOCA followed by failure of high-pressure coolant makeup and failure to depressurize	3.91×10^{-10}	3.24×10^{-6}	2.33×10^{-12}	1.43×10^{-7}	$2.98 \times 10^{+0}$	5.98×10^{-5}	1.51×10^{-7}
8	LOCA followed by failure of high-pressure coolant makeup	4.05×10^{-10}	4.21×10^{-6}	6.64×10^{-10}	1.84×10^{-7}	$4.78 \times 10^{+0}$	8.46×10^{-5}	3.50×10^{-7}

Table 5-11. (contd)

Release Category Description (Accident Class)	Environmental Risk: Core Damage Frequency (Ryr^{-1})	Population Dose (person-Sv Ryr^{-1})[a]	Fatalities (Ryr^{-1}): Early[b]	Latent[c]	Cost[d] (\$ Ryr^{-1})	Land Requiring Decontamination[e] (ha Ryr^{-1})	Population Dose from Water Ingestion (person-Sv Ryr^{-1})[a]
9 ATWS followed by boron injection failure and successful high-pressure coolant makeup	1.70×10^{-10}	2.28×10^{-6}	1.26×10^{-10}	1.08×10^{-7}	$2.24 \times 10^{+0}$	3.74×10^{-5}	2.50×10^{-7}
Total	1.56×10^{-7}	2.35×10^{-5}	7.93×10^{-10}	1.04×10^{-6}	$1.11 \times 10^{+1}$	1.99×10^{-4}	7.97×10^{-7}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).
(c) Latent fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990).
(e) Land risk is farm land requiring decontamination prior to resumption of agricultural usage. To convert hectares (ha) to acres, multiply by 2.47.

Table 5-12. Mean Environmental Risks from Surrogate AP1000 Severe Accidents at the Exelon ESP Site

	Release Category Description (Accident Class)	Environmental Risk						
		Core Damage Frequency (Ryr^{-1})	Population Dose (person-Sv Ryr^{-1})[a]	Fatalities (Ryr^{-1}) Early[b]	Fatalities (Ryr^{-1}) Latent[c]	Cost[d] ($ Ryr^{-1})	Land Requiring Decontamination[e] (ha Ryr^{-1})	Population Dose from Water Ingestion (person Sv Ryr^{-1})[a]
CFI	Intermediate containment failure, after core relocation but before 24 hr	1.89×10^{-10}	1.22×10^{-6}	5.67×10^{-11}	6.25×10^{-8}	4.54×10^{-1}	3.70×10^{-6}	3.31×10^{-8}
CFE	Early containment failure, after onset of core damage but before core relocation	7.47×10^{-9}	5.59×10^{-5}	3.10×10^{-9}	2.69×10^{-6}	$4.16 \times 10^{+1}$	8.74×10^{-4}	2.05×10^{-6}
IC	Intact containment	2.21×10^{-7}	1.24×10^{-5}	$0.00 \times 10^{+0}$	6.03×10^{-7}	5.81×10^{-1}	3.89×10^{-6}	2.94×10^{-8}
BP	Containment bypass, fission products released directly to environment	1.05×10^{-8}	1.43×10^{-4}	1.03×10^{-8}	7.76×10^{-6}	$1.45 \times 10^{+2}$	2.65×10^{-3}	1.31×10^{-5}
CI	Containment isolation failure occurs prior to onset of core damage	1.33×10^{-9}	9.23×10^{-6}	4.40×10^{-11}	5.11×10^{-7}	$6.08 \times 10^{+0}$	1.08×10^{-4}	3.19×10^{-7}
CFL	Late containment failure occurring after 24 hr	3.45×10^{-13}	9.97×10^{-10}	6.66×10^{-14}	5.80×10^{-11}	1.07×10^{-3}	8.59×10^{-9}	7.56×10^{-12}
Total		2.40×10^{-7}	2.21×10^{-4}	1.35×10^{-8}	1.16×10^{-5}	$1.94 \times 10^{+2}$	3.64×10^{-3}	1.35×10^{-5}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).
(c) Latent fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990).
(e) Land risk is farm land requiring decontamination prior to resumption of agricultural usage. To convert hectares (ha) to acres, multiply by 2.47.

Table 5-13. Comparison of Environmental Risks for an ABWR or a Surrogate AP1000 at the Exelon ESP site with Risks for Five Sites Evaluated in NUREG-1150[a]

	Core Damage Frequency (Ryr^{-1})	50-mi (80-km) Population Dose Risk (person-Sv Ryr^{-1})[b]	Fatalities Ryr^{-1}		Average Individual Fatality Risk Ryr^{-1}	
			Early	Latent	Early	Latent Cancer
Grand Gulf [c]	4.0×10^{-6}	5×10^{-1}	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom [c]	4.5×10^{-6}	$7 \times 10^{+0}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah [c]	5.7×10^{-5}	$1 \times 10^{+1}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry [c]	4.0×10^{-5}	$5 \times 10^{+0}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion [c]	3.4×10^{-4}	$5 \times 10^{+1}$	1×10^{-4}	2×10^{-2}	9×10^{-9}	8×10^{-9}
ABWR[d]	1.6×10^{-7}	2.4×10^{-5}	7.9×10^{-10}	1.0×10^{-6}	3.8×10^{-14}	3.9×10^{-12}
AP1000[d]	2.4×10^{-7}	2.2×10^{-4}	1.4×10^{-8}	1.2×10^{-5}	6.4×10^{-13}	5.5×10^{-11}

(a) NRC 1990.
(b) To convert person-Sv to person-rem, multiply by 100.
(c) Risks were calculated using the MACCS code and presented in NUREG-1150 (NRC 1990).
(d) Calculated with MACCS2 code using Exelon ESP site-specific input.

Table 5-14. Comparison of Environmental Risks From Severe Accidents Initiated by Internal Events for an ABWR or a Surrogate AP1000 at the Exelon ESP Site with Risks Initiated by Internal Events for Plants Undergoing Operating License Renewal Review

	Core Damage Frequency (yr^{-1})	80-km (50-mi) Population Dose Risk (person-Sv Ryr^{-1})[a]
Current Reactor Maximum[b]	2.4×10^{-4}	6.9×10^{-1}
Current Reactor Mean[b]	3.6×10^{-5}	1.5×10^{-1}
Current Reactor Median[b]	2.8×10^{-5}	1.4×10^{-1}
Current Reactor Minimum[b]	1.9×10^{-6}	5.5×10^{-3}
ABWR[c]	1.6×10^{-7}	2.4×10^{-5}
AP1000[c]	2.4×10^{-7}	2.2×10^{-4}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Based on MACCS and MACCS2 calculations for current plants undergoing operating license renewal.
(c) Calculated with MACCS2 code using Exelon ESP site-specific input.

NRC staff has reviewed the analysis in the ER and conducted its own confirmatory analysis using the MACCS2 code. The results of both the Exelon analysis and the NRC analysis indicate that the environmental risks associated with severe accidents if an advanced LWR were to be located at the Exelon ESP site would be small compared to risks associated with operation of current-generation reactors at the Exelon ESP site and other sites. These risks are well below the NRC safety goals. On these bases, the staff concludes that the probability weighted consequences of severe accidents at the Exelon ESP site are of SMALL significance for an advanced LWR and that the Exelon ESP site is suitable for operation of an advanced LWR. The environmental impacts of severe accidents have not been evaluated for gas-cooled reactors and will need to be evaluated at the CP or COL stage.

For this evaluation to bound the reactor design selected at the CP or COL stage, Exelon and the staff would need to verify that the environmental impacts of severe accidents at the Exelon ESP site remain bounded by the environmental impacts from the surrogate designs.

5.10.3 Summary of Postulated Accident Impacts

The staff evaluated the environmental impacts from DBAs and severe accidents using the ABWR and the surrogate AP1000 to characterize the environmental impacts from advanced LWRs. As described previously, preliminary information on the IRIS and the ACR-700 reactor designs indicate that the surrogate AP1000 would likely bound the source term, doses, and probability weighted consequences of design basis and severe accidents. Similarly, the ESBWR source term, doses, and probability weighted consequences of design basis and severe accidents is expected to be bounded by the ABWR.

Based on the information provided by Exelon and the staff's independent review, the staff concludes that the potential environmental impacts from a postulated accident from the operation of a new nuclear unit would be SMALL. As noted, the staff concludes that the Exelon ESP site is suitable for the operation of advanced LWRs. The staff did not explicitly evaluate the design basis or severe accident impacts for gas-cooled reactors, which will need to be evaluated at the CP or COL stage. For this evaluation to bound the reactor design selected at the CP or COL stage, Exelon and the staff would need to verify that the environmental impacts of design basis and severe accidents at the ESP site remained bounded by the environmental impacts from the ABWR and surrogate AP1000 designs.

5.11 Measures and Controls to Limit Adverse Impacts During Operation

The following general measures and controls on which the staff relied in its evaluation of environmental impacts during operation of a new nuclear unit at the Exelon ESP site include those for which Exelon would be required (at the Federal, State, and local levels) by applicable permits and authorizations (contained in Table 1.2-1 of the ER) as well as the feasible measures and controls contained in Section 5.10 of the ER (Exelon 2003b):

- Compliance with the applicable Federal, State, and local laws, ordinances, and regulations that prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emission control, noise control, storm water management, spill response and cleanup, and hazardous material management)

- Compliance with applicable requirements of permits and licenses required for operation (e.g., NPDES and IEPA permits and operating license requirements)

- Compliance with Exelon procedures applicable to environmental control and management.

Some of these permits or approvals include:

- NPDES permit requirements imposed on water discharges from the new units (ER Sections 5.2, 5.3, 5.5)

- IEPA permit limits and regulations for installing and operating air emission sources (See Appendix K)

Exelon specifically identified the following general plans or specific mitigation measures in its ER (Exelon 2003b) on which the staff relied in its evaluation:

- Noise levels will be controlled by engineering designs to operate within OSHA's noise exposure limit to workers (29 CFR 1910); Federal noise pollution control regulations (24 CFR 51); and State or local noise pollution control regulations, as applicable (35 IAC 1987). (ER Section 5.10.3.1)

- Care will be taken to control undesirable dust and exhaust emissions. Applicable air-pollution control regulations will be followed. Permits and operating certificates will be secured where required. (ER Section 5.10.3.2)

- Erosion and sedimentation controls will be implemented to retain sediment onsite to the greatest extent practicable. Erosion and sediment runoff will be controlled through the use of structural and/or stabilization practices, good housekeeping, and maintenance of sediment pond capacity. (ER Section 5.10.3.3)

- Measures such as leak detection systems and drip pans will be taken to control discharges of pollutant sources onsite and offsite from fueling stations and vehicle maintenance operations. Runoff from excavated areas and associated stockpiles will be contained or appropriately diverted. Housekeeping practices will ensure containment of onsite materials and proper treatment of trash. (ER Section 5.10.3.4)

- Local, State, and Federal traffic requirements onsite and offsite from active facility operations will be adhered to for traffic control. (ER Section 5.10.3.5)

- Transmission line right-of-way operation and maintenance activities will be conducted in a manner similar to the existing transmission facilities. (ER Section 5.10.3.6.3)

- A target for the Exelon ESP is to maintain a discharge rate within the existing CPS NPDES permit conditions in which the 0.14-m^3 (5-cfs) minimum discharge from Clinton Lake to Salt Creek will be maintained. Water quality, water temperature, and hydrology will be operated in compliance with NPDES water quality requirements and other Federal laws. (ER Sections 5.10.3.7 and 5.10.3.8; see also Section 5.3)

- Total residual chemical concentrations in the discharges to Clinton Lake from treatment to limit biological growth and for deicing and antiscaling, which are subject to limits established by IEPA, will be selected for their effectiveness and ability to minimize the impacts on water quality. The discharge-monitoring program will be revised, as necessary, to monitor for potential water quality impacts. (ER Section 5.10.3.9)

- Monitoring will be performed, as appropriate and if required, for the presence of thermophilic organisms, and the potential health risk will be evaluated during pre-application monitoring. (ER Section 5.10.3.9.4.1)

- Appropriate construction procedures and best management practices will be utilized to make certain that the adverse impacts to any environmentally sensitive areas or important habitats potentially occurring along the proposed transmission line rights-of-way are avoided. (ER Section 5.10.3.12.1)

- Ground faults will be installed to limit induced currents from the EMF given off by the transmission lines. Sufficient ground rods will be installed to reduce the resistance to 10 ohms or less under normal atmospheric conditions. (ER Section 5.10.3.12.3.4)

Exelon evaluated the measures and controls shown in Section 5.10 of the ER (Exelon 2003b) and considered them feasible from both a technical and economic standpoint. In addition, Exelon expects these measures and controls to be adequate for avoiding or mitigating potential adverse impacts associated with operation of the new units. The staff considered these measures and controls in its evaluation of station operation impacts.

5.12 Summary of Operational Impacts

Impact level categories are denoted in Table 5-15 as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts, if any. With the socioeconomic issues for which the impacts are likely to be beneficially MODERATE or LARGE, this is noted in the Comments column. The Impact column designates beneficial impacts as SMALL.

Table 5-15. Characterization of Operational Impacts at the Exelon ESP Site

Category	Comments	Impact Level
Land-use impacts		--
The site and vicinity	Operation of a new nuclear unit within existing site. Possible new housing and retail space added in vicinity due to potential growth.	SMALL
Transmission line rights-of-way	Possible construction of upgraded transmission lines in previously existing rights-of-way. Full extent of impacts can be estimated only after following FERC process for connecting new large generation to the grid.	SMALL
Air quality impacts	Cooling tower, meteorological, and transmission line impacts are expected to be negligible. Pollutants emitted during operations considered insignificant and limits could be incorporated under existing Exclusionary Permit.	SMALL
Water-related impacts		
Water use	During normal water years, the impact would be small. During critical low-water years, the impacts could be temporarily moderate.	SMALL to MODERATE
Water quality	Water effluents are regulated by IEPA and the NPDES permit.	SMALL
Ecological impacts		
Terrestrial ecosystems	Impacts from operation of a new nuclear unit, including the associated heat dissipation system, transmission lines, and rights-of-way maintenance would be SMALL.	SMALL
Aquatic ecosystems	Exelon's adherence to the NPDES permit would likely result in the maintenance of balanced aquatic populations. Potential impacts during drought years could result in increased impact level.	SMALL to MODERATE
Threatened or Endangered species	No threatened or endangered terrestrial or Aquatic species known to inhabit area.	SMALL

Table 5-15. (contd)

Category	Comments	Impact Level
Socioeconomic impacts		
Physical impacts		
Workers/public	Workers would use protective equipment, receive training to mitigate any possible impact, and meet applicable Federal/State regulations. Exelon ESP site is relatively remote, the public would not be impacted.	SMALL
Buildings	No anticipated impact to onsite or offsite buildings.	SMALL
Roads	Roads are two-lane, rural, and lightly traveled and would not be substantially impacted by operational workforces.	SMALL
Aesthetics	Visual impact would be minimal due to remote location and sparse population. Visual impacts of operation would be similar to those existing. Could be moderate during severe drought due to consumptive water use.	SMALL to MODERATE
Demography	Number of new employees small in proportion to population base.	SMALL
Impacts to Community - Social and Economic		
Economy	Increased jobs would benefit the area economically, up to a moderate beneficial impact, possibly in DeWitt County.	SMALL to MODERATE
Taxes	Depends on residence location; generally, impacts would be beneficial, especially for property taxes and employment. The impacts to the City of Clinton could be moderate due to its close proximity to the Exelon ESP site.	SMALL to LARGE
Impacts to Community - Infrastructure and Community		
Transportation	Most local roadways are rural, lightly traveled, and well-maintained.	SMALL
Recreation	Overall impacts to recreation minimal. Traffic around and use of lake could increase. Lower water levels, and their effect on shoreline exposure and recreational usage during severe drought, could temporarily impact area, probably at the MODERATE level.	SMALL to MODERATE

Table 5-15. (contd)

Category	Comments	Impact Level
Housing	Adequate housing is available to handle operational workers if Exelon's assumptions on workforce are correct. DeWitt, Piatt, and Logan Counties could have a temporary housing shortage, possibly at the MODERATE impact level.	SMALL to MODERATE
Public Services	Adequate in all counties for any population increase due to operation workforce.	SMALL
Education	Majority of workers are expected to be from within the region. Current schools could handle any additional students.	SMALL
Historic and cultural resources	A cultural resource procedure is in place for minimizing impacts from routine land disturbances.	SMALL
Environmental justice	No unusual resource dependence in the area.	SMALL
Nonradiological health impacts	Small estimated lake temperature increase would not significantly increase abundance of thermophilic microorganisms. Health impacts of noise, EMF, and occupational injuries would be monitored and controlled in accordance with OSHA regulations.	SMALL
Radiological health impacts	Doses to the public and occupational workers would be monitored and controlled in accordance with NRC limits.[a]	SMALL
Impacts of postulated accidents		--
Design basis accidents	Doses for new advanced LWRs are expected to be a small fraction of the regulatory dose limits. Staff would verify that doses for postulated DBAs on chosen reactor designs are within regulatory limits.	SMALL
Severe accidents	Risks would be small.	SMALL

(a) The International Council on Radiation Protection (ICRP 1977; ICRP 1990) states that if humans are adequately protected, other living things are also likely to be sufficiently protected.

5.13 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 Regulatory Functions."

10 CFR Part 100. Code of Federal Regulations, Title 10, Energy, Part 100, "Reactor Site Criteria."

18 CFR Part 35. Code of Federal Regulations, Title 18, *Conservation of Power and Water Resources*, Part 35, "Filing of Rate Schedules and Tariffs."

24 CFR Part 51. Code of Federal Regulations, Title 24, *Housing and Urban Development*, Part 51, "Environmental Criteria and Standards."

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property on Historic Preservation*, Part 800, "Protection of Historic Properties."

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40 CFR Part 124. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 124, "Procedures for Decisionmaking."

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6.0 Fuel Cycle, Transportation, and Decommissioning

This chapter addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) transportation of radioactive material, and (3) decommissioning for a new nuclear unit at the early site permit (ESP) site. Distinctions between the impacts of advanced light water reactor (LWR) designs and the gas-cooled reactor designs are discussed.

In its evaluation of uranium fuel cycle impacts from a new nuclear unit at the ESP site, Exelon Generation Company, LLC (Exelon) used the plant parameter envelope (PPE) approach for the advanced LWR designs but not for the two gas-cooled reactors. In its evaluation of the impacts from transportation of radioactive materials, however, Exelon did not use the PPE approach but rather evaluated each reactor design individually. Exelon would, therefore, have to perform a new evaluation if a different design is proposed at the construction permit (CP) or combined CP and operating license (combined operating license or COL) stage.

6.1 Fuel Cycle Impacts and Solid Waste Management

This section discusses the environmental impacts from the uranium fuel cycle and solid waste management for both the advanced LWR designs and gas-cooled reactor designs. The impacts of the two types of design are presented separately because Title 10 of the Code of Federal Regulations (CFR), Section 51.51 (10 CFR 51.51) provides specific criteria for evaluating the environmental impacts only for LWR designs.

6.1.1 Light-Water Reactors

The regulations in 10 CFR 51.51(a) state that

> Every environmental report prepared for the construction permit stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S-3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S-3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The PPE for a new nuclear unit at the Exelon ESP site uses the bounding input parameters from the following LWR designs:

- Advanced Canada Deuterium Uranium Reactor (ACR-700) – This reactor, developed by Atomic Energy Canada Limited, is an evolutionary extension of CANDU 6 plant using very slightly enriched uranium fuel and light water coolant.

- Advanced Boiling Water Reactor (ABWR) – This reactor, developed by General Electric Company, is a standardized plant that has been certified under the NRC requirements in 10 CFR Part 52. The ABWR is fueled with slightly enriched uranium and uses a light water cooling system.

- Advanced Pressurized Water Reactor (AP1000) – This is an earlier version of the AP1000 reactor final design developed by Westinghouse Electric Company and subsequently approved by the U.S. Nuclear Regulatory Commission (NRC), using slightly enriched uranium and a light water cooling system. This design is not the AP1000 that has received final design approval from the NRC; therefore, this design will be referred to as the "surrogate AP1000."

- Economic Simplified Boiling Water Reactor (ESBWR) – This reactor, developed by General Electric Company, is fueled with slightly enriched uranium and uses a light water cooling system.

- International Reactor Innovative and Secure (IRIS) next-generation pressurized water reactor (PWR) – This reactor, under development by a consortium led by Westinghouse Electric Company, is a modular LWR.

These light water designs all use uranium dioxide fuel; therefore, Table S-3 can be used to assess environmental impacts. Table S-3 values are normalized for a reference 1000-MW(e) LWR at an 80-percent capacity factor. The 10 CFR 51.51(a) Table S-3 values are reproduced in Table 6-1. The PPE power rating for the Exelon ESP site is 6800 MW(t), assuming that two AP1000 units would be located on the ESP site with a PPE capacity factor of 95 percent (Exelon 2003), which corresponds to 2200 MW(e).

Specific categories of natural resource use are included in Table S-3 (see Table 6-1). These categories relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high-level and low-level wastes, and radiation doses from transportation and occupational exposures. In developing Table S-3, the staff considered two fuel cycle options, which differed in the treatment of spent fuel removed from a reactor. "No recycle" treats all spent fuel as waste to be stored at a Federal waste repository; "uranium only recycle" involves reprocessing spent fuel to recover unused uranium and return it to the system. Neither cycle involves the recovery of plutonium. The contributions in Table S-3 resulting from

Table 6-1. Table of Uranium Fuel Cycle Environmental Data[1] (Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor-Year [NUREG-0116]) (see footnotes at the end of this table)

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1000 MWe LWR
Natural Resource Use		
Land (acres):		
Temporarily committed[2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 100 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hr)	323	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of standard cubic feet)	135	<0.4 percent of model 1,000 MWe energy output.
Effluents--Chemical (MT)		
Gases (including entrainment):[3]		
SO_x	4,400	
NO_x[4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	

Table 6-1. (continued) Table of Uranium Fuel Cycle Environmental Data[1] (Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor-Year [NUREG-0116])
(see footnotes at the end of this table)

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Liquids:		
SO^{-}_{4}	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs., NO_3—20 cfs., Fluoride—70 cfs.
NO^{-}_{3}	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
$C1^{-}$	8.5	
Na^{+}	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills-no significant effluents to environment.
Effluents--Radiological (curies)		
Gases (including entrainment):		
Rn-222	......	Presently under reconsideration by the Commission.
Ra-226	.02	
Th-230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.83	
Tc-99	......	Presently under consideration by the Commission.
Fission products and transuranics	.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226	.0034	From UF_6 production.
Th-230	.0015	
Th-234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{6}	
Solids (buried on site):		

Table 6-1. (continued) Table of Uranium Fuel Cycle Environmental Data(1) (Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor-Year [NUREG-0116]) (see footnotes at the end of this table)

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^7	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

1 In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S—3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH—1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG—0116 (Supp.1 to WASH—1248, NRC 1976); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG—0216 (Supp. 2 to WASH—1248) (NRC 1977b); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM—50—3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S—4 of Sec. 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S—3A of WASH-1248.

2 The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

3 Estimated effluents based upon combustion of equivalent coal for power generation.

4 1.2 percent from natural gas use and process.

reprocessing, waste management, and transportation of wastes are maximized for both of the two fuel cycles (uranium only and no recycle); that is, the identified environmental impacts are based on the cycle that results in the greater impact. The uranium fuel cycle is defined as the total of those operations and processes associated with provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

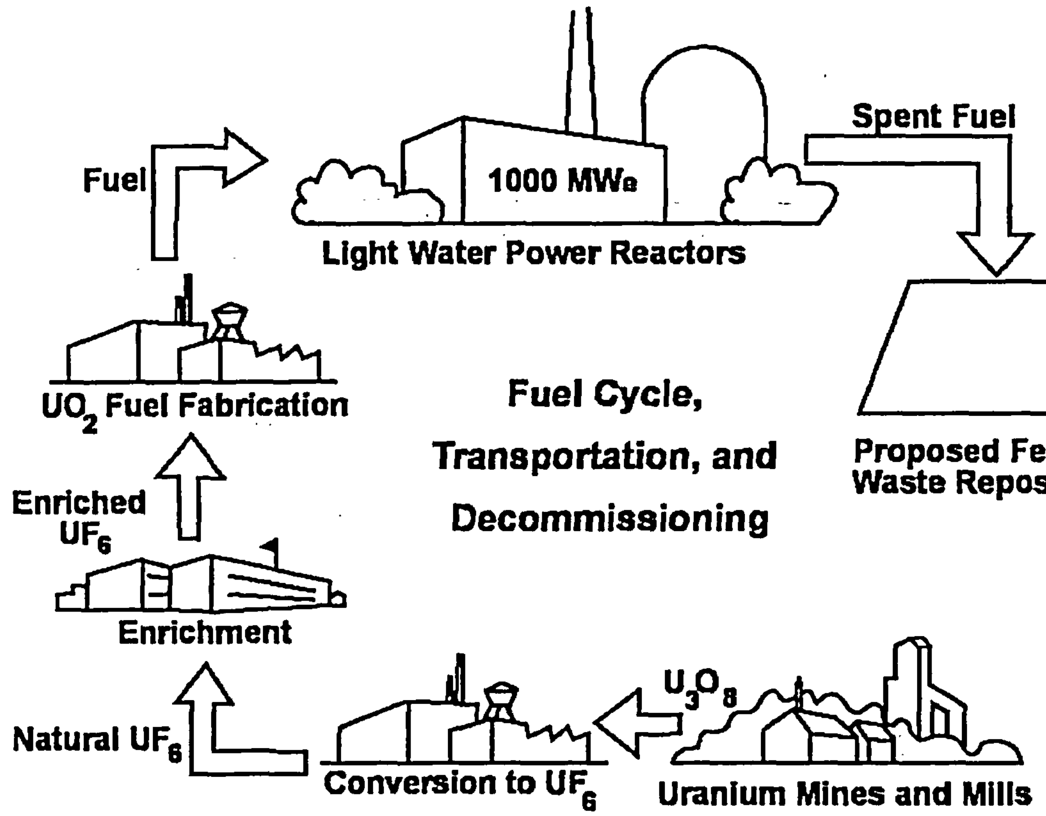

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (derived from NRC 1999)

Because current Federal policy does not support reprocessing spent fuel, only the no-recycle option is considered here. This option is presented schematically in Figure 6-1. Natural uranium is mined in either open-pit or underground mines or by an in situ leach solution mining process. In situ leach mining, the primary form of mining in the United States today, involves injecting a lixiviant solution into the uranium ore body to dissolve uranium and then pumping the solution to the surface for further processing. The ore or in situ leach solution is transferred to mills where it is processed to produce uranium oxide (UO_2) or "yellowcake." A conversion facility prepares the uranium oxide from the mills for enrichment by converting it to uranium hexafluoride, which is then processed to separate the relatively nonfissile isotope uranium-238 from the more fissile isotope uranium-235. At a fuel-fabrication facility, the enriched uranium, which is approximately 5 percent uranium-235, is then converted to UO_2. The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies. The fuel assemblies are placed in the reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reactor has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor. After onsite storage for sufficient time to allow for short-lived fission product decay and to reduce the heat generation rate, the fuel assemblies would be transferred to a waste repository for internment. Disposal of spent fuel elements in a repository constitutes the final step in the no-recycle option.

The following assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project is based on the values given in Table S-3 (see Table 6-1) and the staff's analysis of the radiological impact from radon-222 and technetium-99. In NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996),[a] the staff provides a detailed analysis of the environmental impacts from the uranium fuel cycle. Although NUREG-1437 is specific to the impacts related to license renewal, the information is relevant to this review because the advanced LWR designs considered here use the same type of fuel; the staff's analyses in Section 6.2.3 of NUREG-1437 are summarized and set forth here.

The fuel cycle impacts in Table S-3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). In the following review and evaluation of the environmental impacts of the fuel cycle, the staff considered the capacity factor in the PPE of 95 percent with a total net electric output of 2200 MW(e) for a new nuclear unit at the ESP site (Exelon 2003); this is approximately three times the impact values in Table S-3 (see Table 6-1). Throughout this chapter, this will be referred to as the 1000-MW(e) LWR-scaled model, reflecting 2200 MW(e) for the site.

Recent changes in the fuel cycle may have some bearing on environmental impacts; however, as discussed below, the staff is confident that the contemporary fuel cycle impacts below are those identified in Table S-3.

The values in Table S-3 were calculated from industry averages for the performance of each type of facility or operation within the fuel cycle. Recognizing that this approach meant that there would be a range of reasonable values for each estimate, the staff followed the policy of choosing the assumptions or factors to be applied so that the calculated values would not be under-estimated. This approach was intended to ensure that the actual environmental impacts would be less than the quantities shown in Table S-3 for all LWR nuclear power plants within the widest range of operating conditions. Many subtle fuel cycle parameters and interactions were recognized by the staff as being less precise than the estimates and were not considered or were considered but had no effect on the Table S-3 calculations. For example, to determine the quantity of fuel required for a year's operation of a nuclear power plant in Table S-3, the staff defined the model reactor as a 1000-MW(e) light water cooled reactor operating at

(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.

80-percent capacity with a 12-month fuel reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a "reactor reference year" or "reference reactor-year" depending on the source (either Table S-3 or NUREG-1437), but it has the same meaning. The sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by the now more likely 60-year (40-year initial license term and 20-year license renewal term) lifetime to obtain an average annual fuel requirement. This was done in NUREG-1437 for both boiling water reactors (BWRs) and PWRs; the higher annual requirement, 35 metric tonnes (MT) of uranium made into fuel for a BWR, was chosen in NUREG-1437 as the basis for the reference reactor-year. A number of fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. Since Table S-3 was promulgated, these improvements have reduced the annual fuel requirement.

Another change is the elimination of the U.S. restrictions on the importation of foreign uranium. The economic conditions of the uranium market now and in the foreseeable future favor full utilization of foreign uranium at the expense of the domestic uranium industry. These market conditions have forced the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from these activities. However, the Table S-3 estimates have not been reduced accordingly to ensure that these impacts, which have been experienced in the past and may be fully experienced again in the future, are considered. Factoring in changes to the fuel cycle suggests that the environmental impacts of mining and tail millings could drop to levels below those given in Table S-3.

Section 6.2 of NUREG-1437 discusses the sensitivity to recent changes in the fuel cycle on the environmental impacts in greater detail.

6.1.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1000-MW(e) LWR-scaled model is about 138 ha (339 ac). Approximately 15 ha (39 ac) are permanently committed land, and 123 ha (300 ac) are temporarily committed. A "temporary" land commitment is a commitment for the life of the specific fuel cycle plant (e.g., a mill, enrichment plant, or succeeding plants). Following completion of decommissioning, such land can be released for unrestricted use. "Permanent" commitments represent land that may not be released for use after plant shutdown and decommissioning because decommissioning activities do not result in removal of sufficient radioactive material to meet the limits in 10 CFR Part 20, Subpart E for release of that area for unrestricted use. Of the 123 ha (300 ac) of temporarily committed land, 96 ha (237 ac) are undisturbed and 27 ha (66 ac) are disturbed. In comparison, a coal-fired power plant of 2200-MW(e) capacity using strip-mined coal requires the disturbance of about 243 ha (600 ac) per year for fuel alone. The staff concludes that the impacts on land use to support the 1000-MW(e) LWR-scaled model would be small.

6.1.1.2 Water Use

Principal water use for the fuel cycle supporting a 1000-MW(e) LWR-scaled model is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Scaling from Table S-3, of the total annual water use of 1.29×10^8 m^3 (3.42×10^{10} gal), about 1.26×10^8 m^3 (3.33×10^{10} gal) are required for the removal of waste heat, assuming that a new nuclear unit uses once-through cooling. Other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 1.8×10^6 m^3/yr (4.75×10^8 gal/yr) and water discharged to ground (e.g., mine drainage) of about 1.5×10^6 m^3/yr (3.96×10^8 gal/yr).

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are about 4 percent of the 1000-MW(e) LWR-scaled model using once-through cooling. The consumptive water use of 1.8×10^6 m^3/yr (4.8×10^8 gal/yr) is about 2 percent of the 1000-MW(e) LWR-scaled model using cooling towers. The maximum consumptive water use (assuming that all plants supplying electrical energy to the nuclear fuel cycle use cooling towers) would be about 6 percent of the 1000-MW(e) LWR-scaled model using cooling towers. Under this condition, thermal effluents would be negligible. The staff concludes that the impacts on water use for these combinations of thermal loadings and water consumption would be small.

6.1.1.3 Fossil Fuel Impacts

Electric energy and process heat are required during various phases of the fuel cycle process. The electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy associated with the fuel cycle represents about 5 percent of the annual electric power production of the reference 1000-MW(e) LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the scaled model plant. The staff concludes that the fossil fuel impacts from the direct and indirect consumption of electric energy for fuel cycle operations would be small relative to the net power production of the proposed project.

6.1.1.4 Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents with fuel cycle processes are given in Table S-3 (see Table 6-1) for the reference 1000-MW(e) LWR. The quantities of effluents would be approximately three times greater for the reference 1000-MW(e) LWR-scaled model. The principal effluents are SO_x, NO_x, and particulates. Based on data in the *Seventh Annual Report of the Council on Environmental Quality*, these emissions constitute a small additional atmospheric loading in comparison with emissions from the stationary fuel combustion and transportation sectors in the United States, which is about 0.06 percent of the annual national releases for each of these effluents (CEQ 1976).

Liquid chemical effluents produced in fuel cycle processes are related to fuel enrichment and fabrication and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table S-3 (see Table 6-1) specifies the amount of dilution water required for specific constituents. Additionally, all liquid discharges into the navigable waters of the United States from plants associated with the fuel cycle operations will be subject to requirements and limitations set by an appropriate Federal, State, regional, local, or Tribal regulatory agency.

Tailings solutions and solids are generated during the milling process and are not released in quantities sufficient to have a significant impact on the environment.

The staff determined that the impacts of these chemical effluents would be small.

6.1.1.5 Radioactive Effluents

Radioactive effluents estimated to be released to the environment from waste management activities and certain other phases of the fuel cycle process are set forth in Table S-3 (see Table 6-1). Using these data, the staff has calculated the 100-year environmental dose commitment to the U.S. population from the LWR-supporting fuel cycle for one year of operation of the 1000-MW(e) LWR-scaled model. This calculation estimates that the overall whole body gaseous dose commitment to the U.S. population from the fuel cycle (excluding reactor releases and the dose commitments due to radon-222 and technetium-99) would be approximately 12 person-Sv (1200 person-rem) per year of operation of the 1000-MW(e) LWR-scaled model; this reference reactor-year is scaled to reflect the total electric power rating for the site for a year.

The additional whole body dose commitment to the U.S. population from radioactive liquid effluents due to all fuel cycle operations other than reactor operation would be approximately 6 person-Sv (600 person-rem) per year of operation of the 1000-MW(e) LWR-scaled model. Thus, the estimated 100-year environmental dose commitment to the U.S. population from radioactive gaseous and liquid releases due to these portions of the fuel cycle is approximately 18 person-Sv (1800 person-rem) to the whole body per reference reactor-year.

Currently, the radiological impacts associated with radon-222 and technetium-99 release are not addressed in Table S-3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. Exelon provided an assessment of radon-222 and technetium-99 in its response to a request for additional information on December 13, 2004 (Exelon 2004a). This evaluation relied on the information discussed in NUREG-1437 (NRC 1996).

In Section 6.2 of NUREG-1437 (NRC 1996), the staff estimated the radon-222 releases from mining and milling operation, and from mill tailings for each year of operations of the reference 1000-MW(e) LWR. The estimated releases of radon-222 for the reference reactor-year for the 1000-MW(e) LWR-scaled model, or for the total electric power rating for the site for a year, is approximately 5.8×10^{14} Bq (15,600 Ci). Of this total, about 78 percent would be from mining, 15 percent from milling operations, and 7 percent from inactive tails before stabilization. For radon releases from stabilized tailings, the staff assumed that the scaled model would result in an emission of 1.1×10^{11} Bq (3 Ci) per site year; i.e., three times the NUREG-1437 estimate for the reference reactor-year. The major risks from radon-222 are from exposure to the bone and the lung, although there is a small risk from exposure to the whole body. The organ-specific dose weighting factors from 10 CFR Part 20 were applied to the bone and lung doses to estimate the 100-year dose commitment from radon-222 to the whole body. The estimated 100-year environmental dose commitment from mining, milling, and tailings before stabilization for each site year (assuming the 1000-MW(e) LWR-scaled model) would be approximately 28 person-Sv (2800 person-rem) to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 0.52 person-Sv (52 person-rem) to the whole body. Additional insights regarding National policy/resource perspectives regarding institutional controls comparisons with routine radon-222 exposure and risk and long-term releases from stabilized tailing piles are discussed in NUREG-1437 (NRC 1996).

Also as discussed in NUREG-1437, the staff considered the potential health effects associated with the releases of technetium-99. The estimated releases of technetium-99 for the reference reactor-year for the 1000-MW(e) LWR-scaled model are 7.4×10^8 Bq (0.02 Ci) from chemical processing of recycled uranium hexafluoride before it enters the isotope enrichment cascade and 5.5×10^8 Bq (0.015 Ci) into the groundwater from a repository. The major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney although there is a small risk from exposure to the whole body. Applying the organ-specific dose weighting factors from 10 CFR Part 20 to the gastrointestinal tract and kidney doses, the total-body 100-year dose commitment from technetium-99 to the whole body was estimated to be 3 person-Sv (300 person-rem) for the 1000-MW(e) LWR-scaled model.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). This coefficient was multiplied by the sum of the estimated whole body population doses discussed above, approximately 49 person-Sv/yr (4900 person-rem/yr), to calculate that the U.S. population would incur a total of approximately 3.6 fatal cancers, nonfatal cancers, and severe hereditary effects annually. This risk is quite small compared to the number of fatal cancers, nonfatal cancers, and severe hereditary effects that would be estimated to the U.S. population annually from exposure to natural sources of radiation using the same risk estimation method.

Radon releases from tailings are indistinguishable from background radiation levels at a few km from the tailings pile (at less than one km in some cases) (NRC Docket 50-488 1986). The public dose limit in the U.S. Environmental Protection Agency (EPA)'s regulation, 40 CFR Part 190, is 0.25 mSv/yr (25 mrem/yr) to the whole body from the entire fuel cycle, but most NRC licensees have airborne effluents resulting in doses of less than 0.01 mSv/yr (1 mrem/yr) (61 FR 65120).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published, "Cancer in Populations Living Near Nuclear Facilities," in 1990 (NCI 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the U.S. in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990). The contribution to the annual average dose received by an individual from the fuel cycle-related radiation and other sources as reported in NCRP Report 93 (NCRP 1987) is listed in Table 6-2. The nuclear fuel cycle contribution to an individual's annual average radiation dose is extremely small (less than 0.01 mSv [1 mrem] per year).

Based on the analyses presented above, the staff concludes that the environmental impacts of radioactive effluents from the fuel cycle are small.

Table 6-2. Comparison of Annual Average Dose Received by an Individual from All Sources. Source: NCRP Report 93, *Ionizing Radiation Exposure of the Population of the United States* (NCRP 1987)

Source	Dose (mSv/yr)[a]	Percent of Total
Natural		
Radon	2	55
Cosmic	0.27	8
Terrestrial	0.28	8
Internal (body)	0.39	11
Total natural sources	3	82
Artificial		
Medical x-ray	0.39	11
Nuclear medicine	0.14	4
Consumer products	0.10	3
Total artificial sources	0.63	18
Other		
Occupational	0.009	<0.30
Nuclear fuel cycle	<0.01	<0.03
Fallout	<0.01	<0.03
Miscellaneous sources	<0.01	<0.03

(a) To convert mSv/yr to mrem/yr, multiply by 100.

6.1.1.6 Radioactive Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) are specified in Table S-3 (see Table 6-1). For low-level waste disposal at land burial facilities, the Commission notes in Table S-3 that there will be no significant radioactive releases to the environment. For high-level and transuranic wastes, the Commission notes that these are to be buried at a repository, such as the candidate repository at Yucca Mountain, and that no release to the environment is expected to be associated with such disposal, although it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG-0116 (NRC 1976), which provides background and context for the high-level and transuranic Table S-3 values established by the Commission, the staff indicates that these high-level and transuranic wastes will be buried and will not be released to the environment.

On February 15, 2002, subsequent to receipt of a recommendation by Secretary Abraham, U.S. 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 high-level nuclear waste.

The EPA developed Yucca Mountain-specific repository standards, which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000-year period. The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63.

Therefore, for the high-level waste and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, before promulgation of the affected provisions of the Commission's regulations, the staff assumed that limits were developed along the lines of the 1995 National Academy of Sciences 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 that will comply with such limits, with peak doses to virtually all individuals of 100 millirem (1 mSv) per year or less (NAS 1995; NRC 1996).

Despite the current uncertainty with respect to these rules, some judgment as to the regulatory NEPA implications of offsite radiological impacts of spent fuel and high-level waste disposal should be made. The staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the National Environmental Policy Act of 1969 (NEPA) conclusion that the construction and operation of a new nuclear unit at the ESP site should be denied.

Section 6.2 of NUREG-1437 (NRC 1996) describes the generation, storage, and ultimate disposal of low-level waste, mixed waste, and spent fuel from power reactors. For the reasons stated above, the staff concludes that the environmental impacts of radioactive waste disposal are small.

6.1.1.7 Occupational Dose

In the review and evaluation of the environmental impacts of the fuel cycle, the staff considered the higher capacity factor in the PPE of 95 percent with a total net electric output of 2200 MW(e) for a new nuclear unit at the ESP site (Exelon 2003). This is referred to as the 1000-MW(e) LWR-scaled model. The annual occupational dose attributable to all phases of the fuel cycle for the 1000-MW(e) LWR-scaled model is about 18 person-Sv (1800 person-rem). Occupational doses would be maintained to meet 10 CFR Part 20. On this basis, the staff concludes that environmental impacts from this occupational dose would be small.

6.1.1.8 Transportation

The transportation dose to workers and the public totals about 0.25 person-Sv (25 person-rem) annually for the reference 1000-MW(e) LWR per Table S-3 (see Table 6-1). This corresponds to a dose of 0.75 person-Sv (75 person-rem) for the 1000-MW(e) LWR-scaled model. For comparative purposes, the estimated collective dose from natural background radiation to the population within 80 km (50 mi) of the Exelon ESP site is 2300 person-Sv/yr (230,000 person-rem/yr) (Exelon 2003). On the basis of this comparison, the staff concludes that environmental impacts of transportation would be small.

6.1.1.9 Conclusion

The staff evaluated the environmental impacts of the uranium fuel cycle as given in Table S-3 (see Table 6-1), considered the effects of radon-222 and technetium-99, and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. Based on this evaluation, the staff concludes that the impacts would be SMALL and that mitigation would not be warranted.

6.1.2 Gas-Cooled Reactors

Table S-3 from 10 CFR 51.51(b) (reproduced here as Table 6-1) can be used as a basis for bounding the environmental impacts from the uranium fuel cycle only for LWRs. Exelon performed an assessment of the environmental impacts of the fuel cycle for gas-cooled reactor designs by comparing key parameters for these reactor designs to those used to generate the impacts in Table S-3 (Exelon 2003). Key parameters are energy usage, material involved, and number of shipments for each major fuel cycle activity (i.e., mining, milling, conversion, enrichment, fuel fabrication, and radioactive waste disposal). Exelon sought to demonstrate in its ER that the impacts for the gas-cooled reactor designs were comparable to the environmental impacts identified in the technical basis document, WASH-1248, "Environmental Summary of the Uranium Fuel Cycle" (AEC 1974) and its Supplement 1 (NUREG-0116) (NRC 1976) for Table S-3.

As discussed in Section 6.1, the fuel cycle impacts in Table S-3 (see Table 6-1) were based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). This is termed the "reference reactor-year." For the purposes of evaluating fuel cycle impacts for a new nuclear unit at the Exelon ESP site, it was assumed that the additional LWR site-wide fuel impacts would be based on a total net electric output of 2300 MW(e) at 95 percent annual capacity factor. This was termed the 1000-MW(e) LWR-scaled model and resulted in a factor about three times (i.e., 2200/800) the impacts in Table S-3.

One of the other-than-LWRs considered by Exelon, the Gas Turbine-Modular Helium Reactor (GT-MHR), is a four-module, 2400-MW(t), nominal 1140-MW(e) unit assumed to operate at an annual capacity factor of 88 percent for a net electric output of 1032 MW(e). Therefore, the maximum number of GT-MHR units that could be sited at the Exelon ESP site and remain below the 2200-MW(e) total net electric output PPE for the site is two (i.e., 2 x 1032). This would result in a factor of 2.5 (i.e., 2064/800) for comparison with Table S-3 and LWRs.

The second other-than-LWR considered by Exelon, the Pebble Bed Modular Reactor (PBMR), is an eight module, 3200-MW(t), nominal 1320-MW(e) unit assumed to operate at an annual capacity factor of 95 percent for a net electric output of 1253 MW(e). Therefore, the comparable number of PBMR units to remain below the 2200-MW(e) total net electric output PPE for the site is one (i.e., 1 x 1253); it would result in a factor of about 1.5 (i.e., 1253/800) for comparison with Table S-3 and LWRs.

Exelon (2003) compared the impacts in Table S-3 LWR with those of the gas-cooled reactor designs. The comparison used an annual fuel loading as a starting point and then proceeded in reverse direction through the fuel cycle (i.e., fuel fabrication, enrichment, conversion, milling, mining, radioactive waste). Table 6-3 provides an estimate of the impacts for each phase of the uranium fuel cycle, assuming that the ESP site would host two GT-MHR units or one PBMR unit with the multiplier factors described above.

6.1.2.1 Fuel Fabrication

The quantity of UO_2 required for reactor fuel is a key parameter. The more UO_2 required, the greater the environmental impacts (i.e., more energy, greater emissions, and increased water usage). The 1000-MW(e) LWR-scaled model described in Section 6.1.1 would require the equivalent of 120 MT of enriched UO_2 annually. This compares to 14.3 to 15.3 MT of enriched UO_2 annually for the gas-cooled reactor technologies.

GT-MHR fuel consists of microspheres of uranium oxycarbide coated with multiple layers of pryrocarbon and silicon carbide referred to as TRISO coating. Two types of microspheres are used in the GT-MHR fuel, one enriched to 19.8 percent uranium-235 and one with natural uranium. The microspheres and graphite shims are bound together into a rod-shaped compact, which is stacked into graphite blocks referred to as fuel elements. A reactor core consists of 1020 fuel elements.

Table 6-3. Fuel Cycle Environmental Impacts from Gas-Cooled Reactor Designs for the Exelon ESP Site[(a)]

Reactor Technology Facility/Activity	GT-MHR, 4 Modules (2400 MW[t] total ≈1140 MW[e] total; 88 percent capacity: multiplier=2.5)	PBMR, 8 Modules (3200 MW[t] total ≈1320 MW[e] total; 95 percent capacity: multiplier=1.5)
Mining Operations		
Annual ore supply (MT)	842,850	505,710
Milling Operations		
Annual yellowcake (MT)	758	455
UF_6 Production		
Annual UF_6 (MT)	948	659
Enrichment Operations		
Enriched UF_6 (MT)	20	18
Annual separative work units (MT)	510	291
Fuel Fabrication Plant Operations		
Enriched UO_2 (MT)	15.3	14.3
Annual fuel loading (MTU)	13.5	12.5
Solid Radioactive Waste		
Annual low-level waste from reactor operations (Ci)	2750 Ci[(b)]; 245 m^3	98 Ci[(b)];1200 drums
Low-level waste from reactor decontamination and decommissioning (Ci per reference reactor-year)	Data not available	Data not available

(a) Values calculated by multiplying values from Table 5.7-1 of ER (Exelon 2003) by multiplier.

Notes:

- The enrichment separative work units (SWU) calculation was performed using the United States Enrichment Corporation, Inc. SWU calculator and assumes a 0.30 percent tails assay.
- The information on the reference reactor (mining, milling, UF_6, enrichment, fuel fabrication values) was taken from NUREG-0116, Table 3.2, no recycling (NRC 1976).
- The information on the reference reactor (solid radioactive waste) was taken from 10 CFR 51.51, Table S–3.
- The calculated information on the reference reactor uses the same methodology as for the reactor technologies.
- The normalized information is based on 1000 MW(e) and the reactor vendor-supplied unit capacity factor.
- For the new reactor technologies, the annual fuel loading was provided by the reactor vendor.
- The SWU calculator also calculated the kilograms of uranium feed. This number was multiplied by 1.48 to get the necessary amount of UF_6.
- The annual yellowcake number was generated using the relationship 2.61285 lb. of U_3O_8 to 1 kg U of UF_6; 1.185 kg of U_3O_8 to 1.48 kg.
- The annual ore supply was generated assuming an 0.1 percent ore body and a 90 percent recovery efficiency.
- Cobalt-60 with a 5.26-yr half-life and Iron-55 with a 2.73-yr half-life are the main nuclides listed for the PBMR decontamination and decommissioning waste.

(b) To convert from Ci to Bq, multiply by 3.7×10^{10}.

PBMR fuel consists of UO_2 kernels (enriched to 12.9 percent uranium-235) that are TRISO coated, similar to the GT-MHR fuel. The TRISO-coated particles are imbedded into a graphite matrix to form a fuel sphere that is 60 millimeters in diameter. Each fuel sphere contains approximately 15,000 TRISO-coated particles. Approximately 260,000 fuel spheres make up a core of a single reactor module.

The fuel described above for gas-cooled reactors is fabricated differently than fuel for LWRs. There are no currently operating large-scale fuel fabrication facilities producing gas-cooled reactor fuels in the United States; thus, a direct comparison of environmental impacts is not possible. Based on some environmental impacts from a small-scale fuel fabrication facility producing gas-cooled reactor fuel, Exelon concluded that the environmental impacts from producing gas-cooled reactor fuel would be "not inconsistent" with those of LWRs (Exelon 2003). By comparison with the fuel fabrication impacts for LWR technologies, the staff concludes that the environmental impacts from producing gas-cooled reactor fuel likely would be small, but these impacts will need to be assessed at the CP or COL stage, when the staff will consider the environmental data that is available on a large-scale, fuel fabrication facility for gas-cooled reactors.

6.1.2.2 Enrichment

Exelon (2003) identified two quantities of interest for enrichment. These were (1) the amount of energy required to enrich the fuel measured in separative work units (SWUs), and (2) the amount of uranium hexafluoride (UF_6) needed. A SWU is a measure of energy required to enrich the fuel. The major environmental impacts for the entire uranium fuel cycle are from the emissions of the fossil fuel plants used to supply energy for the gaseous diffusion plants that enrich the uranium. An enrichment technology developed since the impacts in Table S-3 (see Table 6-1) were developed and evaluated includes the gas centrifuge process that uses 90 percent less energy than the gaseous diffusion process.

To produce 120 MT of enriched UO_2 for the 1000-MW(e) LWR-scaled model, the enrichment plant needs to produce about 156 MT of UF_6, which requires approximately 400 MT of SWUs (Exelon 2003). For gas-cooled reactor technologies, the needed enriched UF_6 ranges from 18 to 20 MT of UF_6. The amount of energy to produce these quantities of enriched UF_6 for the gas-cooled reactor designs range from 291-510 MT of SWU. The upper range is up to 30 percent higher than the energy required for the reference LWR. Exelon (2003) concluded that the large reduction in energy associated with using an alternate enrichment technology (e.g., centrifuge) and its associated environmental impacts would more than offset the increase in SWUs. The staff concludes that, on balance, the environmental impacts of enriching gas-cooled fuels by comparison with the impacts of enriching LWR fuel would likely be small, but these impacts will need to be assessed at the CP or COL stage, when the staff will consider impacts from the enrichment technology in use at that time.

6.1.2.3 Uranium Hexafluoride Production – Conversion

There are two uranium conversion processes: a wet and a dry process. In NUREG-1437 (NRC 1996), the NRC stated that environmental releases from the conversion facilities are small compared to the overall fuel cycle impacts and that changing from 100 percent use of one process to 100 percent use of the other would make no significant difference in the overall impacts. Conversion technologies that would be used today to produce UF_6 are similar to those considered when determining the environmental impacts that are part of Table S-3 of 10 CFR 51.51(b) (see Table 6-1).

The conversion facility would need to produce 1080 MT of UF_6 annually for the reference 1000-MW(e) LWR-scaled model, compared to 569 to 948 MT of UF_6 for the gas-cooled reactors based on the SWU calculator (Exelon 2003; see Table 6-3, note a, above). The other-than-LWR values are comparable to the amount of UF_6 required for the LWR; therefore, the associated environmental impacts are expected to be comparable. On this basis, the staff concludes that the environmental impacts from producing UF_6 for gas-cooled reactors would be small.

6.1.2.4 Uranium Milling

Annual yellowcake (U_3O_8) production is the metric of interest for uranium milling. Plants requiring less yellowcake production than the reference plant would require less energy, have fewer emissions, and use less water.

The uranium mill for the 1000-MW(e) LWR-scaled model would produce about 900 MT of yellowcake. The uranium mill for the gas-cooled reactor technologies would need to produce 455 to 758 MT of yellowcake, which is less than the amount of yellowcake needed for the scaled LWR (Exelon 2003). On this basis, the staff concludes that the environmental impacts from uranium milling for the gas-cooled reactors would be small.

6.1.2.5 Uranium Mining

Annual ore supply is the metric of interest for uranium mining. The less ore mined, the smaller the environmental impacts (i.e., less energy used, fewer emissions, less water usage). For the 1000-MW(e) LWR-scaled model, 816,000 MT of raw ore would be required to produce 900 MT of yellowcake. For the gas-cooled reactor technologies, the scaled ore requirements range from 506,000 to 843,000 MT of ore, a range that is comparable to the amount of ore required for the reference 1000-MW(e) LWR-scaled model. For this reason, the staff concludes that the environmental impacts from uranium mining for the gas-cooled reactors would be small.

6.1.2.6 Solid Low-Level Radioactive Waste – Operations

Table S-3 (see Table 6-1) of 10 CFR 51.51(a) states that there are 3.4 x 10^{14} Bq (9100 Ci) of low-level waste generated annually from operation of the reference LWR; operation of the 1000-MW(e) LWR-scaled model would result in 1 x 10^{15} Bq (27,300 Ci) of low-level waste annually. Gas-cooled reactor technologies are projected to generate 3.6 x 10^{12} Bq to 1 x 10^{14} Bq (98 to 2750 Ci) of low-level waste scaled annually, far below the amounts generated by the reference LWR (Exelon 2003). For this reason, the staff concludes that the environmental impacts from low-level radioactive waste operations for gas-cooled reactors would be small.

6.1.2.7 Solid Low-Level Radioactive Waste – Decontamination and Decommissioning

In Table S-3 (see Table 6-1), the Commission states that 5.6 x 10^{13} Bq (1500 Ci) per reference-reactor year "...comes from reactor decontamination and decommissioning — buried at land burial facilities." Exelon (2003) notes that gas-cooled reactor technologies would (1) generate less waste than the reference 1000-MW(e) LWR, and (2) produce less heavy metal radioactive waste due to the higher thermal efficiency and higher fuel burnup. The gas-cooled reactor designs are also more compact than the reference LWR design, which would be expected to result in less decontamination and decommissioning waste (Exelon 2003). Exelon expects that low-level waste impact from decontamination and decommissioning will be comparable to or less than that of the reference LWR (Exelon 2003). On this basis, the staff concludes that the environmental impacts from solid low-level radioactive waste generated during decontamination and decommissioning for gas-cooled reactors would likely be small, but these impacts will need to be assessed again at the CP or COL stage.

6.1.2.8 Conclusions

The staff concludes that the environmental impacts from the uranium fuel cycle activities and solid waste management activities for the proposed gas-cooled reactors would be SMALL. However, because of the uncertainty in the final design of the gas-cooled reactors and the change in technology that could be applied to uranium fuel cycle activities, additional reviews would be needed at the CP or COL stage in the following areas: fuel fabrication, enrichment, and solid low-level waste operation during decontamination and decommissioning.

6.2 Transportation of Radioactive Materials

This section addresses both the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to a nuclear unit at the Exelon ESP site, (2) shipment of spent fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of low-level radioactive waste and mixed waste to offsite disposal facilities. Distinctions between transportation impacts of advanced LWR designs and gas-cooled reactor designs are discussed.

The NRC evaluated the environmental effects of transportation of fuel and waste for light water-cooled nuclear power reactors in WASH-1238 (AEC 1972) and NUREG-75/038 (NRC 1975) and found the impact to be SMALL. These documents provided the basis for Table S-4 in 10 CFR 51.52, which summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 MW(t) (1000 to 1500 MW[e]). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR.

Normal transportation operations were estimated to result in a collective dose to transportation workers of 0.04 person-Sv (4 person-rem) per reference reactor-year. Dose to the public along the route and dose to onlookers both were estimated to result in a collective dose of 0.03 person-Sv (3 person-rem) per reference reactor-year. Doses to the public during accident conditions were determined to be small. Nonradiological impacts during accident conditions were estimated as one fatal injury per reference reactor-year and one nonfatal injury in 10 reference reactor-years. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977a) and Sprung et al. (2000) concluded that impacts were bounded by Table S-4 in 10 CFR 51.52.

In accordance with 10 CFR 51.52(a), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (i.e., impacts are assumed bounded by Table S-4) if an LWR meets the following criteria:

- The reactor has a core thermal power level not exceeding 3800 MW(t).

- Fuel is in the form of sintered UO_2 pellets having a uranium-235 enrichment not exceeding 4 percent by weight, and pellets are encapsulated in zirconium-clad fuel rods.

- Average level of irradiation of the fuel from the reactor does not exceed 33,000 MWd/MT, and no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor.

- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.

- Unirradiated fuel is shipped to the reactor by truck; irradiated fuel is shipped from the reactor by truck, rail, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or rail.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities were resolved generically in 10 CFR 51.52, provided that the specific conditions in the rule (see above) are met; if not, then a full description and detailed analysis is required for initial licensing. The NRC may consider requests for licensed plants to operate at conditions above those in the facility's licensing basis, for example, higher burnups, enrichments, or thermal power levels above 33,000 MWd/MTU, 4 percent, and 3800 MW(t), respectively. The rule has not been changed for the initial licensing of nuclear power facilities, and departures from the conditions itemized in the rule that were found to be acceptable for licensed facilities cannot serve as the basis for initial licensing.

Exelon has not identified a specific reactor design for the ESP site but used bounding parameters from seven reactor designs. Five of the designs are LWRs and include the ACR-700 (3964 MW[t]/unit); the ABWR (4300 MW[t]/unit); the AP1000 (6800 MW[t]/unit); the ESBWR (4000 MW[t]/unit), and the IRIS (3000 MW[t]/unit). For the ACR-700 and AP1000 reactor designs, two reactors make up a unit. For the IRIS design, three reactors (modules) make up a unit. For the remaining LWR designs, one reactor makes up a unit. To make comparisons to Table S-4, the environmental impacts are normalized to a reference reactor-year. The reference reactor is an 1100-MW(e) reactor that has an 80-percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electrical output for the advanced reactor sites to the electrical output of the reference reactor.

None of the proposed LWR designs meets all the conditions in 10 CFR 51.52(a); therefore, a full description and detailed analysis are required for each LWR design. This conclusion is based on the following:

- The ACR-700, ABWR, AP1000, and ESBWR designs exceed the 3800-MW(t) core thermal power-level limit.

- The ABWR, AP1000, ESBWR, and IRIS designs require fuel that exceeds the uranium-235 enrichment of 4 percent.

- The ABWR, AP1000, ESBWR, and IRIS designs are expected to exceed the average irradiation level of 33,000 MWd/MTU.

The remaining two designs are gas-cooled reactors: the GT-MHR and the PBMR. Each GT-MHR unit is a four-module, 2400-MW(t), 1140-MW(e) gas-cooled reactor designed to operate at a unit capacity factor of 88 percent. Each PBMR is an eight-module, 3200-MW(t), 1320-MW(e) gas-cooled reactor designed to operate at a unit capacity factor of 95 percent. This compares to the reference reactor in WASH-1238 (AEC 1972), which is a single-unit, 1100-MW(e) LWR with a unit capacity factor of 80 percent. The gas-cooled reactor designs do not meet the conditions in 10 CFR 51.52 because these reactors are not LWR designs upon which Table S-4 impacts were based. Therefore, a full description and detailed analysis was required for each gas-cooled reactor design. This was provided by Exelon in its response to a request for additional information on September 23, 2004 (Exelon 2004b).

Exelon used a sensitivity analysis to show that transportation impacts from advanced LWR designs would be bounded by the criteria identified in Table S-4 (Exelon 2003). Exelon referenced the related discussion and information in NUREG-1437, Addendum 1 (NRC 1999) to support its basis for exceeding 4 percent uranium-235 enrichment and 33,000 MWd/MTU. However, as discussed above, NUREG-1437, Addendum 1 applies to reactors that are listed in NUREG-1437, Appendix A and not to any other reactor designs.

Exelon also used a sensitivity analysis to show that transportation impacts from the advanced gas-cooled reactor designs would be bounded by the criteria identified in Table S-4 (Exelon 2003); however, as discussed previously, this type of analysis does not adequately meet the requirements of 10 CFR 51.52. Exelon (2003) identified the major contributors to transportation risk to be the number and type of shipment (shipment risk) and the kind of material being shipped (material risk). Its evaluation of shipment risk showed fewer shipments of unirradiated fuel, spent fuel, and low-level waste would be required for the advanced gas-cooled reactors compared to the reference LWR when averaged over 40 years of operation. Regarding material risk, Exelon (2004b) concluded the following:

- The estimated total spent fuel radioactive inventory and fission product inventory was less for the gas-cooled reactors when compared to the reference LWR.

- Actinide inventories would be greater for the gas-cooled reactors (55 to 65 percent greater) due to the increased burnup for these types of reactors; however, actinides are not major contributors to dose during transportation accidents.

- Gas-cooled reactors would generate fewer kilowatts of decay heat per MTU and fewer kilowatts of decay heat per truck cask at the time of shipment.

6.2.1 Transportation of Unirradiated Fuel

The staff performed an independent review of the environmental impacts of transporting unirradiated (fresh) fuel to the proposed ESP site. Environmental impacts of normal operating conditions and transportation accidents are discussed in this section. Appendix G provides the details of the analysis.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without releasing any radioactive cargo to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the unirradiated fuel shipping casks.

Truck Shipments

Table 6-4 provides an estimate of the number of truck shipments of unirradiated fuel for each advanced reactor design compared to those of the reference 1100-MW(e) reactor specified in WASH-1238 (AEC 1972). Estimates are normalized for an equivalent 1100-MW(e) electric generating capacity. The basis for the shipment estimates can be found in Appendix G. Only the ACR-700, PBMR, and GT-MHR reactor designs exceeded the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238. The largest number of shipments, in excess of 700 shipments over 40 years, is for the PBMR. However, this equates to far less than the one truck shipment per day specified in Table S-4 of 10 CFR 51.52.

Shipping Mode and Weight Limits

10 CFR 51.52 stipulates that all unirradiated fuel be shipped to the reactor by truck. In information provided by Exelon, the applicant specifies that unirradiated fuel will be shipped to the reactor site by truck for all reactor designs that it references (INEEL 2003). In addition, 10 CFR 51.52 includes a condition that the truck shipments not exceed 33,100 kg (73,000 lb), as governed by Federal or State gross vehicle weight restrictions. All the advanced reactor designs would meet this weight restriction for unirradiated fuel (INEEL 2003).

Radiological Doses to Transport Workers and The Public

10 CFR 51.52, Table S-4, includes conditions related to radiological dose to transport workers and members of the public along transport routes. These doses are a function of many variables, including the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel and stop times), and the number of shipments to which the individuals are exposed. For this environmental impact statement (EIS), the radiological dose impacts of the transportation of unirradiated fuel were calculated for the worker and the public using the RADTRAN 5 computer code (Neuhauser et al. 2003). Details of the calculations are found in Appendix G.

Table 6-4. Numbers of Truck Shipments of Unirradiated Fuel for Each Advanced Reactor Type

Reactor Type	Number of Shipments per Site: Initial Core[a]	Number of Shipments per Site: Annual Reload	Number of Shipments per Site: Total[b]	Site Electric Generation, MW(e)[c]	Capacity Factor[c]	Normalized, Shipments per 1100 MW(e)[d,e]
Reference LWR (WASH-1238)	18	6	252	1100	0.8	252
ABWR/ESBWR[d,e]	30	6.1	267	1500	0.95	165
AP1000	28	7.6	322	2300[f]	0.95	130
ACR-700	30	15.4	628	1462[g]	0.9	420
IRIS	34	4.3	201	1005[h]	0.96	184
GT-MHR	51	20	831	1140[i]	0.88	729
PBMR	44	20	824	1320[j]	0.95	579

NOTE: The reference LWR shipment values have all been normalized to 880-MW(e) net electrical generation.

(a) Shipments of the initial core have been rounded up to the next highest whole number.

(b) Total shipments of fresh fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).

(c) Unit capacities and capacity factors were taken from INEEL (2003).

(d) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100-MW[e] reactor at 80 percent or net electrical output of 880 MW[e]).

(e) Ranges of capacities are given in INEEL (2003) for these reactor fresh fuel shipments. The fresh fuel shipment data for these reactors were derived using the upper limit of the ranges.

(f) The AP1000 site includes two reactors at 1150 MW(e) per reactor.

(g) The ACR-700 site includes two reactors at 731 MW(e) per reactor.

(h) The IRIS site includes three reactors at 335 MW(e) per reactor.

(i) The GT-MHR site includes four reactors at 285 MW(e) per reactor.

(j) The PBMR site includes eight reactors at 165 MW(e) per reactor.

Table 6-5 presents the radiological impacts to workers, onlookers (members of the public), and members of the public (along the route) for the advanced reactor designs. The cumulative annual dose estimates were normalized to 1100 MW(e). The staff performed an independent review and determined that all dose estimates are bounded by the Table S-4 conditions of 0.04 person-Sv/yr (4 person-rem/yr) to transportation workers, 0.03 person-Sv/yr (3 person-rem/yr) to onlookers, and 0.03 person-Sv/yr (3 person-rem/yr) to members of the public along the route.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates below about 100 mSv (10,000 mrem). However, radiation protection experts

Table 6-5. Radiological Impacts of Transporting Unirradiated Fuel to Advanced Reactor Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose person-Sv/yr per 1100 MW(e)[a]		
		Workers	Public - Onlookers	Public - Along Route
Reference LWR (WASH-1238)	6.1	1.1×10^{-4}	4.2×10^{-4}	1.0×10^{-5}
ABWR/ESBWR	4.2	7.1×10^{-5}	2.7×10^{-4}	6.6×10^{-6}
AP1000	3.3	5.6×10^{-5}	2.2×10^{-4}	5.2×10^{-6}
ACR-700	10.5	1.8×10^{-4}	7.0×10^{-4}	1.7×10^{-5}
IRIS	4.6	7.9×10^{-5}	3.1×10^{-4}	7.4×10^{-6}
GT-MHR	18.2	3.1×10^{-4}	1.2×10^{-3}	2.9×10^{-5}
PBMR	14.5	2.5×10^{-4}	9.6×10^{-4}	2.3×10^{-5}
10 CFR 51.52, Table S-4 condition	<1 per day	4.0×10^{-2}	3.0×10^{-2}	3.0×10^{-2}

(a) Multiply person-Sv/yr times 100 to obtain doses in person-rem/yr.

conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimate those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1000 person-rem]) from ICRP Publication 60 (ICRP 1990). All the public doses presented in Table 6-5 are less than 1×10^{-3} person-Sv/yr (1×10^{-1} person-rem/yr); therefore, the total detriment estimates associated with these doses would all be less than 1×10^{-4} fatal cancers, nonfatal cancers, and severe heredity effects per year. There risks are quite small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

6.2.1.2 Accidents

Accident risks are the product of accident frequency times consequence. Accident frequencies for transportation of fuel to and from future reactors are expected to be lower that those used in the analysis in WASH-1238 (AEC 1972), which forms the basis for Table S-4 of 10 CFR 51.52, because of improvements in highway safety and security and an expected decrease in traffic accident, injury, and fatality rates. There is no significant difference in consequences of accidents severe enough to result in a release of unirradiated fuel particles to the environment between advanced LWRs and current-generation LWRs because the fuel form, cladding, and packaging for advanced LWRs are similar to those analyzed in WASH-1238. Consequently, the impacts of accidents during transport of unirradiated fuel for advanced LWRs to a new nuclear unit at the Exelon ESP site are expected to be smaller than the impacts listed in Table S-4 for current-generation LWRs.

With respect to the advanced gas-cooled reactors, accident rates (accidents per unit distance) and associated accident frequencies (accidents per year) would be expected to follow the same trends as for LWRs (i.e., overall reduction relative to the accident rates used in the WASH-1238 analysis). The consequences of accidents involving gas-cooled reactor unirradiated fuel, however, are more uncertain. The staff assumed that the gas-cooled reactor unirradiated fuel shipments would have the same abilities as LWR unirradiated fuel to maintain functional integrity following a traffic accident. This assumption is considered to be conservative because gas-cooled reactor fuel operates at significantly higher temperatures, and thus maintains integrity under more severe thermal conditions than LWR fuel. Detailed information about the behavior of the gas-cooled reactor fuel under impact conditions was not available. However, packaging systems for unirradiated gas-cooled reactor fuel will be required to meet the same requirements as unirradiated LWR fuel packages. Properly designed and manufactured packaging systems are the most effective means of preventing damage and dispersal of the contained materials under accident conditions. Consequently, it is expected that packaging systems for unirradiated gas-cooled reactor fuels would provide release (i.e., consequence) prevention and mitigation equivalent to those designed for unirradiated LWR fuels. In addition, the fuel forms for the gas-cooled reactors are similar to those for LWRs (i.e., UO_2 for the PBMR and uranium oxycarbide for the GT-MHR versus UO_2 for LWRs). Thus, the failure resistance provided by unirradiated gas-cooled reactor fuels is not expected to be significantly lower than that for LWRs. Based on the assumption that unirradiated gas-cooled and LWR fuels and associated packaging systems would provide equivalent resistance to thermal and impact conditions, the staff concludes that the impacts of accidents involving unirradiated gas-cooled reactor fuel would not be significantly different than for unirradiated LWR fuel and would be within the impacts listed in Table S-4 for current-generation LWRs. However, these impacts will need to be assessed at the CP or COL stage when specific information is available regarding other-than-LWR fuel performance, if the applicant references such designs.

6.2.2 Transportation of Spent Fuel

The staff performed an independent review of the environmental impacts of transporting spent fuel from a new nuclear unit at the ESP site to a spent fuel disposal repository. The Yucca Mountain, Nevada, location is a possible location for a geologic repository. The staff considers an estimate of the impacts of the transportation of spent fuel to a possible repository in Nevada to be a reasonable bounding estimate of the transportation impacts to a monitored retrievable storage facility because of the distances involved and the representative exposure of members of the public in urban, suburban, and rural areas. Environmental impacts of normal operating conditions and transportation accidents are discussed in this section.

This analysis is based on shipment of spent fuel by legal-weight trucks in casks with characteristics similar to casks currently available (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with assumptions made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG-1437 (NRC 1999). These assumptions are conservative because the alternative assumptions involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999).

Environmental impacts of transportation of spent fuel were calculated using the RADTRAN 5 computer code (Neuhauser et al. 2003). Routing and population data used in the RADTRAN 5 code for truck shipments were obtained from the TRAGIS routing code (Johnson and Michelbaugh 2000). The population data in the TRAGIS code are based on the 2000 Census.

The staff's evaluation reviewed the impacts of spent fuel shipments originating from the primary ESP location (i.e., the Exelon site) and the following alternative sites: Braidwood, Quad Cities, and Zion. Three other alternative sites (Byron, Dresden, and LaSalle) were considered by Exelon in its ER, but were not evaluated by the staff because the route characteristics of distance and population would not be significantly different to produce results different from the Braidwood, Quad Cities, and Zion sites.

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without releasing any radioactive cargo to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Radiation doses would occur to (1) persons residing along the transportation corridors between the ESP site and the proposed repository; (2) persons in vehicles passing a spent fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers.

Shipping casks have not been designed for the advanced reactor designs. Information in INEEL (2003) indicates that advanced LWR fuel designs would not be significantly different from existing LWR designs; therefore, the characteristics of current shipping cask designs were used for the analysis for advanced LWR designs. No information is available on spent fuel shipping cask designs for the gas-cooled reactors. For purposes of this analysis, their design was assumed to be the same as those used for the existing LWRs. Spent fuel shipping cask designs for gas-cooled reactors will be evaluated at the CP or COL stage if the applicant references such designs.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate at 1 m from the vehicle, packaging dimensions, number of persons in the truck crew, stop time, and population density at stops. For a listing of the values for these and other parameters, refer to Appendix G. Table 6-6 presents radiation dose estimates to the transport workers and the public for the primary and alternative ESP sites. Doses are presented on a per-shipment basis. The per-shipment dose estimates are independent of reactor technology because they were calculated based on an assumed external radiation dose rate emitted from the cask, which was fixed at the regulatory maximum limit for the advanced reactor designs (i.e., 0.1 mSv/hr [10 mrem/hr] at 2 m).

Population dose estimates per reference reactor-year are presented in Table 6-7 for specific advanced reactor designs. Population doses were calculated by multiplying the number of spent fuel shipments per year for each advanced reactor design times the dose per shipment from Table 6-6. Population doses were normalized to the reference LWR design in WASH-1238 (880 net MW[e]). This corresponds to an 1100-MW(e) LWR operating at 80-percent capacity. Appendix G provides the basis upon which the number of spent fuel shipments was derived for each advanced reactor design.

The bounding cumulative doses to the exposed population given in Table S-4 are

- 0.04 person-Sv (4 person-rem) per reference reactor-year to transport workers
- 0.03 person-Sv (3 person-rem) per reference reactor-year to general public (onlookers)
- 0.03 person-Sv (3 person-rem) per reference reactor-year to general public (along route).

Population doses to the crew and the onlookers for all the reactor types, including the reference reactor found in Table 6-7, exceed Table S-4 values. Two key reasons for the higher population doses relative to Table S-4 are the higher number of spent fuel shipments estimated for some of the reactor technologies and the longer shipping distances assumed for the analyses (i.e., to a possible repository in Nevada) than were used in WASH-1238. WASH-1238 used a "typical" distance for a spent fuel shipment of 1600 km (1000 mi), whereas the shipping distances used in this assessment ranged from about 3000 km (1800 mi) to 4700 km (2900 mi). The higher numbers of shipments are based on spent fuel shipping casks designed to transport shorter-cooled fuel (i.e., 150 days out of the reactor). It was assumed in this analysis that the shipping cask capacities are 0.5 MTU/shipment, roughly equivalent to one PWR or two BWR spent fuel assemblies per shipment.

Table 6-6. Routine (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from Potential ESP Sites to a Spent Fuel Disposal Facility

	Population Dose, person-Sv/shipment[(a)]		
ESP Site	**Crew**	**Onlookers**	**Along Route**
Clinton	7.2×10^{-4}	2.5×10^{-3}	4.5×10^{-5}
Braidwood	7.1×10^{-4}	2.4×10^{-3}	4.4×10^{-5}
Quad Cities	6.7×10^{-4}	2.1×10^{-3}	4.1×10^{-5}
Zion	7.3×10^{-4}	2.5×10^{-3}	5.2×10^{-5}

(a) Multiply person-Sv/yr times 100 to obtain doses in person-rem/yr.

Newer shipping cask designs are based on longer-cooled spent fuel (i.e., 5 years out of reactor) and have larger capacities than those used in this assessment. DOE (2002) spent fuel shipping cask capacities were approximately 1.8 MTU/shipment, or up to four PWR or nine BWR fuel assemblies per shipment. Use of the newer shipping cask designs will reduce the number of spent fuel shipments and the associated environmental impacts. On balance, if the population doses are adjusted for the shipping distance and shipping cask capacity, the routine population doses from spent fuel shipments from all reactor types and all sites fall within Table S-4 limits.

Other conservative assumptions in the staff's calculation include:

- Use of the regulatory maximum dose rate (0.1 mSv/hr [10 mrem/hr] at 2 m) in the RADTRAN 5 calculations. The shipping casks assumed in the EIS prepared in support of the application for a geologic repository at the proposed Yucca Mountain site (DOE 2002) were designed to transport spent fuel that has cooled for 5 years. In reality, most spent fuel will have cooled for much longer than 5 years before it is shipped to a possible geologic repository. Sprung et al. (2000) developed a probabilistic distribution of dose rates based on fuel cooling times that indicates that approximately three-fourths of the spent fuel to be transported to a possible geologic repository will have dose rates less than half of the regulatory limit. Consequently, the estimated population doses in Table 6-7 could be divided in half if more realistic dose rate projections are used.

- Use of 30 minutes as the average time at a truck stop in the calculations. Many stops made for actual spent fuel shipments are short-duration stops (i.e., 10 minutes) for brief visual inspections of the cargo (checking the cask tie-downs). These stops typically occur in minimally populated areas, such as an overpass or freeway ramp in an

Table 6-7. Routine (Incident-Free) Population Doses from Spent Fuel Transportation, Normalized to Reference LWR

Reactor Type	Reference LWR (WASH-1238)			ABWR/ESBWR			AP-1000			ACR-700		
Shipments per Year	60			41			40			90		
	Environmental Effects, person-Sv[(a)] per reference reactor-year											
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Clinton	0.043	0.15	0.0027	0.029	0.10	0.0018	0.028	0.097	0.0018	0.064	0.22	0.0041
Braidwood	0.042	0.15	0.0026	0.029	0.10	0.0018	0.028	0.097	0.0017	0.063	0.22	0.0039
Quad Cities	0.040	0.13	0.0024	0.027	0.09	0.0017	0.026	0.084	0.0016	0.060	0.19	0.0036
Zion	0.044	0.15	0.0031	0.030	0.10	0.0021	0.029	0.097	0.002	0.065	0.22	0.0046

Reactor Type	IRIS			GT-MHR			PBMR		
Shipments per Year	35			34			12		
	Environmental Effects, person-Sv[(a)] per reference reactor-year								
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Clinton	0.025	0.085	0.0016	0.024	0.082	0.0015	0.0080	0.028	0.00051
Braidwood	0.025	0.085	0.0015	0.024	0.082	0.0015	0.0079	0.027	0.00049
Quad Cities	0.023	0.074	0.0014	0.022	0.071	0.0014	0.0075	0.024	0.00046
Zion	0.025	0.085	0.0018	0.024	0.082	0.0017	0.0082	0.028	0.00058

(a) To convert person-Sv to person-rem, multiply by 100.

unpopulated area. Furthermore, empirical data provided in Griego et al. (1996) indicate that a 30-minute stop is toward the high end of the stop time distribution. Average stop times observed by Griego et al. (1996) are on the order of 18 minutes. Based on these observations, it was concluded that the stop model assumptions used in this study overestimate public doses at stops by at least a factor of two. Consequently, the doses to onlookers given in Table 6-7 could be reduced by a factor of two to reflect more realistic truck shipping conditions.

Exelon performed its own RADTRAN 5 calculations looking at the impact of "incident-free" transport of spent fuel to a spent fuel disposal facility. The assumed transport of spent fuel originated from the Maine Yankee Nuclear Plant (a distance further than the Clinton site) and terminated at a disposal facility assumed to be at Yucca Mountain, Nevada. Dose estimates per shipment were similar to those calculated by the staff.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000]) from ICRP Publication 60 (ICRP 1990). All the population doses presented in Table 6-7 are less than 1 person-Sv/yr (1×10^{-2} person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 1×10^{-1} fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are quite small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

6.2.2.2 Accidents

As discussed previously, the staff used the RADTRAN 5 computer code to estimate impacts of transportation accidents involving spent fuel shipments. RADTRAN 5 considers a spectrum of potential transportation accidents, ranging from those with high frequencies and low consequences (e.g., "fender benders") to those with low frequencies and high consequences (i.e., accidents in which the shipping container is exposed to severe mechanical and thermal conditions). Details of the analysis are discussed in Appendix G.

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were from *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003). This report included hundreds of radionuclides for each advanced reactor type. A screening analysis was conducted to select the dominant contributors to accident risks to simplify the RADTRAN 5 calculations. The screening identified the radionuclides that would contribute more than 99.999 percent of the dose from inhalation of radionuclides released following a transportation accident. The dominant radionuclides are similar regardless of the fuel type (i.e., advanced LWR fuel or gas-cooled reactor fuel). Spent fuel inventories used in the staff analysis are presented in Table 6-8. No radionuclide inventory data were presented in INEEL (2003) for the ACR-700 and IRIS advanced reactors; therefore, transportation accident risks were not quantified for these reactor types and would need to be assessed at the CP or COL stage if Exelon referenced either of these designs.

Massive shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe hypothetical accident conditions with essentially no loss of containment or shielding capability. According to Sprung et al. (2000), the probability of encountering accident conditions that would lead to shipping cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). The staff assumed that shipping casks for advanced reactor spent fuels will provide equivalent mechanical and thermal protection of the spent fuel cargo.

The RADTRAN 5 accident risk calculations were performed using unit radionuclide inventories (Bq/MTU) for the spent fuel shipments from the various reactor types. The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (MTU/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from each potential ESP site. As was done for routine exposures, the staff assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities.

For this assessment, release fractions for current-generation LWR fuels were used to approximate the impacts from the advanced reactor spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions. Due to the lack of experimental data on gas-cooled reactor fuels, it is currently not known if this approach is bounding. However, gas-cooled reactors operate at much higher temperatures than LWRs; therefore, high

Table 6-8. Radionuclide Inventories Used in Transportation Accident Risk Calculations for Each Advanced Reactor Type, Bq/MTU[(a)]

Radionuclide	ABWR and ESBWR	AP1000	GT-MHR	PBMR
Am-241	4.96×10^{13}	2.69×10^{13}	8.18×10^{13}	7.55×10^{13}
Am-242m	1.24×10^{12}	4.85×10^{11}	5.03×10^{11}	8.51×10^{11}
Am-243	1.20×10^{12}	1.24×10^{12}	5.14×10^{11}	4.77×10^{12}
Ce-144	4.22×10^{14}	3.28×10^{14}	2.15×10^{15}	1.19×10^{15}
Cm-242	2.04×10^{12}	1.05×10^{12}	1.51×10^{12}	2.78×10^{12}
Cm-243	1.37×10^{12}	1.14×10^{12}	2.02×10^{11}	1.96×10^{12}
Cm-244	1.80×10^{14}	2.87×10^{14}	2.83×10^{13}	5.48×10^{14}
Cm-245	2.43×10^{10}	4.48×10^{10}	1.65×10^{8}	5.29×10^{10}
Co-60	1.01×10^{14}	(b)	(b)	(b)
Cs-134	1.78×10^{15}	1.78×10^{15}	2.21×10^{15}	4.03×10^{15}
Cs-137	4.59×10^{15}	3.44×10^{15}	1.08×10^{16}	1.41×10^{16}
Eu-154	3.81×10^{14}	3.38×10^{14}	3.23×10^{14}	3.74×10^{14}
Eu-155	1.93×10^{14}	1.71×10^{14}	8.77×10^{13}	1.08×10^{14}
Pm-147	1.25×10^{15}	6.51×10^{14}	6.92×10^{15}	5.07×10^{15}
Pu-238	2.27×10^{14}	2.25×10^{14}	1.17×10^{14}	4.55×10^{14}
Pu-239	1.43×10^{13}	9.44×10^{12}	2.25×10^{13}	1.11×10^{13}
Pu-240	2.28×10^{13}	2.01×10^{13}	3.96×10^{13}	3.32×10^{13}
Pu-241	4.51×10^{15}	2.58×10^{15}	8.33×10^{15}	7.18×10^{15}
Pu-242	8.29×10^{10}	6.73×10^{10}	1.56×10^{11}	4.51×10^{11}
Ru-106	6.07×10^{14}	5.74×10^{14}	1.48×10^{15}	1.68×10^{15}
Sb-125	1.99×10^{14}	1.42×10^{14}	2.21×10^{14}	2.51×10^{14}
Sr-90	3.27×10^{15}	2.29×10^{15}	8.95×10^{15}	1.08×10^{16}
Y-90	3.27×10^{15}	2.29×10^{15}	8.95×10^{15}	1.08×10^{16}

(a) To convert Bq/MTU to Ci/MTU, divide the value by 3.7×10^{10}.
(b) Cobalt-60 is an activation product. Only the ABWR/ESBWR submittal in INEEL (2003) provided inventory data for activation products.

temperature conditions anticipated in transportation accident fires should have less of an effect on radionuclide releases than they do for LWR fuels. Thus, smaller release fractions are anticipated for advanced gas-cooled reactor fuels than for LWR fuels subjected to thermal transients.

RADTRAN 5 calculated the population dose from the released radioactive material for five possible exposure pathways. These pathways are:

(1) external dose from exposure to the passing cloud of radioactive material

(2) external dose from the radionuclides deposited on the ground by the passing plume (the staff's analysis included the radiation exposure from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway)

(3) internal dose from inhalation of airborne radioactive contaminants

(4) internal dose from resuspension of radioactive materials that were deposited on the ground (the staff's analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures)

(5) internal dose from ingestion of contaminated food (the staff's analysis assumed interdiction of foodstuffs and evacuation after an accident; thus, no internal dose due to ingestion of contaminated foods was calculated).

Table 6-9 presents the environmental consequences of transportation accidents when shipping spent fuel from the Exelon ESP site and alternative sites to a spent fuel repository assumed to be at Yucca Mountain, Nevada. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions (for details, see Appendix G). The table presents estimates of population dose (person-Sv/reference reactor-year) for several of the advanced reactor designs. These values are normalized to the

Table 6-9. Annual Spent Fuel Transportation Accident Impacts for Advanced Reactors, Normalized to Reference 1000 - MW(e) LWR Net Electrical Generation

	Advanced Reactor Type			
	ABWR/ESBWR	AP-1000	GT-MHR	PBMR
MTU/yr	20.3	19.7	6.0	5.8
Population dose, person-Sv per reference reactor-year[(a)]				
Clinton	1.0×10^{-5}	2.0×10^{-7}	9.0×10^{-8}	1.5×10^{-7}
Braidwood	2.2×10^{-6}	2.0×10^{-7}	8.9×10^{-8}	1.5×10^{-7}
Quad Cities	2.1×10^{-6}	1.8×10^{-7}	8.4×10^{-8}	8.2×10^{-8}
Zion	3.0×10^{-6}	2.7×10^{-7}	1.2×10^{-7}	2.0×10^{-7}

(a) Multiply person-Sv/yr times 100 to obtain person-rem/yr.

WASH-1238 reference reactor (880-MW[e] net electrical generation, 1100-MW[e] reactor operating at 80-percent capacity).

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from ICRP Publication 60 (ICRP 1990). All the population doses presented in Table 6-9 are less than 1×10^{-5} person-Sv/yr (1×10^{-3} person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 1×10^{-6} fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are quite small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

6.2.2.3 Conclusion

Considering the uncertainties in the data and computational methods, the staff concludes that the overall transportation accident risks associated with advanced reactor spent fuel shipments are likely to be SMALL and are consistent with the risks associated with transportation of spent fuel from current-generation reactors presented in Table S-4 of 10 CFR 51.52. The fuel performance characteristics, shipping casks, and accident risks for other-than-LWR designs would need to be assessed at the CP or COL stage if the applicant references such designs.

6.2.3 Transportation of Radioactive Waste

This section discusses the environmental effects of transporting waste from ESP sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- Radioactive waste (except spent fuel) is packaged in solid form.

- Radioactive waste (except spent fuel) is shipped from the reactor by truck or rail.

- The weight limitation is 33,100 kg (73,000 lb) per truck and 100 tons per cask per railcar.

- The traffic density limitation is less than one truck shipment per day or three railcars per month.

In INEEL (2003), the applicant indicates that all the radioactive waste will be transported by truck, and it plans to solidify and package its waste regardless of which advanced reactor technology it chooses. In addition, waste from any of the advanced reactor technologies will be subject to NRC (10 CFR Part 71) and DOT (49 CFR Parts 173 and 178) regulations for the shipment of radioactive material. Radioactive waste from any of the advanced reactor technologies is expected to be capable of being shipped in compliance with Federal or State weight restrictions.

Table 6-10 presents estimates of annual waste volumes and annual waste shipment numbers for the advanced reactor types normalized to the reference 1100-MW(e) LWR defined in WASH-1238 (AEC 1972). Annual waste volumes and waste shipments for the advanced reactor technologies were less than those for the 1100-MW(e) reference reactor, which was the basis for Table S-4 for all designs except the PBMR. As shown in the table, only the PBMR would be expected to generate a larger volume of radioactive waste than the reference LWR in WASH-1238. However, the GT-MHR and PBMR information in INEEL (2003) assumed that Exelon would ship wastes using two different packaging systems: one that hauls 28.3 m^3 per shipment (1000 ft^3 per shipment) and one that hauls 5.7 m^3 per shipment (200 ft^3 per shipment). Under those conditions, the number of shipments of radioactive waste per year, normalized to 1100 MW(e) electric generation capacity, would be about six shipments per year per 1100 MW(e) (880 net MW[e]) for the GT-MHR and seven shipments per year per 1100 MW[e] for the PBMR. These estimates are well below the reference LWR (46 shipments per year per 1100 MW[e]).

All the estimates are well below the one truck shipment per day condition given in 10 CFR 51.52, Table S-4. Doubling the shipment estimates to account for empty return shipments is still well below the one-shipment-per-day condition.

6.2.4 Conclusions

An analysis was conducted of the impacts of transporting unirradiated fuel to advanced reactor sites and spent fuel and wastes from advanced reactor sites to disposal facilities. To make comparisons to Table S-4, the environmental impacts are normalized to a reference

Table 6-10. Summary of Radioactive Waste Shipments for Advanced Reactors

Reactor Type	INEEL (2003) Waste Generation Information	Annual Waste Volume, m^3/yr per site	Electrical Output, MW(e) per site	Normalized Rate, m^3/1100 MW(e) reactor (880 MW(e) net)[(a)]	Shipments/ 1100 MW(e) (880 MW(e) net) Electrical Output[(b)]
Reference LWR (WASH-1238)	100 m^3/yr per reactor	108	1100	108	46
ABWR	100 m^3/yr per reactor	100	1500	62	27
ESBWR	100 m^3/yr per reactor	100	1500	62	27
AP1000	55 m^3/yr per reactor	112	2300[(c)]	45	20
ACR-700	47.5 m^3/yr per reactor	95	1462[(d)]	64	28
IRIS	25 m^3/yr per reactor	74	1005[(e)]	67	29
GT-MHR	98 m^3/yr (4 reactors)	98	1140[(f)]	86	37[(h)]
PBMR	100 drums/yr per reactor	168	1320[(g)]	118	51[(h)]

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 liters (0.21 m^3).

(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are given in Table 6-3 for each reactor type. All are normalized to 880-MW(e) net electrical output (1100-MW[e] plant with an 80-percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m^3/shipment (108 m^3/yr divided by 46 shipments/yr).

(c) The AP1000 site includes two reactors at 1150 MW(e) per reactor.

(d) The ACR-700 site includes two reactors at 731 MW(e) per reactor.

(e) The IRIS site includes three reactors at 335 MW(e) per reactor.

(f) The GT-MHR site includes four reactors at 285 MW(e) per reactor.

(g) The PBMR site includes eight reactors at 165 MW(e) per reactor.

(h) The applicant states in INEEL (2003) that 90 percent of the waste could be shipped on trucks carrying 28 m^3 (1000 ft^3) of waste and the remaining 10 percent in shipments carrying 5.7 m^3 (200 ft^3) of radioactive waste. This would result in six to seven shipments per year after normalization to the reference LWR electrical output.

reactor-year. The reference reactor is an 1100-MW(e) reactor that has an 80-percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electric output for the advanced reactor sites to the electric output of the reference reactor.

Considering the uncertainties in the data and computational methods, the staff concludes that the environmental impacts of transportation of fuel and radioactive wastes to and from advanced LWR designs would be SMALL, and would be consistent with the risks associated with transportation of fuel and radioactive wastes from current-generation reactors presented in Table S-4 of 10 CFR 51.52. For gas-cooled designs, the impacts are likely to be SMALL, but at the CP or COL stage the staff will need to validate the assumptions used in this transportation analysis with more design data. Assumptions that need validation include:

- verifying that unirradiated and spent fuel from gas-cooled reactors have the same abilities as LWR unirradiated and spent fuel to maintain integrity following a traffic accident

- verifying that the shipping cask design assumptions (e.g., cask capacities) are equal to or bounded by the assumptions in this analysis

- verifying that the fresh fuel initial core/refueling requirement, spent fuel generation rates, and radioactive waste generation rate assumptions are equal to or bounded by the assumptions in this analysis

- verifying that shipping cask capacities and accident source terms, including spent fuel inventories, severity fractions, and release fractions, are equal to or bounded by the assumptions in this analysis.

Should the ACR-700 or IRIS reactors be chosen for the ESP site, a transportation accident analysis will be performed because spent fuel inventories were not available for the ESP analysis.

6.3 Decommissioning Impacts

At the end of the operating life of a power reactor, the NRC regulations require that the facility undergo decommissioning. Decommissioning is the removal of a facility safely from service and the reduction of residual radioactivity to a level that permits termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.82, 50.75, and 50.82.

Environmental impacts from the activities associated with the decommissioning of any LWR before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). If Exelon applies for a license to operate a new nuclear unit at the ESP site, there is a requirement to provide a report containing a certification that financial assurance for radiological decommissioning. At the time an application is submitted, the requirements in 50.33, 50.75, and 52.77 (and any other applicable requirements) will have to be met.

At the ESP stage, Exelon is not required to submit information regarding the process of decommissioning, such as the method chosen for decommissioning, the schedule, or any other aspect of planning for decommissioning. The regulatory requirements on decommissioning activities are expected to limit the impacts of decommissioning to a SMALL impact. For the new nuclear unit, if LWR designs are chosen or if other-than-LWRs that were considered in NUREG-0586, Supplement 1 are chosen, the impacts from decommissioning are expected to be within the bounds described in NUREG-0586, Supplement 1. In such cases, the staff expects the impact from decommissioning to be SMALL. However, for whatever design that is selected, the impacts from decommissioning will have to be assessed at the CP or COL stage.

6.4 References

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10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits, Standard Design Certifications, and Combined 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."

10 CFR Part 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

49 CFR Part 173. Code of Federal Regulations, Title 49, *Transportation*, Part 173, "Shippers - General Requirements for Shipments and Packaging."

49 CFR Part 178. Code of Federal Regulations, Title 49, *Transportation*, Part 178, "Specifications for Packaging."

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7.0 Cumulative Impacts

When evaluating the potential impacts of construction and operation of a new nuclear unit at the site proposed by Exelon Generation Company, LLC (Exelon) in the early site permit (ESP) application, the staff considered potential cumulative impacts that fall within the plant parameter envelope (PPE). For purposes of this analysis, past actions are those related to the existing Clinton Power Station (CPS) Unit 1. Present actions are those related to resources at the time of the ESP application until the start of construction. Future actions are those that are reasonably foreseeable through construction and operation of the proposed ESP unit, including decommissioning. The geographical area over which past, present, and future actions could contribute to cumulative impacts is dependent on the type of action considered and is described below for each impact area.

The environmental impacts of the alternatives are evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B. 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, 1999a)[(a)] with the additional impact category of environmental justice.

The impacts of the proposed action, as described in Chapters 4 and 5, are combined with other past, present, and reasonably foreseeable future actions in the vicinity of the CPS site that would affect the same resources impacted by CPS Unit 1, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

7.1 Land Use

For purposes of this analysis, the geographic area considered for cumulative impacts to land use resulting from construction and operation of a new nuclear unit encompasses DeWitt County, Illinois.

(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 staff reviewed the available information on the land-use impacts of constructing an additional nuclear unit at the Exelon ESP site. DeWitt County has developed a comprehensive plan, which includes zoning specifications and other land-use considerations. The cumulative impacts for land use include possible additional growth and land conversions to accommodate new workers and services. However, these impacts would be SMALL as the construction workforce and the operations workforce would be drawn from an area much wider than DeWitt County to include the large cities of Bloomington-Normal, Urbana-Champaign, and Decatur. Because the workforce would be diffused over these larger cities in the labor supply region, induced land-use impacts resulting from either construction or operation of a new nuclear unit at the Exelon ESP site would not be likely. Property tax revenue from a new nuclear unit might also increase infrastructure improvements in DeWitt County generally, and the City of Clinton specifically. Based on the information provided by Exelon and the staff's independent review, the staff concludes that, while lower tax rates or better services might encourage development, the comprehensive plan would control development in DeWitt County. Therefore, the staff concludes that the cumulative land-use impacts would be SMALL, and mitigation would not be warranted.

7.2 Air Quality

The Exelon ESP site is located in an area that is in attainment for criteria pollutants. In addition, the State regulates any emissions to the atmosphere. The air quality impacts of construction and operations are estimated to be small. No other significant impacts from other actions were identified. Based on its evaluation, the staff concludes that the cumulative impacts of air quality would be SMALL and that mitigation would not be warranted.

7.3 Water Use and Quality

The staff, while preparing this assessment, did not identify any other industrial, commercial, or public installations that would be located in the general vicinity of the Exelon ESP site before the end of the proposed Exelon unit operations. The intake of water from, and the discharge of water to, Clinton Lake from a new nuclear unit would be regulated by the Illinois Environmental Protection Agency (IEPA), just as the existing CPS unit is presently regulated by the IEPA. The intake and discharge limits for each installation are set by considering the overall or cumulative impact of all of the other regulated activities in the area. Compliance with the permits issued under the Clean Water Act's National Pollutant Discharge Elimination System (NPDES) minimizes the cumulative effects on aquatic resources. Operation of a new nuclear unit would require discharge permits from IEPA, which would address changing requirements so that cumulative water quality objectives are served. Therefore the staff concludes that the potential cumulative water impacts of construction and operation of a new nuclear unit at the ESP site would be SMALL. The staff concludes that in normal years the potential cumulative water impacts of operation of a new unit would be SMALL. However, the staff also concludes that in dry years, the potential cumulative water impacts of operation of a new unit would be MODERATE.

7.4 Terrestrial Ecosystem

The impacts from construction and operation of a new nuclear unit at the Exelon ESP site were evaluated to determine the magnitude of their contribution to regional cumulative adverse impacts to terrestrial ecological resources. Determinations for construction were made for the important terrestrial species (animal and plant) and habitats (as defined in NRC 2000) by evaluating construction effects in light of other past, present, and future actions in the region. Determinations for operation were made by considering resource attributes normally affected by cooling tower operation and transmission line operation and right-of-way maintenance and by evaluating effects in light of other past, present, and future actions in the region. For this analysis, the geographic region encompassing past, present, and foreseeable future actions includes the area immediately around the ESP site, the associated existing CPS transmission line rights-of-way, and Clinton Lake.

The area around the ESP site, transmission line rights-of-way, and Clinton Lake currently consists mostly of agricultural fields and pasture. This area incurred major losses of prairie species and habitats during agricultural conversion, while losses have since diminished. During the review for the ESP site, the staff did not identify any other present or future actions in the region that could significantly impact terrestrial species or habitats. Construction of a new nuclear unit at the ESP site would occur in areas that were previously disturbed for the CPS and now consist mostly of early successional plant species and a small amount (about 1.5 ha [3.5 ac]) of forest habitat. Construction is anticipated not to adversely affect the four minor wetlands (less than 0.4 ha [1 ac]) onsite. Finally, construction of a new nuclear unit and anticipated expansion of the transmission line rights-of-way likely would not destroy or displace any important terrestrial species or habitats, because none (except for the four minor wetlands noted above) is currently known to occur on or within 16 km (10 mi) of the ESP site. Therefore, the staff concludes that the contribution of construction of a new nuclear unit and associated transmission line rights-of-way expansion to cumulative losses of important species and habitats in the region would be SMALL.

During the review for the ESP site, the staff did not identify any other past, present, or future actions in the region that could significantly affect wildlife and wildlife habitat in ways similar to those associated with cooling operation of a new nuclear unit (i.e., cooling tower noise, exposure of Clinton Lake shoreline habitat due to cooling tower drawdown of the lake, adverse effects on crops and ornamental vegetation and native plants from cooling tower salt drift, and birds via collisions with cooling towers). Thus, because these types of impacts were considered negligible for the new nuclear unit, cumulative adverse impacts of these types in the region would also be considered minor. Consequently, the staff concludes that the contribution of cooling operation of a new nuclear unit to cumulative impacts to wildlife and wildlife habitat in the region would be SMALL.

During the review for the ESP site, the staff did not identify any other past, present, or future actions in the region that could significantly affect wildlife and wildlife habitat in ways similar to those associated with transmission line operation and right-of-way maintenance for a new nuclear unit (i.e., birds via collisions with transmission lines, flora and fauna [plants, agricultural crops, honeybees, wildlife, livestock] from electromagnetic fields and right-of-way maintenance; and floodplains and wetlands via right-of-way maintenance). Thus, because these types of impacts were considered negligible for a new nuclear unit, cumulative adverse impacts of these types in the region would also be considered minor. Consequently, the staff concludes that the contribution of transmission line operation and right-of-way maintenance for a new nuclear unit to cumulative impacts to wildlife and wildlife habitat in the region would be SMALL.

In summary, the staff concludes that the contribution of construction, operation, and eventual decommissioning of a new nuclear unit on the Exelon ESP site and of expansion and operation of associated transmission line rights-of-way to cumulative impacts on terrestrial ecological resources in the region would be SMALL, and that mitigation measures would not be warranted.

7.5 Aquatic Ecosystem

The staff evaluated construction and operation of a new nuclear unit at the Exelon ESP site to determine the magnitude of their contribution to regional cumulative adverse impacts to aquatic ecological resources. Determinations for construction were made for the generic categories of important aquatic species (animal and plant) and habitats (as defined by NRC 2000) by evaluating construction effects in light of other past, present, and future actions in the region. Determinations for operation were made for resource attributes normally affected by the cooling water system. This includes an evaluation of potential effects of water intake, consumption, and discharge in light of other past, present, and future actions in the region. For this analysis, the geographic region encompassing past, present, and foreseeable future actions includes Clinton Lake and Salt Creek immediately downstream of the Clinton Lake Dam.

From an aquatic ecological perspective, the construction of the CPS in the late 1970s converted what was once rural land and approximately 24 ha (60 ac) of flowing water at the confluence of Salt Creek and the North Fork Salt Creek to a 1981-ha (4895-ac) reservoir (IPC 1974). The Clinton Lake Dam moderated the flow to Salt Creek, decreasing the natural wide variation in stream temperatures, flows, and water levels. Thus, the site has already experienced a dramatic change in habitat type and species composition.

Since the filling of Clinton Lake, some aquatic organisms have disappeared or have been displaced while others have been favored by the lake conditions. Clinton Lake currently supports a variety of species common to other Illinois lakes and reservoirs. There is a strong sport fishery supported and managed by the Illinois Department of National Resources although there are no commercial fisheries in the vicinity of the ESP site. There are no Federally or State-listed threatened or endangered aquatic species found in Clinton Lake or immediately downstream in Salt Creek. During the review of the Exelon ESP site, the staff did not identify any other present or future actions in the region that could significantly alter aquatic species or habitats. Construction of a new nuclear unit at the ESP site would occur in areas that have been previously disturbed at CPS. Impacts to aquatic organisms would primarily be associated with construction of a new cooling water intake structure adjacent to the existing CPS intake structure. Benthic macroinvertebrates and nearshore habitat would be lost as a result of dredging, dewatering, and other construction activities; however, the amount of open water, shoreline, benthic habitat, and benthic fauna that would be lost is a small fraction of the total found at Clinton Lake (Exelon 2003). Fish and other mobile aquatic organisms might be temporarily displaced due to water displacement at the construction site, machinery noise, increased turbidity, and boating activities, but would be expected to return to the area once construction was complete. Therefore, the staff concludes that the contribution of construction of a new nuclear unit at the Exelon ESP site to cumulative losses of important species and habits in the region would be SMALL.

The staff considered potential cumulative effects of impacts related to water consumption and to impingement and entrainment of aquatic organisms. Past and present records indicate that water consumption (and discharge) of the existing CPS once-through unit is approximately 35,700 L/s (566,000 gpm) in summer and 28,100 L/s (445,000 gpm) in winter. This is well within the current NPDES permitted discharge limit of 42,300 L/s (670,000 gpm). Entrainment data are not available for the CPS although the recreationally important fish species are not considered to be highly susceptible to entrainment based on their general spawning habitat preferences for shallow littoral zones, which are not associated with the deeper water at the cooling water intake structure (Lutterbie 2002). Previous impingement studies indicate that gizzard shad *(Dorosoma cepedianum)* make up approximately 99 percent of the fish species and biomass found on the intake screens at CPS (Pallo 1988). While the number of fish impinged is large, the abundance of gizzard shad has been consistently high since operation of the CPS began, indicating that there are no apparent adverse impacts to the population as a result of current cooling water intake withdrawals.

After subtracting the summertime consumptive water loss from evaporation in the CPS cooling loop, estimated at 523 L/s (8290 gpm), there remain 6038 L/s (95,710 gpm) in summer and 14,200 L/s (225,000 gpm) in winter available for withdrawal by a new nuclear unit under the existing NPDES permit (Exelon 2003). Water-use requirements estimated for a new nuclear unit under the cooling options being considered are well below 6038 L/s (95,710 gpm)

(Exelon 2003). Although a full review of anticipated impacts due to impingement and entrainment cannot be performed without a specific cooling water intake design, the relatively low water consumption estimated for a new nuclear unit intake will keep impingement and entrainment low, and compliance with a recent U.S. Environmental Protection Agency ruling for new intake structures would protect aquatic organisms (see Section 5.4.2.1). The new ruling requires intake structures to meet best available technology standards for new and existing cooling water intake structures, through design and construction technologies, operational measures, or restoration measures. The adoption of these performance standards would ensure that cumulative impacts from operation of two independent cooling water intake systems on Clinton Lake would not affect the maintenance of a balanced, indigenous population of fish, shellfish, and other aquatic organisms.

Decommissioning would result in the cessation of water consumption from the lake by the power plants and impingement and entrainment impacts would end. The decommissioning of one unit before the other will result in a decrease in water consumption and impingement and entrainment effects proportional to the amount of water that was consumed by the power plant that would have gone out of service. Therefore, based on the above information, the staff concludes that the contribution of a new nuclear unit cooling water intake operation to cumulative impacts on aquatic organisms in the region would be SMALL.

The staff also considered the potential cumulative effects of impacts related to thermal discharge. Since operation of the CPS began, heated effluent has been discharged to the lake. The amount of water, its temperature, and chemical composition are regulated by IEPA through the NPDES permit program. The IEPA regulates point sources discharging pollutants to ensure the protection and propagation of a balanced, indigenous population of fish, shellfish, and other aquatic organisms. The IEPA is required to take into consideration the cumulative impacts of multiple discharges to the same waterbody and discharges from the CPS and other area facilities will be included in the review and development of permit requirements for a new nuclear unit. Additionally, all NPDES permits must be renewed every 5 years, allowing IEPA to ensure that the permit limits provide the appropriate level of protection to the environment. During the staff's review of the suitability of the Exelon ESP site, it considered impacts from discharge of heated effluent (e.g., water temperature, dissolved oxygen, thermal stratification, impacts to Salt Creek fauna), cold shock, and chemical treatment of the cooling water. Because the NPDES permit issued by IEPA would govern the operational impacts to the aquatic environment whether the facility operated alone or jointly with the CPS, the operational impacts of water discharge from a new nuclear unit at the Exelon ESP site on aquatic organisms would normally be SMALL. However, following dry years, the cumulative impacts of operation on the aquatic environment could be MODERATE.

7.6 Socioeconomics, Historic and Cultural Resources, Environmental Justice

Much of the analyses of the socioeconomic impacts presented in Sections 4.5 and 5.5 already incorporate cumulative impact analysis because the metrics used for analysis only make sense when placed in the total or cumulative context. For instance, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number that will be available in the impacted area. Therefore, the geographical area of the cumulative analysis varies depending on the particular impact considered, and may depend on specific boundaries, such as taxation jurisdictions, or may be distance-related, as in the case of environmental justice.

The construction and operation of a new nuclear unit at the Exelon ESP site would not likely add to any cumulative socioeconomic impacts beyond those already evaluated in Sections 4.5 and 5.5. In other words, the impacts of issues such as transportation or taxes would not likely be detectable beyond the regions previously evaluated and would quickly decrease with increasing distance from the site. The staff concludes that construction and operational impacts would generally be SMALL but that there are exceptions. In chapter 4, the staff concluded that the impacts of construction on traffic would be SMALL considering both the construction workforce and the normal CPS workforce. However, the staff also concludes that during an outage at the CPS the combined workforces for construction of a new unit, operation of the CPS, and the outage could have MODERATE impact on traffic. Various measures, including staggered shifts and car pooling could be used to mitigate the impact during these periods.

In terms of beneficial effects, the impact on regional economies and tax revenues would be beneficially SMALL to LARGE, particularly property taxes to DeWitt County resulting from station operations. Impacts of station construction and operation on housing would be SMALL to MODERATE, particularly in DeWitt, Piatt, and Logan Counties if workers decided to locate to these smaller counties where housing is less available (but this is considered a low probability because of available housing in the larger cities near the ESP site). Aesthetic impacts of station operation would be SMALL to MODERATE. There is a concern about the impact of a new nuclear unit's cooling system on Clinton Lake water levels during times of severe drought (considered a rare event), which in turn could have impacts on the recreational use of the lake.

With regard to historic and cultural resources, the construction and operation of a new nuclear unit at the ESP site is not expected to add to any cumulative impacts to these resources beyond those identified in Sections 4.6 and 5.6. Construction, operation, and maintenance of a new nuclear unit would not affect land outside the bounds of current CPS operations; therefore, additional cumulative impacts would be negligible. The staff concludes that the cumulative impacts of construction and operation on historic and cultural resources would be SMALL and that mitigation would not be warranted.

The staff found no unusual resource dependencies or practices through which minority or low-income populations would be disproportionately affected. As a result, cumulative impacts of environmental justice would be SMALL.

Based on the above considerations, the staff concludes that construction and operation of a new nuclear unit at the Exelon ESP site would not likely make a detectable contribution to the cumulative effects associated with any of the socioeconomic issues, including environmental justice. The majority of overall cumulative impacts would be SMALL, and impacts that could be more severe are based on events of low probability or events that could be managed. The staff concludes that the overall cumulative impacts would be SMALL and no mitigation measures other than those identified by Exelon would be warranted.

7.7 Nonradiological Health

In Section 5.8.1, the cumulative health impacts of construction and operation of the existing CPS and a new nuclear unit at the Exelon ESP site on the ambient temperature of Clinton Lake with regard to potential formation of thermophilic microorganisms were evaluated. The evaluation showed that the addition of a new nuclear unit would not increase the temperature in Clinton Lake enough to create an environment conducive to the optimal growth of thermophilic microorganisms. Health risks to workers can be expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts to the public and workers from noise, dust emissions, and acute and chronic electromagnetic fields were also evaluated and found to be small. The staff concludes that the cumulative impacts to nonradiological health would be SMALL and that mitigation would not be warranted.

7.8 Radiological Impacts of Normal Operation

The radiological exposure limits and standards for the protection of the public and for occupational exposures have been developed assuming long-term exposures and, therefore, incorporate cumulative impacts. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of a new nuclear unit at the Exelon ESP site are well below regulatory limits and standards. For purposes of this analysis, the area within an 80-km (50-mi) radius of the ESP site was included. As stated in Section 2.5, AmerGen has conducted a radiological environmental monitoring program (REMP) around the CPS site since 1987. The REMP measures radiation and radioactive materials from all sources including CPS. The U.S. Nuclear Regulatory Commission and the State would regulate any reasonably foreseeable future actions that could contribute to cumulative radiological impacts.

Therefore, the staff concludes that the cumulative radiological impacts of operation of a new nuclear unit at the Exelon ESP site and the currently operating CPS would be SMALL and that additional mitigation would not be warranted.

7.9 Staff Conclusions and Recommendations

The staff considered the potential impacts resulting from construction and operation of a new nuclear unit during the past, present, and future actions in the Exelon ESP site area. For each impact area, the staff's determination is that the potential cumulative impacts resulting from construction and operation would be SMALL and that mitigation would not be warranted.

7.10 References

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Council on Environmental Quality."

Clean Water Act (CWA). 1977. 33 USC 1251, et seq.

Exelon Generation Company, LLC (Exelon). 2003. *Exelon Generation Company, LLC, Early Site Permit Application: Environmental Report*. Exelon Nuclear, Kennett Square, Pennsylvania.

Illinois Power Company (IPC). 1974. "Final Environmental Statement Related to the Proposed Clinton Power Station Units 1 and 2." Illinois Power Company, Docket Nos. 50-461 and 50-462. Prepared by U.S. Atomic Energy Commission, Directorate of Licensing.

Lutterbie, G. 2002. *Clinton Lake Access Areas and Fishing Guide.* Illinois Department of Natural Resources, Division of Fisheries, Springfield, Illinois.

Pallo, M.S. 1988. *Clinton Power Station Fish Impingement Report, April 1987–May 1988.* Illinois Power Company, Environmental Affairs Department, Field Biology Laboratory, Decatur, Illinois.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan (ESRP).* NUREG-1555, Vol. 1, NRC, Washington, D.C.

8.0 Environmental Impacts of the Alternatives

This chapter describes alternatives to the proposed action and discusses the environmental impacts of those alternatives. The evaluation of alternative sites is a two-step process, as set forth in NUREG-1555, Section 9.3 (NRC 2000), and stems from the U.S. Nuclear Regulatory Commission (NRC) decision related to licensing the Seabrook Nuclear Power Plant (5 NRC 503, 1997). The first step looks at a full suite of environmental issues, using reconnaissance-level information to determine if any of the alternative sites are environmentally preferable to the proposed site. If an alternative site appears environmentally preferable to the proposed site, then the analysis proceeds to the second step. If not, then the evaluation of alternative sites ends at the first step. The second step considers economic, technological, and institutional factors among the environmentally preferred sites to determine if any is obviously superior to the proposed site. If there is no obviously superior site, then the proposed site prevails. A staff conclusion that an alternative site is obviously superior to Exelon's proposed site would normally lead to a recommendation that the ESP application be denied.

The environmental impacts of the alternatives are evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B. 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. While the GEIS was developed for license renewal, it provides useful information for this review and is referenced throughout this chapter.

Because 10 CFR Part 52 does not require an Environmental Report (ER) or environmental impact statement (EIS) for an ESP to include consideration of the benefits of construction and operation of a new reactor or reactors at the ESP site, this EIS does not consider such matters. Accordingly, should the NRC issue an ESP for the Exelon site, these matters will be considered in the EIS for any construction permit (CP) or combined license (COL) application that references such an ESP.

Section 8.1 discusses the no-action alternative. Section 8.2 addresses alternative energy sources. Section 8.3 examines the design alternatives. Section 8.4 reviews Exelon's region of interest (ROI) and examines the suitability of the ROI and Exelon's alternative site-selection process. It describes the method Exelon used to select the candidate and alternative sites. Section 8.5 evaluates the selected alternative sites individually. Section 8.6 examines issues

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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.

that are common to all the sites and addresses them collectively for all the sites. Section 8.7 summarizes the environmental impacts for the alternative sites. The comparison of the alternative sites with the proposed site is made in Chapter 9.

8.1 No-Action Alternative

For purposes of this ESP application, the no-action alternative refers to a scenario in which the NRC would deny the ESP request. Upon such a denial, the construction and operation of a new nuclear power station at the proposed ESP location in accordance with the 10 CFR Part 52 process referencing an approved ESP would not occur.

The no-action alternative consists of two parts. First, the no-action alternative would include a scenario in which the NRC would not issue the ESP. There are no environmental impacts associated with not issuing the ESP except that the impacts associated with site-preparation and preliminary work allowed pursuant to 10 CFR 52.17(c) and 10 CFR 52.25(a) would be avoided. Second, given that the EIS addresses the environmental effects of construction and operation as directed by the Commission in 10 CFR 52.18(a)(2), the no-action alternative would result in no such construction and operation. Therefore, the impacts predicted in this EIS would not occur.

In this context, the no-action alternative would accomplish none of the benefits intended by the ESP process, which would include (1) early resolution of siting issues prior to large investments of financial capital and human resources in new plant design and construction, (2) early resolution of issues on the environmental impacts of construction and operation of reactors that fall within the plant parameters, (3) the ability to bank sites on which nuclear plants may be located, and (4) the facilitation of future decisions on whether to build new nuclear plants.

8.2 Energy Alternatives

This section examines the potential environmental impacts associated with electric generating sources other than a new nuclear unit at the Exelon ESP site; purchasing electric power from other sources to replace power that would have been generated by a new unit at the ESP site; a combination of new generating capacity and conservation measures; and other generation alternatives that were deemed not to be viable replacements for a new unit at the ESP site.

A new nuclear unit at the Exelon ESP site would be constructed and operated as a merchant independent power producer (also referred to as a "merchant plant" or "merchant generator"). The power produced would be sold on the open wholesale market, without specific consideration to supplying a traditional service area or satisfying a reserve margin objective. Thus, for the purpose of this alternatives analysis, an ROI has been defined by Exelon as the State of Illinois rather than the more traditional "relevant service area." The delineation of this

ROI is in keeping with current deregulation policies and the proposed location of the facility within the State of Illinois.

8.2.1 Alternatives Not Requiring New Generating Capacity

As described in its ER, from Exelon's perspective, alternatives not requiring additional generation are not reasonable alternatives to a merchant plant. Nevertheless, Exelon considered alternatives not requiring new generating capacity. This section provides an assessment of the economic and technical feasibility of supplying the demand for energy without constructing new generating capacity. Specific elements of analysis could include one or more of the following:

- initiating energy-conservation measures (including implementing demand-side management [DSM] actions)
- purchasing power from other utilities or power generators
- reactivating or extending the service life of existing plants within the power system.

8.2.1.1 Energy Conservation

Historically, State regulatory bodies have required regulated utilities to institute programs designed to reduce demand for electricity. DSM programs included energy-conservation and load-modification measures. In the current deregulated Illinois market, Exelon anticipates that it will not be able to offer competitively priced power if it has to retain an extensive program involving conservation and load-modification incentives (Exelon 2003).

Market and regulatory conditions have undergone dramatic changes in the deregulated market. Changes that have significantly impacted the cost-effectiveness of utility-sponsored DSM activities include a decline in generation costs due to technological advances in electricity generation and national energy legislation that places more reliance on market forces to direct resource planning. Energy efficient appliances and more stringent building codes have also reduced the potential for cost-effective utility-sponsored measures. Finally, third parties in those States deregulated or transitioning to deregulation are increasingly providing load-management services (Exelon 2003).

For these reasons, Exelon determined that DSM programs, which are primarily directed toward load management, are not a sufficient substitute for the generation contemplated at the ESP site (Exelon 2003). The NRC staff reviewed Exelon's assumptions and analysis and concluded that the findings are reasonable.

8.2.1.2 Purchased Power

Power generation is expected to be fully deregulated by the time Exelon would apply for a CP or COL for the ESP site (Exelon 2003). Overall, Illinois is a net exporter of electricity.

If available, purchased power from other sources could make a new nuclear unit at the ESP site unnecessary. Imported power from Canada or Mexico is unlikely to be available to supply the equivalent capacity of a new unit at the site. In Canada, 60 percent of the country's electricity capacity is derived from renewable sources, principally hydropower (DOE/EIA 2004a). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale projects (DOE/EIA 2004a). Canada's nuclear generation is projected to increase from 10,018 megawatts in 2001 to 15,207 megawatts by 2020, or an increase of 52 percent, before beginning to decline to 12,351 megawatts at the end 2025 (DOE/EIA 2004a). The Energy Information Administration (EIA) projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 47.4 billion kilowatt-hours in 2000 to 66.1 billion kilowatt-hours in 2005, and then gradually decrease to 47.4 billion kilowatt-hours in 2020 (DOE/EIA 2001a).

Exelon has evaluated conventional and prospective purchase power supply options that could be reasonably implemented in Illinois. In 1999, Unicom's subsidiary ComEd completed a sale of its coal, gas, and oil units to Midwest Generation. As part of the sale, Unicom entered into long-term purchase contracts with Midwest Generation to provide firm capacity and energy (ComEd 1999). Power covered by these contracts is already included in current and future capacity estimates. Therefore, Exelon does not consider the power purchased by these contracts to be available to satisfy the purchased power alternative.

If power to replace the capacity of a new nuclear unit were to be purchased from sources within the United States or from a foreign country, the generating technology likely would be one of those described in the GEIS for License Renewal (probably coal, natural gas, or nuclear) (NRC 1996). The description of the environmental impacts of other technologies described in the GEIS is representative of the impacts associated with the construction and the operation of a new nuclear unit at the ESP site. Under the purchased power alternative, the environmental impacts of power production would still occur, but would be located elsewhere within the region or the Nation or in another country.

If the purchased power alternative is implemented, the only environmental unknown is whether new transmission line rights-of-way would be required. The construction of these lines could have both environmental and aesthetic consequences, particularly if new rights-of-way have to be acquired. The staff concludes that the local environmental impacts from purchased power would be SMALL when existing transmission line rights-of-way are used and could range from SMALL to LARGE if acquisition of new rights-of-way is required. The environmental impacts of power generation depend on the generation technology and location of the generation site and are, therefore, unknown.

8.2.1.3 Extending the Service Life of Existing Plants

Fossil plants slated for retirement, predominately coal- and natural-gas-fired plants, tend to be ones that are old enough to have difficulty in economically meeting today's restrictions on air-contaminant emissions and, as a result, would require extensive refurbishing to meet the more restrictive environmental standards at great economic cost. As a result, Exelon concluded that the environmental impacts of a refurbishment scenario are bounded by its coal- and natural-gas-fired alternatives.

Nuclear power plants are initially licensed for a period of 40 years. The license can be renewed for 20 years, and regulations permit additional license renewal. Exelon did not consider nuclear power plant license renewal in its ER. However, renewed operating licenses were granted for Quad Cities, Units 1 and 2, and Dresden, Units 2 and 3, which are located at alternative ESP sites. The operating licenses for reactors at the Braidwood, Byron, and LaSalle sites may be renewed in the future. The reactors at the Zion site have permanently ceased operation, and the option of renewal of the operating licenses no longer exists for these reactors.

The environmental impacts of continued operation of a nuclear power plant are significantly less than construction of a new plant. However, continued operation of an existing nuclear plant does not provide additional generating capacity.

8.2.1.4 Conclusions

Exelon evaluated conservation, purchased power, and extension of plant life as alternatives to a new nuclear unit at the Exelon ESP site. The staff reviewed Exelon's evaluation and concludes that these alternatives are not reasonable alternatives to a new nuclear unit.

8.2.2 Alternatives Requiring New Generating Capacity

In keeping with the NRC's evaluation of alternatives to license renewal, a reasonable set of energy alternatives to the construction and operation of a new nuclear unit at the Clinton ESP site should be limited to analysis of single discrete power generation sources and those power generation technologies that are technically reasonable and commercially viable (NRC 1996). The current mix of power-generation options in Illinois is one indicator of the feasible choices for electrical generation technology within the State. Exelon employed the criterion of generation capacity (installed technology choices in terms of its potential output) and utilization characteristics (the degree to which each choice is actually used) to select those technologies to be evaluated.

8.2.2.1 Coal-Fired Generation

In 2001, coal-fired steam electric plants provided about 49 percent of the electric power generation in the United States. The share of coal-fired power generation is projected to increase from 49 percent in 2001 to 52 percent in 2025 as rising natural gas prices improve the cost competitiveness of coal-fired technologies. Some 112 gigawatts of new coal-fired generating capacity is expected to be constructed by 2025 (DOE/EIA 2004b). However, in Illinois coal-fired generation fell from 46.1 percent of total generating capacity in 1993 to 35.0 percent in 2002 (DOE/EIA 1998).

The environmental impacts of constructing and operating a typical coal-fired steam plant are well known and can be substantial. Exelon defined the coal-fired alternative as four 550-MW(e) units. Exelon chose this configuration to have parity with the gas-fired alternative described in Section 8.2.2.2. Exelon based its emission-control technology and percent-control assumptions on alternatives that the U.S. Environmental Protection Agency (EPA) has identified as being available for minimizing emissions (EPA 1998). For the purposes of analysis, Exelon has assumed that coal and lime (calcium oxide) would be delivered by rail to the Clinton site. The staff has reviewed Exelon's assumptions, compared them to other resource material (including NRC 1996), and has found them to be reasonable.

Two types of cooling systems can be used for a coal-fired system: closed-cycle and once-through cooling. A closed-cycle system uses cooling towers, thus creating some aesthetic impacts and potential ecological impacts from cooling tower spray drift. Once-through cooling systems do not use cooling towers, resulting in less land being impacted. However, with respect to surface-water use and quality, there would be an increased thermal load on the receiving body of water, with ecological and aquatic impacts.

Air Quality

The fugitive dust emissions from construction activities for a coal-fired generation plant are expected to be mitigated using best management practices; emissions will be temporary. The impacts to air quality from coal-fired generation would vary considerably from those of nuclear power generation because of emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), particulates, and hazardous air pollutants, such as mercury. Exelon has assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. Exelon (Exelon 2003) estimates the coal-fired alternative emissions for SO_x, NO_x, CO, and total suspended particulates (TSP) and its subset of particulate matter (PM) of 10 microns in diameter or less (PM_{10}) to be as follows:

- SO_x = 7373 MT (8127 tons) per year
- NO_x = 1863 MT (2054 tons) per year
- CO = 1921 MT (2118 tons) per year
- PM:
  - -TSP = 265 MT (292) tons per year
  - -PM_{10} = 61 MT (67 tons) per year

In 2002, emissions of SO_2, NO_x, and CO from Illinois's generators ranked 11th, 4th, and 6th highest nationally, respectively (DOE/EIA 2002). In fact, 17 Illinois generators were cited in the Clean Air Act Amendments of 1990, which required that they be in compliance with stricter emission controls for SO_2 and NO_x by 1995 (Exelon 2003). The acid rain requirements of the Clean Air Act Amendments capped the Nation's SO_2 emissions from power plants. Exelon would have to obtain sufficient pollution credits either from a set-aside pool or purchases on the open market to cover annual emissions from the plant.

The market-based allowance system used for sulfur dioxide emissions is not used for nitrogen oxide emissions. Therefore, this approach may not be feasible for NO_x emissions. The Illinois Environmental Protection Agency (IEPA) allocated NO_x credits among the existing coal-fired generating units in the State (IAC 2004). A new coal-fired power plant would be subject to the new source performance standard for such plants (40 CFR 60.44a(d)(1)), which limits the discharge of any gases that contain nitrogen oxides (expressed as nitrogen dioxide) to 200 ng/J (1.6 lb/MWh) of gross energy output, based on a 30-day rolling average. Mitigation efforts for air-pollution emissions (e.g., emissions trading) generally apply to nonattainment areas. The Clinton ESP site is in an attainment area. Only a small percentage of credits were set aside by the IEPA for new sources. The ESP site would be classified as a new source (Exelon 2003). Under the current circumstances, mitigation strategies for air emissions could be economically prohibitive.

A new coal-fired generation plant would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act Amendments of 1990. The plant would need to comply with the new source performance standards for such plants in 40 CFR Part 60, Subpart Da. The standards establish emission limits for particulate matter and opacity (40 CFR 60.42a), sulfur dioxide (40 CFR 60.43a), and nitrogen oxide (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 for unclassified for criteria pollutants under the Clean Air Act. Criteria pollutants under the Clean Air Act are lead, ozone, particulates, carbon monoxide, nitrogen oxides, and sulfur dioxide. Ambient air quality standards for criteria pollutants are in 40 CFR Part 50. The Clinton ESP site is in an area designated as in attainment or unclassified for criteria pollutants (40 CFR 81.325).

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 occurs because of air pollution resulting from human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308(d)(1)). If a new coal-fired power generation station were located close to a mandatory Class I area, then additional air pollution control requirements would be imposed. There are no mandatory Class I Federal areas in Illinois or downwind in Indiana.

The staff concludes that the environmental impacts on air quality of coal-fired power generation of 2200 MW(e) at the Exelon ESP site would be MODERATE to LARGE. The impacts would be clearly noticeable and, given the current state of Illinois air quality for SO_x and NO_x, could destabilize air quality.

Waste Management

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, and scrubber sludge. Exelon estimates that coal-fired generation of 2200 MW(e) would consume 7.7×10^6 MT (8.5×10^6 tons) of coal and produce approximately 5.3×10^5 MT (5.8×10^5 tons) of recoverable ash per year. Eighty-seven percent of the ash would be recycled, leaving approximately 6.9×10^4 MT (7.6×10^4 tons) of ash per year for disposal. SO_x-control equipment would generate another 4.0×10^5 MT (4.4×10^5 tons) per year of waste in the form of scrubber sludge. Approximately 94 ha (234 ac) would be required as a waste disposal site for both the ash and sludge over the 40-year life of the plant (Exelon 2003).

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (EPA 2000). The EPA concluded that some form of national regulation is warranted to address coal-combustion waste products because of health concerns. Accordingly, EPA announced its intention to issue regulations for disposal of coal-combustion waste under Subtitle D of the Resource Conservation and Recovery Act of 1976 (RCRA 1976). Exelon concludes that waste disposal would not destabilize any resources with proper placement of the facility, coupled with current waste-management and monitoring practices. There would be space within the ESP site footprint for this disposal. After closure of the waste site and revegetation, the land would be available for other uses (Exelon 2003).

For the reasons stated above, the staff concludes that the impacts of disposing of waste generated from burning coal would be MODERATE.

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. In addition, the discharges of uranium and thorium from coal-fired plants can produce radiological doses in excess of those from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including the 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. The EPA has recently concluded that certain segments of the United States 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, given the regulatory oversight exercised by the EPA and State agencies, the staff concludes that the human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal at newly constructed coal-fired plants would be SMALL.

Other Impacts

Construction of the power block and coal storage area would impact approximately 120 ha (300 ac) of land at the Clinton site. This land was disturbed during construction of Clinton Power Station (CPS). Additional land might be needed in the site vicinity for transportation facilities, infrastructure facilities, waste disposal, rail spur, and cooling water intake and discharge facilities. Further impacts for coal and limestone mining would occur in areas remote from the ESP site. Therefore, the staff concludes that the land-use impacts of siting, constructing, and operating a coal-fired unit at the ESP site would be MODERATE.

Constructing and operating a coal-fired generation plant would have ecological impacts that could include wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity. The impacts could occur at the ESP site and at the sites used for coal and limestone mining. Extraction of additional cooling makeup water could have adverse impacts on aquatic resources. Construction and maintenance of a rail spur and, if needed, new or improved transmission lines would have ecological impacts. Cooling tower drift would have minimal impacts on terrestrial ecology. Disposal of fly ash could affect water quality and the aquatic environment. The impacts to threatened and endangered species would be similar to those of a new nuclear plant. Overall, the staff concludes that the ecological impacts would be MODERATE to LARGE.

Erosion and sedimentation from construction activities would be minimized by using best management practices. Impacts to water use and water quality would be MODERATE due to the plant's use of a new cooling water system if once-through cooling were used. Use of cooling towers for coal-fired generation would reduce cooling water intake and discharge water usage by 90 percent compared to once-through cooling. Hybrid wet/dry cooling towers might be used to reduce makeup water consumption to match water demand with available water supply. The staff concludes that the impacts to water resources would be SMALL, if cooling towers were employed, or MODERATE to LARGE, if they were not.

Socioeconomic impacts would result from the approximately 250 people needed to operate the coal-fired facility, demands on housing and public services during the construction period, and loss of jobs after construction. The staff concludes that these impacts would be SMALL, due to the mitigating influence of the site's proximity to the surrounding population area and the small number of employees required to operate the plant. The plant would pay property taxes to DeWitt County. Considering the population and economic condition of the County, the staff concludes that the taxes would have a MODERATE to LARGE (beneficial) impact on the County.

Constructing and operating a coal-fired unit would be consistent with the industrial nature of the ESP site. Coal delivery would add noise and transportation impacts associated with train traffic. Considering the rural character of the surrounding area, the staff concludes that these impacts would be SMALL. Although best management practices would be expected to be implemented to mitigate impacts (for example, noise), the viewshed would be impacted by the presence of large physical structures and plumes from a stack and from cooling towers, if cooling towers were employed. Therefore, the staff concludes that visual and aesthetic impacts of coal-fired power generation would be MODERATE.

The ESP site was disturbed during construction of the Clinton Power Station (CPS). As a result, historic and cultural resource impacts would be unlikely and could be minimized by survey and recovery techniques, if needed. A cultural resources inventory would likely be needed for any on-site property that had 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 recovery of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impact of new power plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site, any offsite affected areas, such as mining and waste disposal sites, and along associated corridors where new construction would occur (for example, roads, transmission line rights-of-way, rail lines, or other rights-of-way). Therefore, the staff concludes that historic and cultural resource impacts would be SMALL.

There is no evidence of environmental justice issues at the ESP site. Therefore, the staff concludes that environmental justice impacts would be SMALL.

Other construction and operation impacts would be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts, mitigation would not be warranted beyond that discussed.

The environmental impacts of constructing coal-fired power generation of 2200 MW(e) at the ESP site are summarized in Table 8-1.

8.2.2.2 Natural-Gas-Fired Generation

Exelon chose to evaluate natural-gas-fired generation. Four natural-gas-fired, combined-cycle plants of 550-MW(e) net capacity, consisting of two 184-MW(e) gas turbines (e.g., General Electric Frame 7FA) and 182 MW(e) of heat-recovery capacity were considered for a total of 2200 MW(e). Exelon based its emission control technology and emission control assumptions on alternatives that the EPA has identified as being available for minimizing emissions (EPA 1998). For the purposes of analysis, Exelon has assumed that there would be sufficient natural gas available. The staff reviewed Exelon's assumptions and found them reasonable.

Natural gas-fired generators can also employ closed-cycle or once-through cooling systems. A closed-cycle system uses cooling towers, thus creating some aesthetic impacts and potential ecological impacts from cooling tower spray drift. Once-through cooling systems do not use cooling towers, resulting in less land being impacted. However, with respect to surface-water use and quality, there would be an increased thermal load on the receiving body of water, with ecological and aquatic impacts. The environmental impacts would be similar to those of a coal-fired generating system employing the same technology.

Air Quality

It is expected that the fugitive dust emissions from construction activities for a natural gas-fired generation plant would be mitigated using best management practices, so emissions would be temporary. Natural gas is a relatively clean-burning fossil fuel and is more efficient in generating electricity than a similar size coal-fired plant. It would release similar types of

Table 8-1. Summary of Environmental Impacts of Coal-Fired Power Generation - 2200 MW(e)

Impact Category	Impact	Comment
Air Quality	MODERATE to LARGE	SO_x: 7373 MT (8127 tons) per year NO_x: 1863 MT (2054 tons) per year CO: 1921 MT (2118 tons) per year TSP: total PM: 265 MT (292 tons) per year PM_{10}: 61 MT (67 tons) per year Some hazardous air pollutants.
Waste Management	MODERATE	69,000 MT (76,000 tons) of ash would require disposal. 400,000 MT (440,000 tons) of scrubber sludge would require disposal. 94 ha (234 ac) would be needed for ash and sludge disposal.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Land Use	MODERATE	120 ha (300 ac) of previously disturbed land at the ESP site for power block and coal storage area. Additional land may be needed for infrastructure and other facilities. Mining activities would have additional impacts offsite.
Ecology	MODERATE to LARGE	Construction of a new cooling-water system. Potential impacts from transmission; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to LARGE	Impact depends on volume of water withdrawal and discharge, the constituents in the discharge water, and the characteristics of the surface-water body. Discharge of cooling tower blowdown would have impacts if cooling towers were built.
Socioeconomic	SMALL (Adverse) to LARGE (Beneficial)	Impacts from 250 people to operate plant would be absorbed easily across the region. Property tax impacts to DeWitt County would have a significant beneficial impact. Construction worker impacts would be temporary.
Aesthetics	MODERATE	ESP site is zoned industrial and located in a rural area. Existing operating nuclear facility onsite. Construction impacts minimized through use of best management practices. Viewshed would have permanent impacts from physical structures and plumes.
Historic and Cultural Resources	SMALL	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on previously disturbed ground. Impacts to offsite properties could be mitigated by inventory, identification and recovery techniques.
Environmental Justice	SMALL	No evidence of environmental justice issues around the ESP site.

emissions, but in lesser quantities than the coal-fired alternative. Exelon estimated the natural-gas-fired alternative emissions as follows (Exelon 2003):

- SO_x = 161 MT (177 tons) per year
- NO_x = 515 MT (568 tons) per year
- CO = 109 MT (120 tons) per year
- TSP = 90 MT (99 tons) per year (all particulates are PM_{10}).

Control technology for natural-gas-fired turbines focuses on the reduction of NO_x emissions. Clean Air Act requirements for coal-fired generation, discussed in 8.2.2.1, are also applicable to the gas-fired generation alternative. NO_x effects on ozone levels, SO_x allowances, and NO_x emission offsets could be issues of concern for gas-fired combustion. There are no mandatory Class I Federal areas in Illinois or downwind in Indiana.

The staff concludes that the environmental impacts on air quality of natural gas-fired power generation of 2200 MW(e) at the Exelon ESP site would be SMALL to MODERATE.

Waste Management

Natural gas-fired power generation would result in almost no waste generation. Combustion of natural gas results in few by-products because of the clean nature of the fuel. The only significant waste generated at a natural-gas-fired plant would be the catalyst used in control of NO_x emissions. The spent catalyst, estimated by the NRC staff to be approximately 38 m^3/yr, could be regenerated or disposed of offsite. Overall, the staff concludes that the waste impacts would be SMALL for natural gas-fired power generation.

Human Health

In the GEIS for License Renewal, the staff identified cancer and emphysema as potential health risks from natural gas-fired plants (NRC 1996). NO_x emissions contribute to ozone formation, which in turn affects human health. However, it is not expected that human health effects would be detectable. Therefore, the staff concludes that the impacts of natural gas-fired power generation on human health would be SMALL.

Other Impacts

The staff estimates that 44 ha (110 ac) would be needed for a four natural gas-fired, combined-cycle plant. The disturbed land area at the ESP site exceeds this land requirement (Exelon 2003). The construction of a pipeline to bring natural gas to the CPS site would result in land impacts. To minimize such impacts, Exelon would route the pipeline along previously disturbed rights-of-way to the extent practical. There could be some temporary ecological damage associated with the burial of the pipeline underground. An easement encompassing 12 to

16 ha (30 to 40 ac) would need to be graded to install the pipeline (Exelon 2003). Therefore, the staff concludes that the land use environmental impacts would be SMALL.

Constructing and operating a natural gas-fired generation plant would have limited ecological impacts at the ESP site. Withdrawal of additional cooling makeup water could have adverse impacts on aquatic resources. Construction and maintenance of the natural gas pipeline and, if needed, new or improved transmission lines would have ecological impacts. Cooling tower drift would have minimal impacts on terrestrial ecology. The impacts to threatened and endangered species would be similar to those of a new nuclear unit. Overall, the staff concludes that the ecological impacts would be SMALL to MODERATE.

Erosion and sedimentation from construction activities would be minimized by using best management practices. Impacts to water use and water quality would be MODERATE due to the unit's use of a new cooling water system if once-through cooling were used. Use of cooling towers for gas-fired generation would reduce cooling water intake and discharge water usage by 90 percent compared to once-through cooling. Hybrid wet/dry cooling towers might be used to reduce makeup water consumption to match water demand with available water supply. The staff concludes that the impacts to water resources would be SMALL, if cooling towers were employed, or MODERATE to LARGE, if they were not.

Socioeconomic impacts would result from the approximately 40 to 80 people needed to operate the natural gas-fired facility, demands on housing and public services during the construction period, and loss of jobs after construction. The staff concludes that these impacts would be SMALL due to the mitigating influence of the site's proximity to the surrounding population area and the small number of employees required to operate the unit. The plant would pay property taxes to DeWitt County. Considering the population and economic condition of the County, the staff concludes that the taxes would have a MODERATE to LARGE (beneficial) impact on the County.

Constructing and operating a natural gas-fired unit would be consistent with the industrial nature of the ESP site. Considering the rural character of the surrounding area, the staff concludes that noise-related impacts would be SMALL. Although best management practices would be expected to be implemented to mitigate impacts, the viewshed would be impacted by the presence of large physical structures and plumes from a stack and from cooling towers, if cooling towers were employed. Therefore, the staff concludes that visual and aesthetic impacts of natural gas-fired power generation would be MODERATE.

The ESP site was disturbed during construction of the Clinton Power Station (CPS). As a result, historic and cultural resource impacts would be unlikely and could be minimized by survey and recovery techniques, if needed. A cultural resources inventory would likely be needed for any on-site property that had not been previously surveyed. Other lands, if any, that are acquired to support the unit would also likely need an inventory of field cultural resources, identification and recovery of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impact of new power plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and any offsite affected areas where new construction would occur (for example, roads, transmission line rights-of-way, pipelines, or other rights-of-way). Therefore, the staff concludes that historic and cultural resource impacts would be SMALL.

There is no evidence of environmental justice issues at the ESP site. Therefore, the staff concludes that environmental justice impacts would be SMALL.

Other construction and operation impacts would be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts, mitigation would not be warranted beyond that mentioned.

The environmental impacts of constructing natural gas-fired power generation of 2200 MW(e) at the ESP site are summarized in Table 8-2.

8.2.3 Other Alternatives

This subsection discusses alternatives that Exelon has determined are not reasonable, the basis given by Exelon for this determination, and the staff conclusions about the overall environmental impact of each alternative. A new nuclear unit at the ESP site would be a baseload generator and merchant plant. Any feasible alternative to this facility would need to generate baseload power. In performing its initial evaluation in the ER, Exelon relied heavily on the GEIS for License Renewal (NRC 1996). Subsequently, in response to an NRC request, Exelon submitted an updated analysis of the wind and solar alternatives (Exelon 2004b). The staff reviewed the information submitted by Exelon and conducted its own independent review and finds that Exelon's conclusion that these generation options are not reasonable alternatives to a new nuclear unit is acceptable.

The staff has not assigned significance levels to the environmental impacts associated with the alternatives discussed in this section because, in general, the generation alternatives would have to be installed at a location other than the ESP site. Any attempt to assign significance levels would require staff speculation about the unknown site.

Table 8-2. Summary of Environmental Impacts of Natural Gas-Fired Power Generation - 2200 MW(e)

Impact Category	Impact	Comment
Air Quality	SMALL to MODERATE	SO_x: 161 MT (177 tons) per year NO_x: 515 MT (568 tons) per year CO: 109 MT (120 tons) per year TSP: all PM_{10}: 90 MT (99 tons) per year Some hazardous air pollutants.
Waste Management	SMALL	38m^3 of spent catalyst would be regenerated or would require disposal.
Human Health	SMALL	Health effects would not be detectable if technology met regulatory controls.
Land Use	SMALL	44 ha (110 ac) of previously disturbed land at the ESP site for power block, offices, roads, and parking areas. Additional land might be needed for infrastructure and other facilities.
Ecology	SMALL to MODERATE	Construction of a new cooling-water system. Potential impacts from transmission; limited habitat loss and fragmentation; limited impact to productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to LARGE	Impact depends on volume of water withdrawal and discharge, the constituents in the discharge water, and the characteristics of the surface-water body. Discharge of cooling tower blowdown would have impacts if cooling towers were built.
Socioeconomic	SMALL (Adverse) to LARGE (Beneficial)	Impacts from 40-80 people to operate plant would be absorbed easily across the region. Property tax impacts to DeWitt County would have a significant beneficial impact. Construction worker impacts would be temporary.
Aesthetics	MODERATE	ESP site is zoned industrial and located in a rural area. Existing operating nuclear facility onsite. Construction impacts minimized through use of best management practices. Viewshed would have permanent impacts from physical structures and plumes.
Historic and Cultural Resources	SMALL	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on previously disturbed ground. Impacts to offsite properties could be mitigated by inventory, identification and recovery techniques.
Environmental Justice	SMALL	No evidence of environmental justice issues around the ESP site.

8.2.3.1 Wind

Approximately 8 percent of the land area in Illinois has a wind-power classification sufficient to support wind generation of power (Exelon 2003). The current estimate of the National

Renewable Energy Laboratory is that there are approximately 1800 km^2 (700 mi^2) of land in Illinois suitable for wind development with a 9000-MW(e) wind potential (NREL 2004). The closest region to the ESP site with a good wind resource is found in the Bloomington area, about 40 km (25 mi) north of the site.

There have been various environmental concerns related to wind generation, including land usage and bird collisions. Approximately 20 ha (50 ac) are required per installed MW(e). This requirement is about a factor of 3 lower than estimated in the GEIS for License Renewal (NRC 1996) and assumed by Exelon (2003). Although the land requirement for wind generation is large, only a small fraction of the total land requirement need be dedicated solely to wind generation. Much of the land in the vicinity of wind turbines can be used for agriculture. Bird collisions have not proven to be the problem that was predicted. They have only been a serious concern at one location, Altamont Pass in California. The wind industry has learned to avoid locations that pose problems for birds (DeMeo and Parsons 2003).

However, wind power, by itself, is not suitable for large baseload capacity. As discussed in the GEIS for License Renewal (NRC 1996), wind has a high degree of intermittence, and average annual capacity factors for wind plants are relatively low (less than 30 percent). In conjunction with energy storage mechanisms, wind power might serve as a means of providing base-load power. However, current energy storage technologies are too expensive for wind power to serve as a large baseload generator. Based on the intermittent nature of the wind resource, the staff concludes that wind power generation is not a viable alternative to the baseload capacity that would be offered by a new nuclear unit at the ESP site.

8.2.3.2 Geothermal

Although geothermal plants might be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent (NRC 1996), there are no high-temperature geothermal sites in Illinois. Therefore, the staff concludes that geothermal is not a reasonable alternative to a new nuclear unit at the ESP site.

8.2.3.3 Hydropower

A small portion (about 80 MW) of Illinois utility generating capacity is hydroelectric. As discussed in the GEIS for License Renewal (NRC 1996), the percentage of U.S. generating capacity from hydropower 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 destruction of natural river courses. According to the U.S. Hydropower Resource Assessment for Illinois (INEL 1997), there are no remaining sites in Illinois that would be environmentally suitable for a large hydroelectric facility.

The GEIS for License Renewal (NRC 1996) estimates land-use requirements of 4100 km^2 (1600 mi^2) per 1000 MW(e) for hydroelectric power. Based on this estimate, a project the size of a new nuclear unit at the ESP site would require the flooding of more than 9120 km^2 (3520 mi^2) of land, resulting in a large impact on land use (Exelon 2003). Further, operation of a hydroelectric facility could alter aquatic habitats above and below the dam, thereby impacting existing aquatic species. Exelon concluded that, due to the lack of suitable sites in Illinois and the amount of land needed, hydropower is not a reasonable alternative to a new nuclear unit at the ESP site (Exelon 2003).

The staff reviewed Exelon's discussion on hydropower and independently verified the analysis. The staff concludes that hydropower is not a reasonable alternative to a new nuclear unit at the ESP site.

8.2.3.4 Solar Thermal Power and Photovoltaic Cells

Solar technologies use energy and light from the sun to provide heating and cooling, light, hot water, and electricity for consumers. Solar power technologies (both photovoltaic and thermal) cannot currently compete with conventional nuclear and fossil-fueled technologies in grid-connected applications because of solar power's higher capital cost per kilowatt of capacity. The cost of solar power using concentrating technologies is $0.09 to $0.12 per kilowatt-hour (SNL 2005). Energy storage requirements also limit the use of solar energy systems as baseload electricity supply. In the GEIS for license renewal, the staff determined that the average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 to 40 percent (NRC 1996).

Construction of solar generating facilities has substantial impacts on natural resources (such as wildlife habitat, land-use, and aesthetics). As stated in the GEIS for License Renewal, land requirements are high— 142 km^2 (55 mi^2) per 1000 MW(e) for photovoltaic (NRC 1996) and approximately 57 km^2 (22 mi^2) per 1000 MW(e) for solar thermal systems (NRC 1996). Although more recent information indicates that these land requirement estimates may be high (e.g. SNL 2005), neither type of solar electric system would fit the land area footprint available at the Clinton ESP site.

The solar resource for the Clinton ESP site is annual average of 4.0 to 4.5 kWhr m^{-2} per day for flat-plate solar systems, and 3.5 to 4.0 kWhr/m^2 per day for solar concentrating systems (DOE 2005). Areas in the southwest United States receive up to 7.5 kWhr/m^2 per day (DOE 2005). For the preceding reasons, the staff concludes that a solar energy facility at or in the vicinity of the Clinton ESP site would not be an economical alternative to construction of a nuclear power generation plant that would be operated as a baseload plant.

8.2.3.5 Wood Waste

A wood-waste 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 energy-conversion efficiency (NRC 1996). The energy-conversion efficiency of a conventional fossil-fired plant is on the order of 35 percent.

The fuels required for a wood-waste burning facility 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 for License Renewal (NRC 1996) suggest that the overall level of construction impact per MW of installed capacity would 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. The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Oregon, Washington, Maine, Georgia, Minnesota, and Michigan (Exelon 2003).

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a base-load generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), relatively low energy-conversion efficiency, and potential air pollution from emission, the staff concludes that wood waste combustion is not a reasonable alternative to a new nuclear unit at the ESP site.

8.2.3.6 Municipal Solid Waste

Municipal waste combustors incinerate 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). The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills, rather than by energy considerations. 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. Increasingly, these plants have come under increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain the combustion facilities (DOE/EIA 2001b).

Estimates in the GEIS for License Renewal were that the overall level of construction impacts from a waste-fired plant are on the order of those incurred in building a coal-fired plant

(NRC 1996). In addition, the operation of waste-fired plants have the same or greater environmental impacts as coal-fired plants, including air and waste disposal impacts of the ash.

Based on the above considerations, the staff concludes that generating electricity from municipal solid waste would not be a reasonable alternative to a new nuclear unit at the ESP site.

8.2.3.7 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including crops, crops converted to a liquid fuel such as ethanol, and crops (including wood waste) that have been converted to a gas. As discussed in the GEIS for License Renewal, 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 a new nuclear unit at the ESP site (NRC 1996).

The GEIS for License Renewal (NRC 1996) further suggests that the overall level of construction impacts from a crop-fired plant would be approximately the same as those of a wood-waste-fired plant. Crop-fired plants would have similar operational impacts (including impacts on the aquatic environment and air). In addition, these systems have large impacts on land use, due to the acreage needed to grow the energy crops. Exelon concludes that, due to the high costs and lack of obvious environmental advantage, burning other biomass-derived fuels is not a reasonable alternative.

The staff reviewed Exelon's assumptions and analysis and finds their conclusions reasonable. The staff concludes that converting biomass-derived fuels to energy is not a reasonable alternative to a new nuclear unit at the ESP site.

8.2.3.8 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.

Phosphoric acid fuel cells are generally considered first-generation technology and are commercially available at a cost of approximately $4500 per kW of installed capacity (DOE 2002). Higher-temperature, second-generation fuel cells achieve higher fuel-to-electricity ratios and thermal efficiencies.

During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications, but progress has been slow

(DOE 2004). Today, the most widely marketed fuel cells cost about $4500 per kWh of installed capacity. By contrast, a diesel generator costs $800 to $1500 per kWh of installed capacity, and a natural gas turbine can cost even less (DOE 2004).

DOE has launched an initiative – the Solid State Energy Conversion Alliance – to bring about dramatic reductions in fuel cell cost. DOE's goal is to cut costs to as low as $400 per kWh of installed capacity by the end of this decade, which would make fuel cells competitive for virtually every type of power application (DOE 2004).

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. The staff concludes that, at the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation and that the fuel cell alternative is not a reasonable alternative to a new nuclear unit at the ESP site.

8.2.3.9 Oil-Fired Generation

The 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 2001c). Illinois, for example, has several oil-fired units, producing less than 1 percent of the State's electricity. The cost of an oil-fired operation is much higher than that of nuclear or coal-fired power generation. As a result, from 1997 to 1998, production of electricity by oil-fired plants dropped by about 40 percent in Illinois (DOE/EIA 1998). In the GEIS for License Renewal, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 49 ha (120 ac) (NRC 1996). 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. On these bases, the staff concludes that oil-fired generation is not a reasonable alternative to a new nuclear unit at the ESP site.

8.2.3.10 Combination of Alternatives

Individual alternatives to the construction of a new nuclear unit at the Clinton ESP site might not be sufficient on their own to generate Exelon's target capacity because of the small size of the resource or lack of cost-effective opportunities. Nevertheless, it is conceivable that a combination of alternatives might be cost-effective. There are many possible combinations of alternatives.

Section 8.2.2.2 assumes the construction of four 550 MW(e) natural gas combined-cycle generating units at the ESP site. As a reasonable combined alternatives option, the staff assessed the environmental impacts assuming a combination of three 550 MW(e) natural gas combined-cycle generating units at the site; 60 MW(e) of wind energy, hydropower, or pumped storage; 90 MW(e) from biomass sources, including municipal solid waste; and 400 MW(e) from purchased power, conservation and demand-side management. The impacts associated with the combined-cycle natural-gas-fired units would be the same as shown in Table 8-2 with magnitudes scaled for reduction in capacity from 2200 MW(e) to 1650 MW(e). While the demand-side management measures would have few environmental impacts, operation of the new natural gas-fired plant would result in increased emissions and other environmental impacts. The environmental impacts associated with power purchased from other generators would still occur, but would be located elsewhere within the region or the Nation or in another country. A summary of the environmental impacts of this combination of alternatives is given in Table 8-3.

8.2.4 Evaluation of Alternative Energy Sources and Systems

This section evaluates the environmental impacts from what Exelon has determined to be reasonable alternatives to a new nuclear unit at the ESP site: coal-fired generation and natural-gas-fired generation. The NRC staff evaluated Exelon's approach and analysis and finds that its findings and approach are reasonable. The environmental impacts of constructing and operating a new nuclear unit at the ESP site and the alternative energy sources of coal- and natural gas-fired power generation at the same site, and a combination of power alternatives are summarized in Table 8-4.

When compared to the viable energy alternatives, a new nuclear unit at the ESP site is either environmentally equivalent or preferable to either coal-fired or natural gas-fired power generation, or a reasonable combination of power generation alternatives. A new nuclear unit at the ESP site is preferable to coal-fired power generation in the areas of air resources, waste management, land resources, ecological resources, water resources, and aesthetics. A new nuclear unit at the ESP site is preferable to natural gas-fired power generation and the combination of alternatives in the areas of air resources, ecological resources, water resources, and aesthetics.

Based on this analysis, the staff concludes that none of the economically viable alternative energy-generating technologies is environmentally preferable to a new nuclear unit at the ESP site.

8.3 System Design Alternatives

The purpose of the plant cooling system is to dissipate energy to the environment. The various cooling system options differ in how the energy transfer takes place and, therefore, have different environmental impacts. Sections 8.3.1, 8.3.2, and 8.3.3 contain information regarding alternative plant cooling systems for a new nuclear unit. Section 8.3.1 discusses wet cooling

Table 8-3. Summary of Environmental Impacts of a Combination of Power Sources - 2200 MW(e)

Impact Category	Impact	Comment
Air Quality	SMALL to MODERATE	SO_x: 121 MT (133 tons) per year NO_x: 387 MT (426 tons) per year CO: 82 MT (90 tons) per year TSP: all PM_{10}: 68 MT (75 tons) per year Some hazardous air pollutants.[a]
Waste Management	SMALL	28m^3 of spent catalyst would be regenerated or would require disposal.[b]
Human Health	SMALL	Health effects would not be detectable if technology met regulatory controls.
Land Use	SMALL	Power block, offices, roads, and parking areas would use previously disturbed land at the ESP site. Additional land might be needed for infrastructure and other facilities.
Ecology	SMALL to MODERATE	Construction of a new cooling-water system. Potential impacts from transmission; limited habitat loss and fragmentation; limited impact to productivity and biological diversity; limited impact from bird strikes on wind turbines; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to LARGE	Impacts would depend on volume of water withdrawal and discharge, the constituents in the discharge water, and the characteristics of the surface-water body. Discharge of cooling tower blowdown would have impacts if cooling towers were built.
Socioeconomic	SMALL (Adverse) to LARGE (Beneficial)	Impacts from limited number of people (less than 80) to operate facilities would be absorbed easily across the region. Property tax impacts to DeWitt County would have a significant beneficial impact. Construction worker impacts would be temporary.
Aesthetics	MODERATE	ESP site is zoned industrial and located in a rural area. Existing operating nuclear facility onsite. Construction impacts minimized through use of best management practices. Wind turbines have limited noise impacts. Viewshed would have permanent impacts from physical structures and plumes.
Historic and Cultural Resources	SMALL	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on previously disturbed ground. Impacts to offsite properties could be mitigated by inventory, identification and recovery techniques.
Environmental Justice	SMALL	No evidence of environmental justice issues around the ESP site.

[a] Impacts are principally from natural gas power generation. Municipal solid waste or biomass facilities may generate some additional emissions.

[b] Impacts are principally from natural gas power generation. Municipal solid waste or biomass facilities may generate some additional waste.

Table 8-4. Comparison of Environmental Impacts of Alternative Energy Sources to a New Nuclear Unit

Impact Category	Nuclear	Coal	Natural Gas	Combination
Air quality	SMALL	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Waste management	SMALL	MODERATE	SMALL	SMALL
Human health	SMALL	SMALL	SMALL	SMALL
Land use	SMALL	MODERATE	SMALL	SMALL
Ecology (including threatened or endangered species)	SMALL	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Water use and quality	SMALL	SMALL to LARGE	SMALL to LARGE	SMALL to LARGE
Socioeconomic	SMALL (Adverse) to LARGE (Beneficial)	SMALL (Adverse) to LARGE (Beneficial)	SMALL (Adverse) to LARGE (Beneficial)	SMALL (Adverse) to LARGE (Beneficial)
Aesthetics	SMALL	MODERATE	MODERATE	MODERATE
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL

tower heat dissipation systems, Section 8.3.2 hybrid wet/dry cooling tower heat dissipation systems, and Section 8.3.3 dry cooling towers' heat dissipation systems.

Exelon (2003) proposes the use of all three types of systems but states that full wet or hybrid wet/dry cooling processes have been assumed for most purposes because, of the range of options proposed, they have the greatest consumptive water use. Exelon does not provide information on a dry cooling system to support an environmental assessment not does the applicant address the adverse environmental impacts of such a system (noise, large footprint, and inefficiency). Therefore, the staff did not evaluate a dry cooling system during its review. The specific cooling system design for a new nuclear unit at the Exelon ESP site has not been selected; therefore, system design alternatives would be discussed at the CP or COL stage if an application were submitted to build a new plant at the site.

8.3.1 Plant Cooling System: Wet Cooling Towers

Wet cooling towers (mechanical or natural draft) systems transfer energy to the atmosphere via evaporation. This design results in a consumptive loss of about 2.0 m^3/s (70 cfs) of water because the majority of the rejected heat is dissipated through the conversion of liquid water to atmospheric water vapor. A consumptive loss of about 2.0 m^3/s (70 cfs) from Clinton Lake's water budget would result in reduced downstream flows and lower lake elevations during dry periods. While not discharging significant amounts of heat as blowdown to the lake, by decreasing the volume of water available in the lake to assimilate and dissipate the rejected heat in the once-through discharge from the existing CPS unit, a new nuclear unit would also contribute to higher temperatures in Clinton Lake. These higher temperatures, in turn, would contribute to greater induced evaporation.

8.3.2 Plant Cooling System: Hybrid Wet/Dry Cooling Towers

A hybrid wet/dry cooling system uses dry cooling to reduce evaporative losses associated with a wet cooling tower. Exelon did not include bounds for a hybrid wet/dry cooling system design in the plant parameter envelope (PPE). Therefore, the staff assumed that a hybrid wet/dry design would be bounded by the combined maximum values of the wet and dry cooling towers. This assumption would need to be validated at the COL stage if Exelon were to proceed with a hybrid wet/dry design at that time.

8.3.3 Plant Cooling System: Dry Cooling Towers

The use of dry cooling towers would largely eliminate the impacts on the lake and the aquatic ecosystem from a new nuclear unit. The lake would not be heated by rejected heat from that unit, and there would be no additional consumptive water use.

A dry cooling tower heat dissipation system reduces water-related impacts of operating, but it also has disadvantages. In particular, dry cooling systems are not as efficient as wet systems. They require movement of a large amount of air through the heat exchanger to achieve the necessary cooling. The fans that force the air through the heat exchanger use a significant amount of power. This power reduces the net power output of the facility. In addition, the fans and the large volume of air required for cooling make dry cooling towers noisy.

8.4 Region of Interest and Site-Selection Process

NRC regulations require that the ER submitted in conjunction with an application for an ESP include an evaluation of alternative sites to determine whether there is any obviously superior alternative to the site proposed (10 CFR 52.17(a)(2)). This section includes subsections discussing Exelon's ROI for selecting alternative sites and its alternative site-selection process. The alternative sites considered in this EIS are six other nuclear power plant sites in Illinois.

8.4.1 Exelon's Region of Interest

The ROI is the geographical area considered in searching for candidate sites. Before deregulation of the power industry, the ROI for a utility typically would have been the state in which the proposed site was located or its service area. However, Exelon's proposal involves siting a merchant plant that would sell generated power in a deregulated marketplace. Exelon defines its ROI to be the State of Illinois on the basis of current deregulation policies, the availability of transmission facilities in the state, market flexibility, and the proximity of Exelon's customer base (Exelon 2003). The NRC staff considers Exelon's definition of its ROI to be reasonable.

8.4.2 Exelon's Alternative Site-Selection Process

Candidate sites are those sites within the ROI that are considered to be among the best sites that can be reasonably found and made available for the siting of a nuclear power plant. *Alternative sites are those that are specifically compared to the proposed site to determine if* there is an obviously superior site. Existing nuclear power plant sites, greenfield sites, and brownfield sites within the ROI were all considered by Exelon as candidates. The candidate-site criteria presented in NUREG-1555 (NRC 2000) were used to select the alternative sites from among the candidate sites. The alternative sites selected were: Braidwood Generating Station, Byron Generation Station, Dresden Generating Station, LaSalle County Station, Quad Cities Generating Station, and Zion Generating Station. The locations of these sites are shown in Figure 8-1.

Exelon undertook a site-by-site comparison of alternative sites with the proposed site in the ER to "determine if there are any alternative sites that are environmentally preferable to the proposed site." Their review process involved the two-part sequential test outlined in NUREG-1555 (NRC 2000). The first stage of the review uses reconnaissance-level information to determine whether there are environmentally preferable sites among the alternatives. If environmentally preferable sites are identified, the second stage of the review considers economics, technology, and institutional factors for the environmentally preferred sites to see if any is obviously superior to the proposed site.

Exelon developed a two-phase, three-step process for reviewing the sites. This process is outlined below.

- Step 1 – *Identify the alternative sites.* The proposed site is co-located with an existing nuclear facility (Clinton Power Station). Therefore, Exelon chose its other nuclear facilities within the ROI as alternative sites. Thus, there are six alternative sites to Clinton, each co-located with an existing nuclear facility site. In addition, Exelon considered a generic greenfield site and brownfield sites.

- Step 2a – *Consider sites without existing nuclear facilities.* The initial step was evaluation of undeveloped greenfield and brownfield sites. The impacts of building on a greenfield site would be greater than building at an existing site with a nuclear facility (disturbing land that had not previously been disturbed). Therefore, greenfield sites were determined not to be environmentally preferable to the proposed site. Most brownfield sites in the ROI are not large enough to meet the size requirements for a new

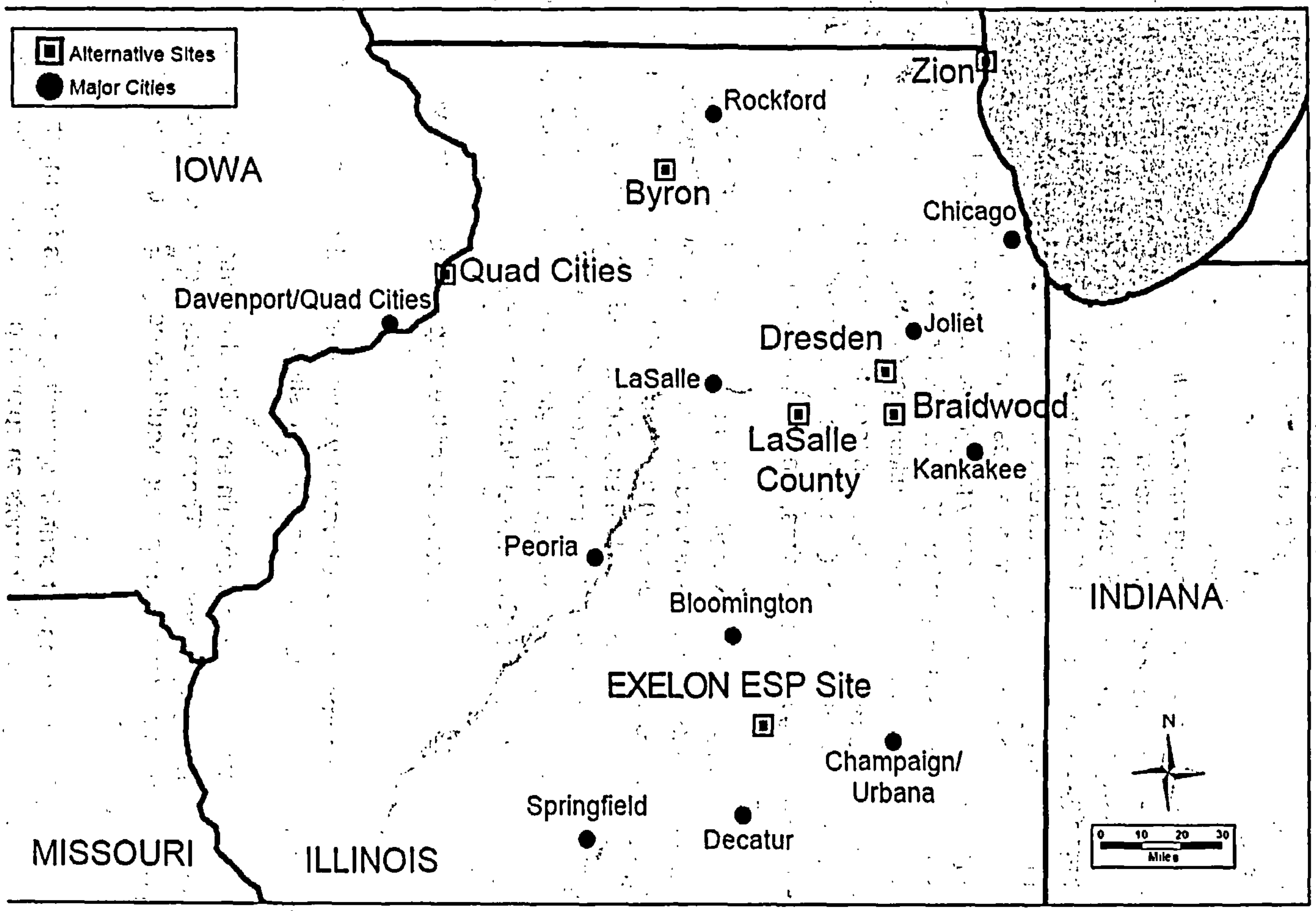

Figure 8-1. Sites Considered by Exelon for an Early Site Permit

nuclear plant: 200 to 400 ha (500 to 1000 ac). Exelon concluded that the environmental impacts from building on a brownfield site would be greater than or equal to those at the proposed ESP site (Exelon 2004a).

- Step 2b – *Consider sites with existing nuclear facilities.* The next step was evaluation of sites with an existing nuclear facility to determine if the sites met the minimum land requirements specified in the PPE, set forth in the ESP application (Exelon 2003). If additional land would be required, Exelon assumed that the environmental impacts of developing a new nuclear facility would be similar to the impacts for developing a previously undeveloped site. Alternative sites with an existing facility but with insufficient land were deemed "not environmentally preferable" to the proposed site and excluded from further analysis (Exelon 2004a). Exelon relied on NUREG-1437 (NRC 1996) as a basis of defining land requirements for building a new nuclear unit at the ESP site and used these land requirements as one basis for eliminating three of the six alternative sites with nuclear facilities (Byron, Quad Cities, and Dresden). Although Exelon eliminated three of the alternative sites, the staff considered all six sites in its review.

- Step 3 – *Compare remaining alternative sites with proposed ESP site.* The environmental impacts of siting a new nuclear unit at remaining alternative sites were compared against the impacts for siting a new unit at the proposed site. The comparisons made using the candidate site criteria and reconnaissance-level information did not indicate that the alternative sites were environmentally preferable. Exelon did not identify any environmentally preferable site in its evaluation process. Therefore, Exelon did not continue the evaluation process.

In its ER, Exelon summarized the advantages of the proposed ESP site over the alternative sites as follows:

- The postulated consumptive use of water by a new unit at the proposed ESP site would be no greater than water use at the alternative sites.

- The proposed ESP site does not contain any critical habitat for or occurrence of listed, threatened, or endangered species. Therefore, impacts of development of a new unit at the proposed site on endangered species would be no greater than impacts postulated for the alternative sites.

- The proposed ESP site does not contain spawning grounds for any threatened or endangered species. Thus, the impacts on spawning areas would be no greater than impacts at the alternative sites.

- The proposed ESP site impact review does not postulate effluent discharge beyond the limits of existing National Pollutant Discharge Elimination System (NPDES) permits or regulations. Based on the information available for the alternative sites, the impacts from effluent discharge at the proposed site would be no greater than impacts at the alternative sites.

- The siting of a new unit at the proposed ESP site would not require preemption or land-use changes for construction and operation. Therefore, land-use impacts at the proposed site would be no greater than the impacts at the alternative sites.

- The potential impacts of a new nuclear facility on terrestrial and aquatic environments at the proposed ESP site would be no greater than the impacts at the alternative sites.

- The proposed ESP site is in a rural setting and has a population density that meets the population criteria of 10 CFR Part 100.

- The ESP site does not require decommissioning or dismantlement of an existing facility, as would be required for the Byron, Quad Cities, and Dresden alternative sites.

On the basis of its review, Exelon concluded that the proposed ESP site is the environmentally preferred candidate site, so the applicant stopped its alternative site evaluation and did not go on to the second stage of the two-part sequential test.

The NRC staff reviewed the methodology used by Exelon for selecting and evaluating the alternative sites and considers Exelon's methodology to be reasonable. The NRC staff also concludes that the Exelon findings of LARGE and MODERATE significance levels for certain environmental impacts at greenfield and brownfield sites, respectively, are reasonable.

8.5 Evaluation of Alternative Sites

The staff reviewed Exelon's findings for each of the alternative sites, visited each of these sites, and collected additional reconnaissance-level information about the sites. The following sections present the results of the staff's review and evaluation of the information.

8.5.1 Dresden Generating Station

The Dresden Generating Station is located in Goose Lake Township, Grundy County, Illinois, on the south shoreline of the Illinois River at the confluence of the Des Plaines and Kankakee Rivers (immediately below the junction of the Kankakee and Des Plaines Rivers at River Mile 272.4) (Exelon 2002a).

The Dresden site consists of approximately 1000 ha (2500 ac) owned by Exelon with an additional 0.4 ha (1 ac) of river frontage leased from the State of Illinois. In addition to the two operating nuclear reactors and their turbine building, intake and discharge canals, cooling pond and canals, and auxiliary buildings, the site includes switchyards and Dresden Unit 1 (retired in August 31, 1984) (Exelon 2002a).

No major metropolitan areas exist within 10 km (6 mi) of the Dresden site. The nearest town is Channahon, approximately 5 km (3 mi) northeast of the site. The site is approximately 13 km (8 mi) east of Morris, Illinois; 24 km (15 mi) southwest of Joliet, Illinois; and 80 km (50 mi) southwest of downtown Chicago. The area within 10 km (6 mi) of the site includes parts of both Grundy and Will Counties.

8.5.1.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

Portions of the site outside the Dresden station footprint have been leased to a neighboring farmer for grazing cattle and raising crops. Hunting is also permitted outside security areas. Current land use is industrial. Given the fact that the entire Dresden site has been a large power-generating facility since 1965, the current land use would not be expected to change with construction of a new nuclear unit at the Dresden site (Exelon 2003a).

The local terrain is level to gently undulating, except for the Kankakee Bluffs just northeast of Dresden on the north bank of the Illinois River. The area around Dresden is largely rural, characterized by farmland, woods, and small residential communities. The area around Dresden has become increasingly urbanized, and it is expected that the trend will continue. The construction and operation of a new nuclear unit at the site would not be expected to affect the land-use patterns of the area (Exelon 2003).

In its ER, Exelon states that the Dresden site does not have additional available land within its boundaries to build a new nuclear unit. To build a new nuclear unit, an operating unit or Unit 1 would need to be decommissioned and dismantled so that the new nuclear unit could be constructed on the decommissioned unit footprint (Exelon 2003).

Overall, the land-use factors of construction and operation of a new nuclear unit are not particularly site-dependent. The staff visited the Dresden site on March 9, 2004. The footprint of the new nuclear unit would be about 41 ha (100 ac) (Exelon 2003) and, based on observation of the site, the staff believes that a new unit could be configured to fit within previously disturbed land on the existing 1000-ha (2500-ac) Dresden site. On this basis, the staff concludes that land-use impacts associated with site-preparation and construction, or resulting from operation of a new nuclear unit, at the Dresden site would be SMALL.

The impacts of construction and operation of a new nuclear unit on air quality would be similar at each of the alternative sites and would not be a significant factor in determination of environment preferability. Therefore these impacts are discussed generically in Section 8.6.1.

Although not stated by Exelon, the staff assumed that the existing transmission lines serving Dresden do not have the capacity to carry the power that would be generated by a new nuclear unit. The procedures for adding the new transmission lines that would be required to connect a new nuclear unit at the Dresden site to the transmission grid are similar to those described in Section 3.3. They involve both the power provider and the transmission provider, with the transmission provider having the ultimate responsibility for determining the nature of modifications to the existing transmission system to accommodate the additional load. It is likely that new transmission lines, and possibly additional rights-of-way, would be needed. The additional transmission lines could be installed via expansion of existing rights-of-way, which the staff believes to be the likely scenario, or they could follow a new right-of-way. The staff assumes that any transmission system modifications would be expansions of existing rights-of-way. For reasons similar to those discussed in Chapters 4 and 5 related to expansion of the rights-of-way for the Exelon ESP site, the staff concludes that the land-use impacts of transmission-line rights-of-way expansion would be SMALL. The procedures for adding new transmission lines to connect a new unit at Dresden to the transmission would be similar to those described in Section 3.3.

8.5.1.2 Hydrology, Water Use, and Water Quality

The staff assumed that a new nuclear unit at Dresden would withdraw makeup water from the Illinois River. The staff estimated the 7Q10 (7-day average minimum annual flow) and 30Q2 (median 30-day minimum annual discharge) based on data from the U.S. Geological Survey (USGS) stream gauge 05543500 (Illinois River at Marseilles, Illinois). Data for the period of record from 1919 through 2003 were used to estimate the 7Q10 and 30Q2 values. This gauge is slightly downstream of Dresden. The drainage area upstream of the gauge that is near the site was reported by the USGS to be 21,391 km^2 (8259 mi^2). The 7Q10 and 30Q2 values estimated by staff are 75 m^3/s (2661 cfs) and 111 m^3/s (3911 cfs), respectively. The net consumptive loss for a wet cooling tower, based on the PPE, is 2.0 m^3/s (70 cfs) or 2.6 and 1.8 percent of the 7Q10 and 30Q2, respectively. Wet towers were used as the basis of the assessment because wet towers represent the greatest consumptive loss of water.

Any releases of contaminants to the waters of the State of Illinois would be regulated by the IEPA through the NPDES permit process to ensure that water quality is protected.

Based on the requirements of the NPDES permit and the above analysis, the staff concludes that the water-use and water quality impacts of an additional unit at the Dresden site would be SMALL.

8.5.1.3 Terrestrial Resources Including Endangered Species

The Dresden site occupies approximately 1000 ha (2500 ac). Undeveloped areas are located mostly on the western half of the site and support a mosaic of habitats, including old fields, wetlands, and woodland vegetation (NRC 2004a). It is assumed that structures for a new nuclear unit at the Dresden site (power block structures, normal heat-sink cooling towers, switchyard expansion, new intake structures, and safety-related cooling towers) would be constructed in developed areas on the eastern half of the Dresden site and in old field areas, where possible, and would minimally impact woodlands and wetlands. Consequently, habitat impacts from construction of a new unit at the Dresden site would be minimal.

Seven transmission line rights-of-way, spanning 350 km (220.5 mi) and covering about 2440 ha (6030 ac), connect Dresden Units 2 and 3 to the electric grid (NRC 2004a). These lines traverse primarily farmland but also cross a small amount of forest and four natural terrestrial habitat areas: Goose Lake Prairie State Natural Area (containing tall grass prairie and marshes), Des Plaines Fish and Wildlife Area (contains river shorelines, lakes, swamps, marshes, and prairie), Midewin National Tallgrass Prairie (previously disturbed, with plans to restore tallgrass prairie vegetation), and Heidecke Lake State Fish and Wildlife Area (cooling lake area leased to Illinois Department of Natural Resources [IDNR] for hunting and fishing) (NRC 2004a). Ten Federally listed species near Dresden (none of which have designated critical habitat except the Indiana bat) are known to occur in counties traversed by these transmission lines (NRC 2004a). These species are associated with prairie, wetland, or open water habitats and could occur along portions of the transmission line rights-of-way where suitable habitat is present (NRC 2004a).

It is assumed that these seven transmission lines do not have the capacity to carry the power that would be generated by a new unit at the Dresden site, and it is likely that new transmission lines, and thus additional rights-of-way, would be needed. For the purpose of this analysis, the staff assumes that any transmission system modifications would be expansions of existing rights-of-way. Potential habitat impacts associated with the expansions could range from small to large, the latter depending on potential impacts to the Goose Lake Prairie State Natural Area, Des Plaines Fish and Wildlife Area, Midewin National Tallgrass Prairie, and Heidecke Lake State Fish and Wildlife Area.

There are nine Federally listed threatened or endangered terrestrial species that may occur in the vicinity of the Dresden site or its transmission lines: the endangered Indiana bat (*Myotis sodalis*), the threatened bald eagle (*Haliaeetus leucocephalus*), the endangered Hine's emerald dragonfly (*Somatochlora hineana*), the endangered leafy prairie clover (*Dalea foliosa*), the threatened lakeside daisy (*Hymenoxys herbacea*), the threatened eastern prairie fringed orchid (*Platanthera leucophaea*), the threatened prairie bush clover (*Lespedeza leptstachya*), the threatened Mead's milkweed (*Asclepias meadii*), and the threatened decurrent false aster

(*Boltonia decurrens*) (NRC 2004b; FWS 2004a). Of these nine species, designated critical habitat exists only for the Indiana bat (NRC 2004b; FWS 1976, 2004a). There is also one Federal candidate species that may occur in the vicinity of the Dresden site or its transmission lines, the eastern massasauga (rattlesnake) (*Sistrurus catenatus*) (NRC 2004b).

Six of these Federally listed species could occur on the undeveloped Dresden site: the bald eagle, the Indiana bat, the eastern prairie fringed orchid, the Mead's milkweed, the prairie bush clover, and the eastern prairie massasauga (FWS 2004a). The bald eagle is known to winter along large rivers, lakes, and reservoirs in Grundy County. However, no night roost sites are known to occur there (FWS 2004a, b). The bald eagle is likely to occur at least occasionally in the vicinity of the Dresden site as a winter visitor to the Illinois River, Heideke Lake, or the Dresden cooling pond (NRC 2004b). The Indiana bat potentially occurs throughout Illinois where forest habitat is present (FWS 2004a). However, its potential occurrence on the Dresden site is considered possible (NRC 2004b). The only designated critical habitat for the Indiana bat in Illinois is the Blackball Mine in LaSalle County (FWS 1976).

The eastern prairie fringed orchid is known to occur in Grundy County (FWS 2004a), within 3.2 to 16 km (2 to 10 mi) of the Dresden site (IDNR 2004a). The eastern prairie fringed orchid (Federally listed as threatened) prefers mesic to wet prairie habitat and potentially occurs throughout Illinois. It occurs in tallgrass silt-loam or sand prairies, sedge meadows, fens, and occasionally sphagnum bogs (Bowles 1999). It appears to be adapted to disturbance and occasionally colonizes early succession habitats or recolonizes previously occupied areas (NRC 2004b). Although no populations of eastern prairie fringed orchid are known from the projected area, it is possible that undeveloped portions of the Dresden site and associated transmission line rights-of-way could support this species (NRC 2004a).

The primary habitat of Mead's milkweed is mesic to dry mesic, upland tallgrass prairie. Although no populations of Mead's milkweed are known from the project area, it is possible that undeveloped portions of the Dresden site and associated transmission line rights-of-way could support this species (NRC 2004b).

The prairie bush clover occurs on dry gravel and sand prairies and is rare throughout its range. Although no populations of prairie bush clover are known to occur in the project area, it is possible that undeveloped portions of the Dresden site and associated transmission line rights-of-way could support the species (NRC 2004a).

The eastern massasauga is usually found in or near wet areas including wetlands, wet prairie, and nearby woodland or shrub habitat. The species also uses dry old fields with goldenrod (*Solidago spp.*) and woody species, such as dogwood (*Cornus spp.*) or multiflora rose (*Rosa mulitflora*). Dry upland areas up to 2.4 km (1.5 mi) away from wet habitat are used during the summer (NRC 2004a). Although the eastern massasauga is not known to occur in the project area, undeveloped portions of the Dresden site and associated transmission line rights-of-way could support the species.

Because these six species could occur on the Dresden site and along the associated transmission line rights-of-way, impacts to these species from construction and operation of a new nuclear unit at the Dresden site would range from small to large (NRC 2004b).

There are 30 State-listed threatened or endangered terrestrial species known to occur from 3.2 km (2 mi) to 16 km (10 mi) of the Dresden site, and 14 that occur within 3.2 km (2 mi) (IDNR 2004a). Potential impacts to State-listed species from construction and operation of a new nuclear unit at the Dresden site could range from small to large depending on their presence.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that impacts to terrestrial resources, including Federally listed threatened and endangered species, from construction and operation of a new nuclear unit at the Dresden site and associated transmission line rights-of-way could range from SMALL to LARGE.

8.5.1.4 Aquatic Resources Including Endangered Species

The Dresden facility draws water from the Kankakee River and discharges into the Illinois River (Exelon 2003). Fish sampling conducted during 2001 in the Dresden Pool and downstream of the Dresden Island Lock and Dam yielded 54 fish species and two hybrids. Numerically, the catch was dominated by gizzard shad (*Dorosoma cepedianum)*, emerald shiner (*Notropis atherenoides*), bluegill (*Lepomis macrochirus*), spotfin shiner (*Notropis spilopterus*), bluntnose minnow (*Pimephales notatus*), and bullhead minnow (*Pimephales vigilax)* (NRC 2004a). Other species present in significant numbers (greater than 1 percent of the sample) included green sunfish (*Lepomis cyanellus*), spottail shiner (*Notropis hudsonius)*, largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), sand shiner (*Notropis stramineus*), threadfin shad (*Dorosoma petenense*), freshwater drum (*Aplodinotus grunniens*), common carp (*Cyprinus carpio*), and golden redhorse (*Moxostoma erythrurum*) (NRC 2004a). Benthic community studies of the Dresden Pool conducted in 1999 and 2001 found that the benthic community was poor and dominated by tolerant and facultative taxa, such as Oligochaeta (aquatic worms) and Chironomidae (fly larvae) (NRC 2004a).

No Federally listed aquatic plant or animal species have been found in the vicinity of Dresden (NRC 2004b). However, three Illinois endangered or threatened listed species, the pallid shiner (*Notropis amnis*), the greater redhorse (*Moxostoma valenciennesi*), and the river redhorse (*Moxostoma carinatum*), have been collected near Dresden (FR 2001). The pallid shiner has only been collected downstream of Dresden Island Lock and Dam, and both redhorse species prefer a more complex channel substrate than is found near Dresden. The non-indigenous Asiatic clam (*Corbicula fluminea*) is found in the Kankakee River in the vicinity of the site (USGS 2004), and the zebra mussel (*Dreissena polymorpha*) began infesting the Dresden cooling pond in 1991 (NRC 2004a). The round goby (*Neogobious melanostromus*) is another invasive species found in the vicinity of the Dresden site (NRC 2004a).

The construction of both a cooling water intake structure and discharge might be necessary if a new nuclear unit was built at the Dresden site. While aquatic biota, including recreational sport fish, would be temporarily displaced during the construction period, they would be expected to recolonize the area after construction was complete. It is expected that the disturbance to aquatic resources from construction would be localized and of relatively short duration. The NRC staff has reviewed the information provided by Exelon and visited the Dresden site and concludes that the environmental impacts of construction of a new nuclear unit at the Dresden site on aquatic resources, including Federally listed threatened and endangered species, would be SMALL.

With respect to operation of a new nuclear unit at the Dresden site, the ecology of the area surrounding the Dresden cooling pond and the intake and discharge structures has been studied extensively since the late 1960s. Studies of the lower trophic levels (phytoplankton, zooplankton, periphyton, and benthic invertebrates) and the fish community indicate that operation of the existing Dresden nuclear units has not had a measurable detrimental impact on the ecology of the Illinois River system.

No Federally listed aquatic plant or animal species have been found in the vicinity of the Dresden site (NRC 2004b). The three Illinois listed endangered or threatened species that have potential to inhabit areas near the Dresden site (the river redhorse, the greater redhorse, and the pallid shiner) have been collected in low numbers and are unlikely to be impacted by operation of a new nuclear unit at the Dresden site.

In addition, impingement sampling was conducted at the traveling intake screens at the operating Dresden nuclear units from 1977 to 1987. The study concluded that the number of fish impinged at Dresden was low and that the fish in the adjacent river system were not being adversely impacted by Dresden operations. In April 1987, the Illinois Department of Conservation agreed to eliminate impingement sampling from the Dresden Aquatic Monitoring Program. The licensee submitted information on the Dresden intake structure to the IEPA pursuant to Section 316(b) of the Clean Water Act. The IEPA determined that additional monitoring was not required, but further monitoring might be necessary at the time of any modification or re-issuance of the NPDES permit. Entrainment and impingement both occur as a result of operation of the intake of the existing units and would be expected to continue during the operations of a new nuclear unit at the Dresden site (Exelon 2003).

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the environmental impacts to aquatic ecosystems, including Federally listed threatened and endangered species, from operation of a new nuclear unit at the Dresden site, would be SMALL.

8.5.1.5 Socioeconomics

This section evaluates the social and economic impacts to the surrounding region as a result of constructing and operating a new nuclear unit at the Dresden site. The evaluation assesses impacts of construction and station operation and of those demands placed by the workforce on the surrounding region.

Physical Impacts

The physical impacts of the construction and operation of a new nuclear unit are similar for each of the alternative sites. They are discussed generically in Section 8.6.4.

Demography

Dresden is in Grundy County, Illinois, adjacent to Will County and approximately 80 km (50 mi) southwest of Chicago. Both counties are components of the nine-county Chicago Primary Metropolitan Statistical Area, which boasted a regional 2000 population of 8,272,768 (based on the 2000 Census) and includes the City of Chicago (USCB 2000a). Grundy County has a total population of 37,575 and Will County 502,266 (USCB 2000b). As derived from Census Bureau information, 337,882 people live within 32 km (20 mi) of Dresden and 7,078,561 people live within 80 km (50 mi) (Exelon 2002a).

It is expected that most construction workers would come from within the region. Should a larger than expected number of construction workers decide to locate to Grundy County, there could be a noticeable increase in population, but it would not be excessive. If 20 percent of the construction workforce, or about 650 workers (without their families), decided to relocate temporarily to Grundy County or Will County, it would represent only a 1.7 and 0.13 percent increase in total population, respectively, based on 2000 Census data.

Some new jobs might result from the multiplier effect[a] attributable to the construction workforce and might result in some increase in population in the region. But these increases, when

(a) In the multiplier effect, each dollar spent on goods and services by a construction worker becomes income to the recipient, who saves some but re-spends the rest on consumption. His re-spending becomes income to someone else, who in turn saves part and re-spends the rest. The number of times the final increase in consumption exceeds the initial dollar spent is called the "multiplier."

compared to the total population base in the region, would be minimal. Any multiplier effects resulting from construction worker expenditures would most likely mean that some residents would obtain new or higher paying jobs as a result of the increased economic activity. Therefore, based on information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the demographic impact of construction of a new unit at Dresden would be SMALL.

Exelon employs a permanent workforce of approximately 870 workers and an additional 120 to 130 contract and matrixed employees at Dresden to operate two functioning reactors (Exelon 2002a). Approximately 580 additional permanent workers would be required for the operation of a new unit at Dresden (Exelon 2003). Exelon expects that most of the new operating workforce would come from within the region (Exelon 2003a). But even if the 580 additional employees and their families were to come from outside the region, the potential increases in population of most impacted counties would not be significant. For example, the 580 additional employees would translate into an increase in population of about 2320, assuming each new employee represented a family of four. The addition of the new employees and their families would equate to a population increase for Grundy County of 6.2 percent and for Will County of 0.46 percent (assuming all 2320 individuals located to one county or the other). Overall, the potential increases in population do not represent a large percentage increase in the total population for the most impacted counties. Therefore, based on the staff's independent review of reconnaissance-level information, the staff concludes that the demographic impact of operation of a new unit at Dresden would be SMALL.

Impacts to the Community - Social and Economic

This subsection discusses the site-specific impacts of construction and operation of a new nuclear unit at the Dresden site. Some of the impacts of construction and operation of a new nuclear unit that are generic are discussed in Section 8.6.4.

Economy

Grundy County is one of Illinois's commercial and agricultural centers. Grundy County has a smaller economic base than Will County, which means that economic impacts such as construction of a new nuclear unit would have more of an impact than in neighboring Will County. While the County's agriculture sector ranks high in production relative to other Illinois counties, it ranks relatively low in employment when compared to the County's other major industries (Government Information Sharing Project 1997). As of 2001, Grundy County's industrial profile was led by retail trade (17 percent), manufacturing (14 percent), health care and social assistance (12 percent), and accommodation and food services (11 percent) (USCB 2001a).

In the late 1800s, Will County's prairie soil, soft coal, and river access spurred the emergence of a steel and manufacturing industry. When the steel industry eventually waned, the County embraced a broader base of industrial and commercial enterprise (CPN 2004). Today, Will County's dominant industries are manufacturing (18 percent), retail trade (13 percent), construction (11 percent), and health care and social services (9 percent) (USCB 2001b).

The annualized unemployment rate for the State of Illinois in 2000 was 4.3 percent. In comparison, Will and Grundy Counties had year-2000 unemployment rates of 5.9 and 3.9 percent, respectively (IDES 2000a and 2000b).

Based on the information provided by Exelon and the NRC staff's independent review of reconnaissance-level information, the staff concludes that the beneficial impacts of construction and station operation on the economy of the region would be SMALL everywhere in the region except Grundy County, where the impacts could be MODERATE.

Taxes

Corporate and personal income taxes and sales and use taxes would be collected during both the construction and operation of a new unit at the Dresden site. Property taxes would be collected after construction was completed and the unit became operational. Taxes collected as a result of constructing and operating a new unit at Dresden would be of benefit to the State and the local jurisdictions that collected and spent them. In absolute terms, the personal and corporate income, sales, and use taxes associated with construction and operation of a new nuclear unit would be large, but the total would be small when compared to the total amount of taxes Illinois collects annually. Based on information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the overall beneficial impacts of corporate and personal income and sales and use tax collection during construction and operation would be SMALL.

Following the construction period and at the start of operation of a new nuclear unit, Dresden would pay annual property taxes to Grundy and Will Counties. For the years 1997 to 2000, the Dresden property taxes provided between 13 and 20 percent of Grundy County's total levy extension and between 13 and 21 percent of Grundy County's total collections available for distribution. For these years, Dresden's property taxes provided less than 1 percent of Will County's total levy. Exelon projects that the Dresden annual property taxes will change in the future due to deregulation of the electric utility industry in Illinois (see Section 2.8.2) (Exelon 2003). Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that impacts of a new nuclear unit on property tax collections during operation would be SMALL to MODERATE (depending on the impacts of deregulation) for Grundy County[a] and SMALL for Will County. In all cases, the tax impacts would be beneficial to the receiving counties.

The MODERATE impact is based on the impact of deregulation at the CPS (see Section 2.8.2.3). While a new nuclear unit at the ESP site would potentially operate in a deregulated environment, the impacts of deregulation on the facility's value, and thus property taxes paid by the facility, are not fully known.

Impacts to the Community - Infrastructure and Community

This subsection discusses the site specific impacts of construction and operation of a new nuclear unit at the Dresden site concerning transportation, aesthetics and recreation, and housing. Some of the impacts of construction and operation of a new nuclear unit that are generic (such as public services) are discussed in Section 8.6.4.

Transportation

Road access to Dresden is via Dresden Road, a two-lane paved road. Dresden Road intersects with Pine Bluff Road approximately 3.2 km (2 mi) south of the station. Continuing south for approximately 6.4 km (4 mi), Dresden Road ends at the Coal City limits. Most employees from Grundy and Will Counties travel on these roads to reach the Dresden Generating Station. The State of Illinois does not make level-of-service (LOS) determinations in rural, non-metropolitan areas such as Dresden unless it is deemed necessary. Neither Dresden Road nor Pine Bluff Road has had an LOS determination calculated by the Illinois Department of Transportation (Exelon 2002a).

A daily average of approximately 4050 cars traveled Dresden Road from the plant to Pine Bluff Road in 1996 (Exelon 2002a). If each of the 3150 construction workers commuted alone to the Dresden site, this could put an additional 3150 cars on a two-lane highway, causing potential congestion during shift changes. Also, the traffic of hauling construction materials to the site could bring additional congestion to Dresden and Pine Bluff Roads during certain times of the day, particularly at shift changes.

With respect to the operations of the facility, adding an additional 580 cars (again assuming a single occupant per car) to the existing 4050 cars on the road would not materially congest the

(a) Given the facility's potential value and property taxes paid to Grundy County, the staff assumed that the facility's impact on collected property taxes would, at a minimum, be SMALL and could be MODERATE when compared to the taxes the facility could pay and the total property taxes collected by the county.

highway, except potentially at shift changes, which could be staggered between the two plants (Dresden and the new unit) so that the traffic increases would not occur at the same time.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction of a new nuclear unit at Dresden on transportation would be SMALL to MODERATE although some mitigation actions might need to be undertaken. Mitigation measures could include traffic control zones, staggered shift changes, and traffic control devices, among others. Construction could bring congestion to Dresden and Pine Bluff Roads. Based on the staff's independent review of reconnaissance level information, the staff concludes that the impacts on transportation of the operations workforce at the new unit at Dresden would be SMALL, and that mitigation would not be warranted.

Aesthetics and Recreation

The terrain of the Dresden site is relatively flat. Portions of the site are relatively open and clear of woods while other parts of the site have woods with trees of small diameter, indicating that at one time the site was logged. Light residential development is close to the site, including a house sitting just outside the main gate and three new houses going up around the cooling pond. There are several marinas located in the area on the rivers. Construction of a new unit at Dresden would be noticed by these close residents.

The local terrain is level to gently undulating, except for the Kankakee Bluffs just northeast of Dresden on the north bank of the Illinois River. The area around Dresden is largely rural, characterized by farmland, woods, and small residential communities (Exelon 2003a). The Kankakee River supports a sports fishery. The Illinois River is used for commercial traffic such as barges.

A new nuclear unit at Dresden probably would have visual impacts similar to those of the existing Dresden facility. But the use/discharge by another unit of additional heated water to the cooling reservoir and the use of cooling towers could exacerbate fog conditions during adverse meteorological conditions, warranting some mitigation such as fog drift eliminators on the cooling towers. There could be additional impacts on aesthetic quality for nearby residences in the area as a result of the fog, even though the area is predominately in agricultural use.

Based on information provided by Exelon, the staff's independent review of reconnaissance-level information, and information collected during the site visit on March 4, 2004, the staff concludes that the aesthetic impacts of station construction and operation would be SMALL.

Housing

In Will County there are 175,524 housing units, of which 7982 are vacant (or 5 percent); in Grundy County, there are 15,040 total housing units, of which 747 are vacant (5 percent) (USCB 2000b). A 5-percent vacancy rate would appear to indicate a potential shortage of housing for the construction workforce of 3150 and an operations workforce of 580. However, in an area that has a population of 7,078,561 within an 80-km (50-mi) radius of Dresden and, assuming the construction workforce would commute from all over the 80-km (50-mi) radius, there should not be discernable impacts on housing availability, rental rates, housing values, or the spurring of housing construction or conversion. There might be a shortage of housing if construction workers decided to locate in Will and Grundy Counties, but this would be unlikely if they were already located in the region. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction on the availability of housing would be SMALL.

If built, a new nuclear unit at Dresden would have 580 employees when operational (Exelon 2003a). Exelon assumes that the operating workforce would come from within the region. Of the current employees at Dresden, 72 percent live in Will and Grundy Counties. If it is assumed that the new workforce would not come from within the region and that the new workforce would follow past practices, then approximately 400 of the new operating employees would locate in the two counties. There are no growth restrictions in either county. Depending on how the new employees split between the two counties, there could be small to moderate impacts on housing values and rents and a similar incentive for new construction. Based on the information provided by Exelon and staff independent review of reconnaissance-level information, the staff concludes that the impacts of station operation on the availability of housing would be SMALL in both Will and Grundy counties, if workers came from the region, to SMALL (Will County) to MODERATE (Grundy County), if workers relocated to the region. Mitigative measures would operate through market forces leading to construction of additional housing.

8.5.1.6 Historic and Cultural Resources

The impacts on historic and cultural resources of construction and operation of a new unit at Dresden and at the other alternative sites are discussed generically in Section 8.6.5.

8.5.1.7 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. Exelon followed NRC guidance (NRC 2001) in applying environmental justice criteria in its ER for license renewal of Dresden (Exelon 2002a). The NRC staff has reviewed the analysis using updated guidance (NRC 2004; 69 FR 52040).

The 2000 Census and block groups were used for ascertaining environmental justice issues for minority populations for license renewal, and the 1990 Census and census tracts were used for low-income environmental justice issues. There are 5503 block groups within an 80-km (50 mi) radius of Dresden. No Native Hawaiians or other Pacific Islanders live in the geographic area; American Indian or Alaskan Native minority populations exist in one block group; Asian minority populations exist in 83 block groups; and black minority populations exist in 1470 block groups "All Other Single Minorities" exist in 3 block groups; "Aggregate of Minority Races" populations exist in 33 block groups.; and "Hispanic Ethnicity" minority populations exist in 12 block groups (Exelon 2002a).

The Census Bureau data characterize 11.47 percent of Illinois households as low-income, while 10.78 percent of Indiana households are similarly classified. Based on the "more than 20 percent" criterion, 263 census tracts out of a possible 1693 contain a low-income population (Exelon 2002a).

The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately affected. In addition, the staff did not identify or observe any location-dependent disproportionate impacts affecting these minority and low-income populations. Based on a review of the Dresden ER for license renewal, the staff's independent review, and a visual reconnaissance during the site visit to Dresden (March 9, 2004), the staff concludes that environmental justice consequences of the construction and operation of a new nuclear unit at Dresden would be SMALL, and that mitigation would not be warranted.

8.5.2 Braidwood Generating Station

The Braidwood Generating Station is located on a site in the southwest corner of Will County, southwest of Joliet. The site covers 1804 ha (4457 ac), of which the cooling pond occupies about 1027 ha (2537 ac). Braidwood is on the Kankakee plain, in a region characterized by abandoned strip coal mines. The site itself is located on a former strip mine (Exelon 2000; AEC 1974a). Braidwood was originally developed for four units. Two nuclear units are currently operating (Exelon 2003).

The site is approximately 5 km (3 mi) west of the Kankakee River at a point 23 km (14 mi) upstream from its confluence with the Des Plaines River. The Mazon River and its branches (East Fork, Reddick Run, Crane Creek, and Granary Creek) are to the west, southwest, and south of the site. The Mazon River passes within 1.6 km (1 mi) of the southwestern site boundary.

8.5.2.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

The terrain surrounding the site is flat. Despite its proximity to Joliet and Chicago, the area is not heavily industrialized and remains primarily agricultural. The Kankakee River is a popular recreational area and supports numerous sports such as fishing and hunting. No land would be preempted for additional facilities built at this station. Exelon states that Braidwood has sufficient land to construct a new unit at the site (Exelon 2003). The NRC staff visited the Braidwood site on March 9, 2004, and met with Exelon personnel.

Overall, the land-use factors of construction and operation of a new nuclear unit are not particularly site-dependent. The footprint of a new unit would be about 41 ha (100 ac) (Exelon 2003) and could be configured to fit within the existing, previously disturbed area of the Braidwood site. The staff concludes that land-use impacts associated with site-preparation, construction, and operation of a new nuclear unit at Braidwood would be SMALL.

The impacts of construction and operation of a new nuclear unit on air quality would be similar at each of the alternative sites and would not be a significant factor in determinating environmental preferability. Therefore, these impacts are discussed generically in Section 8.6.1.

The staff assumed that the existing transmission lines serving Braidwood do not have the capacity to carry the power that would be generated by a new unit at the site. It is likely that new transmission lines, and possibly additional rights-of-way, would be needed. The additional transmission lines could be installed via expansion of existing rights-of-way, which the staff considers to be the most likely scenario, or could follow a new right-of-way. Assuming that any transmission system modifications would be expansions of existing rights-of-way, for reasons similar to those discussed in Chapters 4 and 5 for expansion to support the ESP site, the staff concludes that the land-use impacts associated with right-of-way expansion would be SMALL. The procedures for adding new transmission lines to connect a new unit at Braidwood to the transmission grid are similar to those described in Section 3.3.

8.5.2.2 Hydrology, Water Use, and Water Quality

A new nuclear unit at Braidwood was assumed to withdraw makeup water from the Kankakee River. The staff estimated the 7Q10 (7-day average minimum annual flow) and 30Q2 (median 30-day minimum annual discharge) based on data from the USGS stream gauge 05527500 (Kankakee River near Wilmington, Illinois). Data for the period of record from 1914 through 2003 was used to estimate the 7Q10 and 30Q2 values. The drainage area upstream of the gauge is reported by the USGS to be 13,338 km^2 (5150 mi^2). The 7Q10 and 30Q2 values estimated by the staff are 13.1 m^3/s (463 cfs) and 21.7 m^3/s (765 cfs), respectively. The net consumptive loss for a wet cooling tower, based on the PPE, is 2.0 m^3/s (70 cfs) or 15 and 9.2 percent of the 7Q10 and 30Q2, respectively.

Any releases of contaminants to the waters of the State of Illinois would be regulated by the IEPA through the NPDES permit process to ensure that water quality was protected. Based on the requirements of the current Braidwood NPDES permit and the above analysis, the staff concludes that the water-use and water quality impacts of an additional unit at the Braidwood site would be SMALL.

8.5.2.3 Terrestrial Resources Including Endangered Species

Between the years 1940 and 1974, about 971 ha (2400 ac), about 54 percent, of the 1804-ha (4457-ac) Braidwood site was used for coal strip mining (ComEd 1974a). The majority of the remainder of the site consists of Braidwood Lake (IDNR 2004). The Braidwood site includes strip mine spoils, cultivated fields, fallow fields, and open woodlands; no climax plant communities (tall grass prairie with areas of deciduous forest) were found within its boundaries. Strip mine spoils were interspersed with excavations containing stagnant water, and some marshy areas were found along roadsides and railroad tracks and between fields. Spoil areas were characterized as having packed, infertile soils with low vegetation density, and strip mine spoils were reclaimed via revegetation programs that included planting woody and herbaceous species (AEC 1974a).

Currently, partially to fully forested habitats occupy the area just west of the Braidwood site infrastructure, whereas areas to the east appear to be mostly cleared of forest, based on 1998/1999 digital orthophoto quadrangle data (ISGS 2004). It is assumed that structures for a new nuclear unit (power block structures, normal heat-sink cooling towers, switchyard expansion, new intake structures, and safety-related cooling towers) would be primarily constructed in areas already cleared of forest, if possible, and that forested habitat would thus be minimally impacted. Consequently, the habitat impacts from construction of a new unit at the Braidwood site would be negligible.

There are no known occurrences of Federally listed threatened or endangered terrestrial species on or in the vicinity of the Braidwood site (FWS 2004b), except for the threatened eastern prairie fringed orchid (*Platanthera leucophaea*) that is known to occur between 3.2 km (2 mi) to 16 km (10 mi) from the site (IDNR 2004). Its habitat includes, but is not restricted to, mesic prairie, sedge meadows, marsh edges, and bogs (FWS 2004b). It is unlikely that this species occurs on the Braidwood site, given the above description of habitats onsite. There is no designated critical habitat for this species. There are 24 State-listed threatened or endangered terrestrial species that occur within a 16-km (10-mi) radius of the Braidwood site, but only one of these, the endangered upland sandpiper (*Bartramia longicauda*), is known to occur within 3.2 km (2 mi) of the site (IDNR 2004). Because the upland sandpiper's breeding habitat is grassland (USGS 2004) and this habitat likely does not occur at the Braidwood site, it is unlikely that the species occurs there. The other 23 State-listed species also likely do not occur onsite based on their known distribution, i.e., being located at least 3.2 km (2 mi) from the site. Consequently, impacts to Federal and State-listed species, if any, from construction of a new nuclear unit on the Braidwood site would be minimal.

There are two transmission lines, spanning a total of 134 km (84 mi) and covering 961.5 ha (2376 ac), that currently serve Braidwood (NRC 1996). Land cover along these lines consists of farmland (85 percent), open woodland and hedgerows (10 percent), and riparian woodlands (5 percent) (AEC 1974a). These transmission lines are assumed not to have the capacity to carry the power that would be generated by a new unit at Braidwood, and it is likely that new transmission lines, and possibly additional rights-of-way, would be needed. Assuming that any additional transmission system modifications would be expansions of existing rights-of-way and that the expansions would consist of doubling the current corridor width, a loss of 48 ha (119 ac) of woodland could occur. Loss of this amount of woodland over 134 km (84 mi) of corridor would be considered negligible.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that impacts to terrestrial resources, including threatened and endangered species, from construction and operation of a new nuclear unit at the Braidwood site and associated transmission lines would be SMALL.

8.5.2.4 Aquatic Resources Including Endangered Species

Braidwood Lake was constructed in the late 1970s and impounded during 1980 and 1981 with water pumped from the Kankakee River. Several surface-mined pits were flooded within the lake, and fisheries management actually began in 1978 before the lake existed (IDNR 2003). The lake was a semi-private area used by employees of the power station until 1981 when the Department of Conservation (now the Illinois Department of Natural Resources) acquired a long-term lease agreement that allowed general public access. Braidwood Lake currently is used for recreational but not commercial fishing and is larger than any of the more than 200 water impoundments in the area which range from 0.3 to 12 ha (0.75 to 30 ac). The water area is managed by IDNR for sport fish and currently contains largemouth bass, smallmouth bass, bluegill, green sunfish, crappie, channel catfish, and bullhead (IDNR 2003). The area is also managed for other resident or migratory game and non-game fish species. No Federally listed aquatic species are found in the vicinity of the Braidwood site (Sackschewsky 2004).

Water from the Kankakee River is used to cool the existing Braidwood station and would be expected to be used to cool a new nuclear unit constructed at that site. As the site was designed for four units, the space is already set aside for construction of an additional unit. Although aquatic biota, including recreational sport fish, would be temporarily displaced during the construction period, they would be expected to recolonize the area after construction is complete. It is assumed that any disturbance to aquatic resources from construction would be localized and of relatively short duration. The NRC staff has reviewed information provided by Exelon and concludes that the environmental impacts of construction of a new nuclear unit at Braidwood on aquatic resources, including Federally listed threatened and endangered species, would be SMALL.

The aquatic impact most likely to occur as a result of operations of a new unit at Braidwood is entrainment and impingement of organisms from the Kankakee River (ComEd 1973a; Exelon 2000). The EPA's recent Phase I ruling on new cooling water intake structures (see 40 CFR, Parts 9, 122-125) requires facilities to meet certain criteria designed to protect organisms from entrainment and impingement. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information , the staff concludes that the potential for adverse impacts to aquatic resources, including Federally listed threatened and endangered species, from operation of a new unit at Braidwood would be SMALL.

8.5.2.5 Socioeconomics

This section evaluates the social and economic impacts to the surrounding region as a result of constructing and operating a new unit at the Braidwood site. The evaluation assesses impacts of construction and station operation and of those demands placed by the workforce on the surrounding region.

Physical Impacts

The physical impacts of construction and operation of a new unit at Braidwood are similar to those of construction and operation of a new unit at the other alternative sites. They are discussed generically in Section 8.6.4.

Demography

The Town of Godley (population 594) is about 0.8 km (0.5 mi) from the site. Within a 8-km (5-mi) radius, there are the Towns of Coal City (population 4797) and Braidwood (population 5203) (USCB 2000c). Projected population of the area suggests that the population, including the transient population, within 16 km (10 mi) of the Braidwood Station will reach nearly 86,000 by the year 2020. The population between 16 and 80 km (10 and 50 mi) includes the Chicago metroplex, and the total population is predicted to reach more than 5 million by the year 2020. There are approximately 22 urban centers within a 48-km (30-mi) radius of the site (Exelon 2003b).

As with Dresden, most construction and operation workers are expected to come from within the region. The total number of workers hired would be the same as with Dresden. Should some decide to relocate to Will County, the increase in population would be very small when compared to the total population already resident in the county.

As with Dresden, some new jobs might result from the multiplier effect attributable to the construction and operations workforce and might result in some increase in population in the region. However, when compared to the total population base in the region, these increases would be minimal. Any multiplier effects resulting from construction and operations workers' expenditures would most likely mean that some residents would obtain new or higher paying jobs as a result of the increased economic activity. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the demographic impacts of construction and station operation on increases in population within the region would be SMALL.

Impacts to the Community - Social and Economic

This subsection discusses the site-specific impacts of construction and operation of a new nuclear unit at the Braidwood site. Some of the impacts of construction and operation of a new nuclear unit that are generic are discussed in Section 8.6.4.

Economy

The economy surrounding Braidwood would be similar to Dresden's, which is described in Section 8.5.1.5. Will County would be the main beneficiary of construction and operation of a new nuclear unit at Braidwood. In Will County, the magnitude of the economic impacts would be diffused within the larger economic base, as is also the case in the surrounding counties. Thus, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the beneficial impacts of construction and station operation on the economy of the region would be SMALL.

Taxes

All of Braidwood is in Will County. As a result, all of the property taxes paid by Exelon on the facility at Braidwood would go to Will County. The taxes, while large in absolute amount, would be small when compared to the total taxes collected by Illinois and Will County. In addition, Will County has a larger economic base than some of the surrounding counties. Thus, the percentage of total property taxes collected from Exelon for the Braidwood site would not be significant when compared to the total property taxes collected in the county. Therefore, the NRC staff concludes that the beneficial tax impacts (property, income, sales, and use taxes) of constructing and operating a new facility at Braidwood would be SMALL.

Impacts to the Community - Infrastructure and Community

This subsection discusses the site specific impacts of construction and operation of a new nuclear unit at the Braidwood site concerning transportation, aesthetics and recreation, and housing. Some of the impacts of construction and operation of a new nuclear unit that are generic (such as public services) are discussed in Section 8.6.4.

Transportation

Braidwood is located off Interstate (I) 55, which is less than 3.6 km (2 mi) west-northwest of the plant. Illinois SRs 53 and 129 are located less than 1.6 km (1 mi) to the northwest of the site. SR 113, located approximately 3.6 km (2 mi) north of the site, also provides access to the interstate and state highways.

Construction of a new nuclear unit at Braidwood would employ 3150 workers, in addition to the 1000 or so employees already employed at Units 1 and 2. Truck traffic would increase greatly and rail traffic would increase as well. Heavy loads of materials might necessitate additional maintenance on the roads leading to the site. While traffic counts on the roads around and leading to Braidwood were not available, congestion on the roads leading to and around the site could be expected, particularly at shift changes, which could be mitigated by staggering shifts so that all employees would not enter or leave the site at the same times. Based on the information provided by Exelon and the NRC staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction on transportation would be SMALL to MODERATE and some mitigating actions might need to be undertaken.

With respect to the operations workforce at the facility, adding an additional 580 cars (assuming a single occupant per car) to the existing 1000 cars on the road of employees of Braidwood Units 1 and 2 would not materially congest the highway except at shift changes. These impacts could be mitigated by staggering the shift changes between the two plants (Braidwood and a new nuclear unit) so that they would not all occur at the same time. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of the operations workforce on transportation would be SMALL, and that mitigation would not be warranted.

Aesthetics and Recreation

The terrain of the Braidwood site is relatively flat and open. The local terrain around the site is very flat and is largely rural and agricultural, characterized by farmland, woods, and small residential communities. Residential development exists to the northeast and south-southeast of the site. There are two boat-launching ramps on Braidwood's cooling reservoir that were in use at the time of the NRC staff visit (March 9, 2004).

The construction of a new nuclear unit at Braidwood could be viewed from offsite at certain locations, but the addition of another facility would not substantially change the view of the current Braidwood units. There might be a need to construct a cooling-water intake structure and discharge at the site. As the cooling reservoir is currently at maximum use with Braidwood Units 1 and 2, a new nuclear unit at the site would need one or more cooling towers. The operation of a new nuclear unit probably would have visual impacts similar to those of the existing Braidwood units, with the addition of occasional visible plumes from cooling towers. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation of a new nuclear unit on aesthetics would be SMALL and that further mitigation would not be warranted.

Housing

In Will County, there are 175,524 housing units, of which 7982 (5 percent) are vacant (USCB 2000b). A 5-percent vacancy rate would, on its surface, indicate a potential shortage of housing near the Braidwood site for the Exelon construction workforce of 3150. Assuming that the construction workforce would commute from an area within a 80-km (50-mi) radius of Braidwood, which has a population of 7,078,561, there would be few discernible impacts on housing availability, rental rates or housing values, or housing construction or conversion in Will County. Those who chose to relocate to the region would find adequate housing available. Therefore, based on information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction on housing would be SMALL.

If built, a new nuclear unit at Braidwood would have 580 employees when it became operational (Exelon 2003a). Of the current employees at Braidwood, 72 percent live in Will and Grundy Counties. If it is assumed that the new operating workforce would not come from within the region, but would relocate to the region, and follow similar past practices, one would expect as many as 415 of the new operating employees to locate in the two counties. There are no growth restrictions in either Will or Grundy Counties. If the workers were not already in the region, Will County would have a sufficient number of housing units to handle the station operations personnel and their families. Should all of the 415 new employees locate to Will County, it is unlikely there would be discernible impacts on housing availability, rental rates, or housing values. There might be some new construction of housing, but it would be minor as a result of operating a new nuclear unit. Grundy County has a smaller housing base and vacant units. If all the new employees decided to relocate to Grundy County, there could be upward pressure on housing prices, on values, and on new construction.

It is expected that most of the operational workforce would already be in the region and have residences. Should this be the case, there would be little demand for housing. However, if the workers were not already in the region, Will County currently has a sufficient number of housing units to handle the station operations personnel and their families. Grundy County has a smaller housing base and less vacant units. If all the new employees decided to relocate to Grundy County, there could be upward pressure on housing prices. Therefore, based on the staff's independent review and on reconnaissance- level information, the staff concludes that the impacts of station operation on the availability of housing would be SMALL for Will County and MODERATE for Grundy County, and mitigation would occur through market forces, leading to the construction of new housing.

8.5.2.6 Historic and Cultural Resources

The impacts of construction and operation of a new nuclear unit on historic and cultural resources at the alternative sites are discussed generically in Section 8.6.5.

8.5.2.7 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.

The staff used the Geographical, Environmental and Siting Information (GEN&SIS) database to develop maps of minority and low-income populations around the Braidwood site (GEN&SIS 2004). The data used are based on the 2000 Census and census blocks and followed the NRC criteria for determining the presence of low-income or minority populations (NRC 2001; 69 FR 52040). Maps were created showing census blocks of minority and low-income populations within a 80-km (50-mi) radius of Braidwood. There is a concentration of minority populations located about 48 km (30 mi) to the southwest of Braidwood near Pontiac. Another concentration of minority populations lies 48 km (30 mi) to the southeast of the site, near Bourbonnais, Bradley, and Kankakee, and another small concentration is almost due south, about 64 km (40 mi) from the site. To the northeast, the Chicago area has numerous concentrations of minority populations. For low-income populations, there is a concentration around Kankakee and within the Chicago metropolitan area.

The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which the populations could be disproportionately affected. In addition, the staff did not identify or observe any location-dependent disproportionate impacts affecting these minority and low-income populations. Based on the staff's independent review of reconnaissance-level information including a site visit to Braidwood (March 9, 2004), the staff concludes that environmental justice consequences of the construction and operation of a new nuclear unit at Braidwood would be SMALL and that mitigation would not be warranted.

8.5.3 LaSalle County Generating Station

The LaSalle County Generating Station is located on a site in the southeast corner of LaSalle County, Illinois. It is approximately 110 km (70 mi) southwest of the center of Chicago and approximately 39 km (24 mi) west-southwest of Dresden Nuclear Power Station. It is approximately 8 km (5 mi) south of the Illinois River, which at that point flows to the west. The land use around the site is predominately agricultural. Nearby towns around the site include Seneca (population 2053), Marseilles (population 4655), and Ransom (population 409) (USCB 2000d).

LaSalle occupies approximately 1240 ha (3060 ac) with two nuclear units in operation. The Illinois River is the primary surface-water source for the facility. LaSalle does not significantly affect surface-water use from the Illinois River because of an 833-ha (2058-ac) cooling-water reservoir. Exelon assumes that a new nuclear facility at the area would have roughly the same general environmental impact as that of the existing facility (Exelon 2003).

8.5.3.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

LaSalle County and the two counties adjacent to its southeast corner, Livingston and Grundy Counties, are predominantly agricultural areas. All three have a large percentage of their land under cultivation. Principal crops are corn, soybeans, and wheat; other crops include barley, rye, and hay. Livestock is another production commodity (ComEd 1973b). Land use remains predominantly agricultural. No new land will be preempted if new units are placed on the site.

Overall, the land-use factors of construction and operation of a new nuclear unit are not particularly site-dependent. The footprint of a new unit would be less than 41 ha (100 ac) (Exelon 2003) and could be configured to fit within previously disturbed land on the LaSalle site.

Based on these considerations, the staff concludes that the potential land-use impacts associated with site-preparation and construction and resulting from operation of a new unit at the LaSalle site would be SMALL.

The impacts of construction and operation of a new nuclear unit on air quality would be similar at each of the alternative sites and would not be a significant factor in determination of environmental preferability. Therefore, these impacts are discussed generically in Section 8.6.1.

The existing transmission lines for LaSalle do not have the capacity to carry the power that would be generated by a new nuclear unit. It is likely that new transmission lines, and possibly additional rights-of-way, would be needed. The additional transmission lines could be installed via expansion of an existing right-of-way, which the staff believes to be likely, or could follow a new right-of-way. Assuming that any additional transmission system modifications would be expansions of existing rights-of-way, for reasons similar to those discussed in Chapters 4 and 5 for expansion to support the Exelon ESP site, the staff concludes that the land-use impacts associated with the expansion would be SMALL. The procedures for adding the new transmission lines to connect a new nuclear unit at LaSalle to the transmission grid are similar to those described in Section 3.3.

8.5.3.2 Hydrology, Water Use, and Water Quality

A new nuclear unit at LaSalle was assumed to withdraw makeup water from the Illinois River. The staff estimated the 7Q10 (7-day average minimum annual flow) and 30Q2 (median 30-day minimum annual discharge) based on data from the USGS stream gauge 05543500 on the Illinois River near Marseilles, Illinois. Data for the period of record from 1919 through 2003 was used to estimate the 7Q10 and 30Q2 values. This gauge is slightly downstream of the alternative ESP site. The drainage area upstream of the gauge near the site is reported by the USGS to be 21,391 km^2 (8259 mi^2). The 7Q10 and 30Q2 values estimated by the staff are 85.7 m^3/s (3028 cfs) and 126 m^3/s (4451 cfs), respectively. The net consumptive loss for a wet cooling tower, based on the PPE, is 2.0 m^3/s (70 cfs), or 2.3 and 1.6 percent of the 7Q10 and 30Q2, respectively.

Any releases of contaminants to the waters of the State of Illinois would be regulated by the IEPA through the NPDES permit process to ensure that water quality is protected. Based on the requirements of the current LaSalle NPDES permit and the above analysis, the staff concludes that the water use and water quality impacts of an additional unit at the LaSalle site would be SMALL.

8.5.3.3 Terrestrial Resources Including Endangered Species

The 1240-ha (3060-ac) LaSalle site supports five plant communities: upland woods, Illinois River floodplain woods, creek bottom woods, cleared woods on transmission line rights-of-way, and old fields in various stages of succession (NRC 1978). Partially to fully forested habitat is found north and northeast of the existing LaSalle site infrastructure, and areas cleared of forest are found to the west, south, and east, based on 1998/1999 digital orthophoto quadrangle data (ISGS 2004). The remainder of the site remains largely unaltered since the late 1970s. The staff assumed that structures for a new nuclear unit (power block structures, normal heat-sink cooling towers, switchyard expansion, new intake structures, and safety-related cooling towers) would be primarily constructed in areas already cleared of forest, if possible, and that forested habitat would thus be minimally impacted. Consequently, habitat impacts from construction of a new nuclear unit at LaSalle would be negligible.

Currently, there are two Federally listed threatened or endangered terrestrial species that may occur in the vicinity of the LaSalle site: the threatened bald eagle (*Haliaeetus leucocephalus*) and the endangered Indiana bat (*Myotis sodalis*) (FWS 2004a). The bald eagle is known to winter along large rivers, lakes, and reservoirs in LaSalle County; however, no night roost sites are known to occur there. The Indiana bat potentially occurs throughout Illinois where forest habitat is present (FWS 2004a). However, there is no suitable habitat for the Indiana bat near LaSalle and the species does not occur on or near the site (NRC 1978). Designated critical habitat exists for only one of these two Federally listed species, the Indiana bat (FWS 2004a). The only critical habitat in Illinois is the Blackball Mine (FWS 1976), located near Utica in LaSalle County, about 32 km (20 mi) northwest of the LaSalle site (NRC 1978). There is one State-listed threatened or endangered terrestrial species known to occur from 3.2 km (2 mi) to 16 km (10 mi) from the LaSalle site, and none that occurs within 3.2 km (2 mi) (IDNR 2004). Consequently, impacts to Federal and State-listed species, if any, from construction of a new nuclear unit at LaSalle would be minimal.

There are 166 km (103 mi) of transmission lines covering 922 ha (2278 ac) that currently serve LaSalle (NRC 1996). Land cover along these lines consists primarily of farmland (NRC 1978). These transmission lines are assumed not to have the capacity to carry the power that would be generated by a new nuclear unit, and it is likely that new transmission lines and possibly additional rights-of-way would be needed. Assuming that any transmission system modifications would be expansions of existing rights-of-way, potential terrestrial ecological impacts associated with the expansion would be small due to the prevalence of agriculture along the existing corridor.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that impacts to terrestrial resources, including threatened and endangered species, from construction and operation of a new nuclear unit at the LaSalle site and associated transmission lines would be SMALL.

8.5.3.4 Aquatic Resources Including Endangered Species

LaSalle is approximately 6.6 km (4 mi) south of the Illinois River in southeast LaSalle County. The Illinois River near the plant has been reported to have essentially no commercial or recreational value for fishing because of reduced biological diversity related to pollutants (ComEd 1973b). LaSalle Lake is an 833-ha (2058-ac) reservoir that serves as a cooling reservoir for LaSalle. Soil excavated for the lake's construction was used to build the shoreline and internal dikes, which are covered with rock riprap. The raised dikes are used to direct cooling water through a 5-day circulation pattern from the discharge channel back to the intake channel. There is typically an 11°C (20°F) water-temperature difference between the two channels. The average depth of LaSalle Lake is 4.6 m (15 ft), but there are excavated areas within the lake up to 21.3 m (70 ft) deep (IDNR 2004). The lake is popular with anglers who may encounter walleye, muskellunge, tiger muskie, yellow bass, white bass, striped bass, hybrid striped bass, largemouth and smallmouth bass, white crappie, black crappie, bluegill, bullhead and channel catfish, freshwater drum, carp, goldfish, minnows, suckers, and threadfin shad (LaSalle Cooling Lake 2004). Largemouth and smallmouth bass, channel catfish, walleye, sauger, crappie, and hybrid striped bass have all been stocked since 1989 (Madeja 2002). No Federally listed aquatic species are found in the vicinity of the LaSalle nuclear facility (Sackschewsky 2004).

While aquatic biota, including recreational sport fish, would be temporarily displaced during the construction period, they would be expected to recolonize the region after construction was complete. It is expected that the disturbance to aquatic resources would be localized and of relatively short duration. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the environmental impacts of construction of a new nuclear unit on aquatic resources, including Federally listed threatened and endangered species, would be SMALL.

LaSalle does not significantly affect surface-water use from the Illinois River because of the 830-ha (2058-ac) cooling reservoir. However, according to plant personnel (interviewed during a site visit on March 11, 2004, by NRC staff), the reservoir is near its cooling capacity in serving the two existing nuclear units at the site.

Even if water for a new nuclear unit was withdrawn from the Illinois River, adverse impacts to aquatic environments as a result of impingement and entrainment are not expected to result. The Illinois River is best characterized as a recovering river system, and abundance and diversity of aquatic species and habitats are restricted by upstream pollutants, commercial and recreational boat traffic, and continuing habitat alteration. These factors arise from offsite use of the river corridor; operation of the current LaSalle nuclear facility is not a significant factor in the overall quality of aquatic habitats in the vicinity of the plant (Exelon 2003). The EPA's recent Phase I ruling on new cooling water intake structures (see 40 CFR Parts 9, 122-125) requires new cooling water intake facilities to meet certain criteria designed to protect organisms from entrainment and impingement. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the potential for adverse impacts to aquatic resources, including Federally listed threatened and endangered species, from operation of a new nuclear unit at LaSalle would be SMALL.

8.5.3.5 Socioeconomics

This section evaluates the social and economic impacts to the surrounding region as a result of constructing and operating a new nuclear unit at the LaSalle site. The evaluation assesses impacts of construction and station operation and of those demands placed by the workforce on the surrounding region.

Physical Impacts

The physical impacts of the construction and operation of a new nuclear unit at LaSalle are similar to those for the other alternative sites. They are discussed generically in Section 8.6.4.

Demography

LaSalle is located in the southeast corner of LaSalle County, Illinois (population 115,509 (USCB 2000d). It is approximately 110 km (70 mi) southwest of the center of Chicago and approximately 39 km (24 mi) west-southwest of the Dresden Nuclear Power Station. It is approximately 8 km (5 mi) south of the Illinois River, which at that point flows to the west. The land use around the site is predominantly agricultural. Nearby towns around the site include Seneca (population 2053), Marseilles (population 4655), and Ransom (population 409) (USCB 2000d).

Most construction and operation workers are expected to come from within the region. The total number of workers hired would be about 3150. Should some decide to relocate to LaSalle County, the increase in population would be very small when compared to the total population already resident in the county.

Some new jobs might result from the multiplier effect attributable to the construction and operations workforce and might result in some increase in population in the region. But these increases, when compared to the total population base in the region, would be minimal. Any multiplier effects resulting from construction and operations workers' expenditures would most likely mean that some residents would obtain new or higher paying jobs as a result of the increased economic activity.

Based on the information provided by Exelon and the NRC staff's independent review of reconnaissance-level information, the staff concludes that the demographic impacts of construction and station operations within the region would be SMALL.

Impacts to the Community - Social and Economic

This subsection discusses the site-specific impacts of construction and operation of a new nuclear unit at the LaSalle site. Some of the impacts of construction and operation of a new nuclear unit that are generic are discussed in Section 8.6.4.

Economy

LaSalle County and the two counties adjacent to its southeast corner, Livingston and Grundy Counties, have a large agricultural base. All three counties have a large percentage of their land in cultivation. Crops grown include corn, soybeans, wheat, barley, rye, and hay; livestock are also raised.

LaSalle County's business profile is led by retail trade, which has 18 percent of the County's total employment, followed by manufacturing (17 percent) and health care and social assistance (13 percent) (USCB 2001c). The unemployment rate for LaSalle County in 2000 was 5.8 percent, while that for Illinois as a whole was 4.3 percent (IDES 2000a, 2000b).

In counties other than LaSalle County, which will not experience the direct benefits of construction or operation, the magnitude of the economic impacts would be diffused within the larger economic base. In LaSalle County, Exelon contributes moderately to the tax base (see discussion under "Taxes" below). By inference, the same would be expected in the other economic contributions to the county's economy. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and station operation on the economy of the region would be SMALL in all counties in the region except LaSalle County, where it could be MODERATE. In all cases, the impacts would be beneficial.

Taxes

Taxes collected as a result of constructing and operating a new nuclear unit at LaSalle would be of benefit to the State and to local jurisdictions that collected and spent them. Following the construction period and at the start of operations, Exelon would pay annual property taxes to LaSalle County. For the tax year 2003 to 2004, Exelon paid approximately 15 to 18 percent of the total property taxes paid in LaSalle County.[a]

Personal and corporate income taxes and sales and use taxes would also be collected during the construction and operating periods of a new nuclear unit. While large in absolute amount, these tax amounts would be small when compared to the total taxes collected by Illinois as a whole and by LaSalle County. Based on the staff's independent review of reconnaissance-level information, the staff concludes that for LaSalle County the beneficial impacts of taxes collected during construction would be SMALL, that the beneficial impacts of taxes collected during

(a) Personal telephone communication with Gary Kleinhans, Chief Deputy to the LaSalle County Treasurer, May 28, 2004.

operation would be SMALL to MODERATE,[(a)] and that further mitigation would not be warranted.

Impacts to the Community - Infrastructure and Community

This subsection discusses the site specific impacts of construction and operation of a new nuclear unit at the LaSalle site concerning transportation, aesthetics and recreation, and housing. Some of the impacts of construction and operation of a new nuclear unit that are generic (such as public services) are discussed in Section 8.6.4.

Transportation

The major transportation routes near the site include the Illinois River, approximately 5 km (3 mi) north of the northern boundary; Illinois State Highway 170, 0.8 km (0.5 mi) east of the eastern boundary of the site; and I-80, 13 km (8 mi) north of the northern site boundary. The Chicago, Rock Island, & Pacific Railroad, approximately 5 km (3 mi) north of the northern site boundary, is the closest operable railroad line (Exelon 2003a).

The construction workforce would number 3150 (Exelon 2003a), in addition to what are believed to be about 1000-plus operating employees of LaSalle Units 1 and 2. If the construction of a new nuclear unit were to follow past practices when Units 1 and 2 were constructed, construction would attract a large number of workers who would commute to the site from the surrounding area (AEC 1973). Highway transport would be used in the conveyance of construction materials to the site. Both of these events would put more traffic on the roads leading to the site, resulting in more congestion, particularly at shift changes. Corrective measures probably could be taken to minimize traffic congestion and safety hazards, such as using multi-shift workforces.

The NRC staff observed highway traffic around LaSalle during its site visit. The addition of upwards of 3150 cars (assuming a single occupant per car) on the road leading to the site could cause congestion, particularly at shift changes, and could be exacerbated with the addition of trucks carrying construction materials to the site. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff

(a) The MODERATE impact is based on the impact of deregulation (see Section 2.8.2.3). While a new nuclear unit would potentially operate in a deregulated environment, the impacts of deregulation on the facility's value, and thus property taxes paid by the facility, are not fully known. Given the facility's potential value and property taxes paid to LaSalle County, the staff assumed that the facility's impact on collected property taxes would, at a minimum, be SMALL and could be MODERATE when compared to the taxes the facility could pay and the total property taxes collected by the county.

concludes that the impacts of construction on transportation would likely be SMALL, provided that impacts are actively mitigated, to MODERATE, if mitigation does not take place.

During operation of a new nuclear unit, adding 580 cars (assuming a single occupant per car), to what are believed to be about 1000 cars for operating employees of LaSalle Units 1 and 2, would not materially congest the highway except at shift changes. These impacts could be mitigated by staggering the shift changes among the plants (the current units and the new unit). Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of a new nuclear unit on transportation would be SMALL, and that mitigation is not warranted.

Aesthetics and Recreation

The Rock River is the major waterway for the area surrounding the LaSalle site. The Illinois River is the primary surface-water source for the facility and an important source of commercial and recreational navigation. The topography of the site is flat, with open grassland and few woods, except in the corridor that contains the pipelines for intake and discharge of cooling water to the Illinois River. However, the corridor is not directly owned by Exelon. LaSalle has a cooling reservoir, which is open for recreation.

Construction of a new nuclear unit would not be expected to have major impacts on the Illinois River due to the distance of the site from the river. Any impacts to the river of an additional cooling-water structure, if needed, would be transitory. Based on the staff's independent review of reconnaissance-level information, the staff concludes that the impacts on aesthetics and recreation of construction of a new nuclear unit at LaSalle would be SMALL and that mitigation would not be warranted.

The main visual impacts of operating a new nuclear unit would be the addition of a cooling tower onsite. None currently exists, but the cooling reservoir is near its capacity because of the heat load of LaSalle Units 1 and 2. In some meteorological conditions, the plume from a cooling tower could be seen for miles. This would add marginally to the visual impacts. However, recreation on the cooling reservoir likely would not be materially impacted. Based on the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation of a new nuclear unit at LaSalle would be SMALL, and that mitigation is not warranted.

Housing

In the six-county area of LaSalle, Bureau, Grundy, Kendall, DeKalb, and Lee Counties in 2000, there were a total 143,626 housing units, of which 8009 units were vacant (6 percent of the total [USCB 2000d]). Most construction workers would come from within the region and commute to the job site. Most of the workers hired for the initial construction of LCGS came from neighboring communities, such as Streator, Ottawa, Joliet, and Kankakee (NRC 1978). Thus, with the construction of a new nuclear unit, relatively few workers would be expected to move and take up residence in the area, and those that did could find housing within the six-county area.

When operational, a new nuclear unit would have 580 employees (Exelon 2003). Information on where the current 1000-plus operating employees of LaSalle Units 1 and 2 live was not available, although Commonwealth Edison estimated that less than 20 percent of the total operating staff for LaSalle Units 1 and 2 relocated to the local area, defined as Ottawa, Streator, and Marseilles (NRC 1978). There are 3021 vacant housing units in LaSalle County, a 6.5-percent vacancy rate. If 115 employees decided to live in LaSalle County, there would not be a discernable impact on housing availability, rental rates, or housing values. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of station construction and operation on the availability of housing would be SMALL and that mitigation would not be warranted.

8.5.3.6 Historic and Cultural Resources

The impacts of construction and operation of a new nuclear unit at the LaSalle site on historic and cultural resources are discussed generically in Section 8.6.5.

8.5.3.7 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.

The staff used the Geographical, Environmental, and Siting Information (GEN&SIS) database to develop maps of minority and low-income populations around the LaSalle site (GEN&SIS 2004). The data used are based on the 2000 Census and census blocks and followed the NRC criteria for determining the presence of minority or low-income populations (NRC 2001; 69 FR 52040). Maps were created showing census blocks of minority and low-income populations within 80 km (50 mi) of the LaSalle site.

There is a concentration of minority populations about 48 km (30 mi) south of LaSalle, near Pontiac. Another concentration of minority populations lies 48 km (30 mi) to the southeast of the site, near the Towns of Bourbonnais, Bradley, and Kankakee, and another small concentration almost due south, 64 km (40 mi) from the site. The Chicago area to the northeast has large concentrations of minority populations. Low-income populations are concentrated around Kankakee and within the Chicago metropolitan area.

The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately affected. In addition, the staff did not identify or observe any location-dependent disproportionate impacts affecting these minority and low-income populations. Based the staff's independent review of reconnaissance-level information including a site visit to LaSalle on March 11, 2004, the staff concludes that the environmental justice consequences of the construction and operation of a new nuclear facility would be SMALL and that mitigation would not be warranted.

8.5.4 Quad Cities Generating Station

The Quad Cities Generating Station is located in Rock Island County, Illinois, on the east bank of Pool 14 of the Mississippi River, about 26 km (16 mi) below Dam 13 and 21 km (13 mi) from Dam 14. The station is approximately 800 km (500 mi) upstream from the Mississippi's confluence with the Ohio River (i.e., River Mile [RM] 506.5) (Exelon 2002b).

The Quad Cities metropolitan area, consisting of the cities of Davenport and Bettendorf, Iowa, and Rock Island, Moline, and East Moline, Illinois, is located 32 km (20 mi) southwest of the Quad Cities site. The station is about 6 km (4 mi) north of Cordova, Illinois, and 16 km (10 mi) southwest of Clinton, Iowa (Exelon 2002b). The region within 10 km (6 mi) of the site includes portions of Rock Island and Whiteside Counties in Illinois and Scott and Clinton Counties in Iowa.

The Quad Cities site consists of 331 ha (817 ac) and includes two nuclear reactors and their turbine buildings, intake and discharge canals, and ancillary buildings, switchyards, and a retired spray canal now used to raise fish (Exelon 2002c). Most of the western portion of the Quad Cities site is industrial, containing the major generating facilities, switchyard, warehouses, parking lots, and roads. Open fields and areas of planted pines occupy most of the eastern portion of the Quad Cities site. With the exception of an industrial park immediately north of the site and some forested bottom lands between the developed portion of the site and the Mississippi River, the surrounding lands are mostly agricultural, with large fields planted in grain (primarily corn) and forage crops.

8.5.4.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

Land around the station supports a combination of agricultural and industrial uses. Some land in the region has been set aside for recreational and environmental use. The Mississippi River supports a large sport fishery as well as commercial and recreational boating. Current land use at the Quad Cities site is not expected to change or expand, and there would be no preemption or adverse effects on land that has been set aside for environmental or recreational uses (Exelon 2003).

In its ER, Exelon states that the site does not have additional available land within its boundaries to build a new nuclear unit. An operating unit would need to be decommissioned and dismantled so that the new nuclear unit could be constructed on the decommissioned unit's footprint (Exelon 2003).

Overall, the land-use factors of construction and operation of a new nuclear unit are not particularly site-dependent. The staff visited the Quad Cities site in March 2004. The footprint of a new unit would be less than 41 ha (100 ac) (Exelon 2003) and, based on observation of the site, the staff believes it could be configured to fit within the existing, previously disturbed 331 ha (817 ac) of the Quad Cities site. Based on these considerations, the staff concludes that the potential land-use impacts associated with site-preparation and construction and resulting from operation of a new unit at the Quad Cities site would be SMALL.

The impacts of construction and operation of a new nuclear unit on air quality would be similar at each of the alternative sites and would not be a significant factor in the determination of environmental preferability. Therefore, these impacts are discussed generically in Section 8.6.1.

The existing transmission lines serving the Quad Cities site are assumed not to have the capacity to carry the power that would be generated by a new nuclear unit. It is likely that new transmission lines and possibly additional rights-of-way would be needed. An additional transmission line could be installed via an expansion of an existing right-of-way, which the staff believes to be the likely scenario, or could follow a new right-of-way. Assuming that any transmission system modifications would be expansions of existing rights-of-way for reasons similar to those discussed in Chapters 4 and 5 for expansion to support the Exelon ESP site, the staff concludes that the land impacts associated with the expansion would be SMALL. The procedures for adding the new transmission lines to connect a new nuclear unit at Quad Cities to the transmission grid are similar to those described in Section 3.3.

8.5.4.2 Hydrology, Water Use, and Water Quality

The staff assumed that a new nuclear unit at the Quad Cities site would withdraw makeup water from the Mississippi River. Because there is no stream gauge on the Mississippi River near the Quad Cities location, the staff estimated the 7Q10 (7-day average minimum annual flow) and 30Q2 (median 30-day minimum annual discharge) based on data from three USGS stream gauges: 05420500 (Mississippi River at Clinton, Iowa), 05422000 (Wapsipinicon River near DeWitt, Iowa), and 05446500 (Rock River near Joslin, Illinois). Data for the period of record from 1939 through 2003 were used to estimate the 7Q10 and 30Q2 values. The drainage area contributing to the site was estimated to be 253,819 km^2 (98,000 mi^2). The 7Q10 and 30Q2 values estimated by the staff are 439 m^3/s (15,490 cfs) and 723 m^3/s (25,532 cfs), respectively. The net consumptive loss for a wet cooling tower, based on the PPE, is 2.0 m^3/s (70 cfs) or

0.5 and 0.3 percent of the 7Q10 and 30Q2, respectively. Wet towers were used as the basis of this assessment because wet towers represent the greatest consumptive loss of water.

Any releases of contaminants to the waters of the State of Illinois would be regulated by the IEPA through the NPDES permit process to ensure that water quality is protected.

Based on the requirements of the current Quad Cities NPDES permit and the above analysis, the staff concludes that the water-use and water quality impacts of an additional unit at the Quad Cities site would be SMALL.

8.5.4.3 Terrestrial Resources Including Endangered Species

The 331-ha (817-ac) Quad Cities site is located in an area with sandy soil and little shrub or forest habitat. The site consists of developed and undeveloped areas. The developed areas mostly occupy the western half of the site. Undeveloped areas are located generally on the eastern half of the site and support habitats that include open fields and planted pines (NRC 2004b). The staff assumes that structures for a new nuclear unit (power block structures, normal heat-sink cooling towers, switchyard expansion, new intake structures, and safety-related cooling towers) would be constructed primarily in developed areas of the Quad Cities site, where possible. However, if construction were to occur in undeveloped portions of the site, it would be of minor ecological consequence because of the disturbed nature of the habitats that occur there. Consequently, habitat impacts from construction of a new nuclear unit at the Quad Cities site would be negligible.

There are six Federally listed threatened or endangered terrestrial species that may occur in the vicinity of the Quad Cities site or its transmission lines: the endangered Indiana bat (*Myotis sodalis*), the threatened bald eagle (*Haliaeetus leucocephalus*), the endangered Iowa Pleistocene snail (*Discus macclintocki*), the threatened western prairie fringed orchid (*Platanthera praeclara*), the threatened eastern prairie fringed orchid (*Platanthera leucophaea*), and the threatened prairie bush clover (*Lespedeza leptstachya*) (NRC 2003; FWS 2004b). Of these six species, designated critical habitat exists only for the Indiana bat (FWS 1976, 2004a; NRC 2004b).

The Indiana bat potentially occurs throughout Illinois where forest habitat is present (FWS 2004a). However, its occurrence on the Quad Cities site has not been noted (NRC 2003b). The only critical habitat for the Indiana bat in Illinois is the Blackball Mine in LaSalle County (FWS 1976). The bald eagle is known to winter and night roost along large rivers, lakes, and reservoirs in Rock Island County (FWS 2004a). The bald eagle is a common visitor to the Upper Mississippi River Valley, within which the Savanna District of the Upper Mississippi River National Wildlife and Fish Refuge (NWFR) is located, and to which the Quad Cities site is adjacent. The bald eagle uses this area as a winter migration corridor and for nesting. The bald eagle nest nearest to the Quad Cities site is located on Beaver Island, 11 km (7 mi) to the north (NRC 2003; IDNR 2004b). The Iowa Pleistocene snail inhabits algific (i.e., cold-producing) talus slopes, within the leaf litter of cool and moist hillsides. The snail has been found at approximately 30 sites in Iowa and Illinois, but not at the Quad Cities site. Suitable habitat is unlikely to occur at the site, because the majority of the land is flat and agricultural (NRC 2004b). The western prairie fringed orchid occurs in mesic to wet tallgrass prairies and meadows, but is also found in old fields and roadside ditches. It is restricted to areas west of the Mississippi River and is thus unlikely to be found at the Quad Cities site (NRC 2004b). The eastern prairie fringed orchid prefers mesic to wet tallgrass prairie or grassland habitats, but can also occupy bogs, fens, and sedge meadows. No occurrences of this species have been documented for the Quad Cities site (NRC 2004b). The prairie bush clover occurs on dry gravel and sand prairies, in areas too rocky or steep to be plowed. Fourteen known populations occur in Illinois at present, but none of these are in Rock Island County (NRC 2004b). Because occurrences of the Indiana bat, Iowa Pleistocene snail, western and eastern prairie fringed orchids, and prairie bush clover on the Quad Cities site are unlikely, and because the nearest bald eagle nest is sufficiently distant to preclude disturbance, potential impacts to these species, if any, from construction and operation of a new nuclear unit on the Quad Cities site would be minimal.

There are four State-listed threatened or endangered terrestrial species known to occur from 3.2 km (2 mi) to 16 km (10 mi) of the Quad Cities site, and one (the river otter *[Lutra canadensis]*) that occurs within 3.2 km (2 mi) (IDNR 2004). The river otter inhabits primarily shoreline areas (IDNR 2004b) and would thus not be likely to occur in areas that would be affected by construction. Consequently, potential impacts to State-listed species from construction of a new nuclear unit on the Quad Cities site would be minimal.

Five transmission lines connect Quad Cities Units 1 and 2 to the electric grid. These lines span 185 km (115 mi) and cover approximately 880 ha (2200 ac) (NRC 2004a), traversing 90 to 95 percent agricultural land along with some natural terrestrial habitats, the upper Mississippi River NWFR, and the Princeton Wildlife Management Area (NRC 2004b).

The six Federally listed species noted above could occur in areas along the Quad Cities transmission lines. However, occurrence of the Indiana bat along the Quad Cities transmission lines has not been noted (NRC 2004b). The bald eagle nest nearest to a Quad Cities transmission line is located on Beaver Island, 7.2 km (4.5 mi) north of the Rock Creek transmission line (NRC 2004b). Suitable habitat for the Iowa Pleistocene snail is unlikely to occur in the immediate vicinity of the Quad Cities transmission line rights-of-way, because the majority of this land is flat and agricultural (NRC 2004b). The western prairie fringed orchid could be found along the Davenport and Rock Creek transmission lines (because it is restricted to areas west of the Mississippi River) but has not been documented there (NRC 2004b). The eastern prairie fringed orchid could be found along the Quad Cities transmission lines but has not been documented there (NRC 2004b). It is unlikely that the prairie bush clover could be found along the Quad Cities transmission lines, because it grows on primarily agricultural land.

The five existing transmission lines are assumed not to have the capacity to carry the power that would be generated by a new nuclear unit, and it is likely that new transmission lines and possibly additional rights-of-way would be needed. Assuming that any additional transmission lines would be installed via expansion of an existing right-of-way, potential habitat impacts associated with the expansion could range from small to moderate, the latter depending on potential impacts to the Upper Mississippi River NWFR and Princeton Wildlife Management Area. Because the occurrence of the Indiana bat, Iowa Pleistocene snail, western and eastern prairie fringed orchids, and prairie bush clover along the Quad Cities transmission lines is unlikely, and because the nearest bald eagle nest is sufficiently distant to preclude disturbance, potential impacts to these Federally listed species from rights-of-way expansion would be small.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that impacts to terrestrial resources, including threatened and endangered species, from construction and operation of a new nuclear unit at the Quad Cities site and associated transmission lines could range from SMALL to MODERATE.

8.5.4.4 Aquatic Resources Including Endangered Species

The principal aquatic resources in the vicinity of the Quad Cities site are associated with the Mississippi River. Other important aquatic habitats include several tributaries of the Mississippi River (e.g., the Wapsipinicon River in Iowa that flows into the Mississippi River immediately upstream of the Quad Cities site) and the Quad Cities Units 1 and 2 retired spray canal. The spray canal is currently used to raise walleye (*Stizostedion vitreum*) primarily for release into Pool 14 of the Mississippi River (NRC 2004b).

The overall fish biodiversity of the Upper Mississippi River has been persistent and resilient. Fish species considered abundant within the Upper Mississippi River include gizzard shad (*Dorosoma cepedianum*), common carp (*Cyprinus carpio*), emerald shiner (*Notropis atherinoides*), river shiner (*N. blennius*), bullhead minnow (*Pimephales vigilax*), and bluegill (*Lepomis macrochirus*). Common species include longnose and shortnose gar (*Lepisosteus osseus* and *L. platostomus*), bowfin (*Amia calva*), mooneye (*Hiodon tergisus*), spottail shiner (*N. hudsonius*), river carpsucker (*Carpiodes carpio*), quillback (*C. cyprinus*), bigmouth buffalo (*Ictiobus cyprinellus*), shorthead redhorse (*Moxostoma macrolepidotum*), channel catfish (*Ictalurus punctatus*), white and hybrid white bass (*Morone chrysops* and *M. chrysops* x *M. saxatilis*), rock bass (*Ambloplites rupestris*), green sunfish (*Lepomis cyanellus*), and river darter (*Percina shumardi*) (NRC 2004b). Favorite sport fish species include walleye, sauger (*Stizostedion canadense*), largemouth bass (*Micropterus salmoides*), smallmouth bass

(*Micropterus dolomieu*), white bass (*morone chrysops*), bluegill, black and white crappie (*Pomoxis nigromaculatus* and *P. annularis*), pumpkinseed (*L. gibbosus*), and channel catfish (*Ictalurus punctatus*). Commercial fisheries also exist for some species, such as the bigmouth buffalo, common carp, catfish and bullheads (*Ictaluridae*), and freshwater drum (*Aplodinotus grunniens*) (NRC 2004b).

The impoundments for the navigation system on the Mississippi River favor submersed aquatic vegetation by increasing shallow water surface area and stabilizing low-discharge water levels (NRC 2004b). Generally, benthic macroinvertebrate densities are low throughout the Upper Mississippi. The Upper Mississippi River contains a rich assemblage of freshwater mussels. The non-indigenous zebra mussel (*Dreissena polymorpha*) became established in the Upper Mississippi River by 1992 and has continued to spread throughout the river system. Its increase causes a decline in many native mussels, as it can out-compete native species for oxygen and food and is so prolific that it can smother native mussel beds.

One endangered aquatic species listed by the U.S. Fish and Wildlife Service, the Higgins eye pearly mussel (*Lampsilis higginsii*), has the potential to occur in the vicinity of Quad Cities (NRC 2004b). Two areas designated as Essential Habitat Areas are located as near as 1.6 km (1 mi) downstream of the Quad Cities site (NRC 2004b; FWS 2003). These Essential Habitat Areas are locations known to contain reproducing populations of the Higgins eye pearly mussel in association with a healthy and diverse community (e.g., mussel beds). This species is found in sand/gravel substrates and swift-flowing currents.

The construction of a cooling-water intake structure and discharge might be necessary if a new nuclear unit were to be located at the Quad Cities site. Aquatic biota, including recreational sport fish, would be temporarily displaced during the construction period. However, they would be expected to recolonize the region after construction is complete. It is expected that the disturbances to aquatic resources would be localized and of relatively short duration. The Federally listed endangered Higgins eye pearly mussel, noted as near as 1.6 km (1 mi) downstream from the Quad Cities site, would not be able to temporarily relocate. The staff assumes that best management practices for erosion and sediment control would be followed to minimize the potential for adverse impacts to the Higgins eye pearly mussel during construction of a new nuclear unit at the Quad Cities site.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the potential impacts of construction of a new nuclear unit at the Quad Cities site on aquatic resources, including impacts to Federally listed threatened and endangered species, would be SMALL if mitigation measures are followed, but could be MODERATE if measures are not followed to protect the endangered Higgins eye pearly mussel.

The aquatic impact most likely to occur as a result of operations of a new nuclear unit at the Quad Cities site would be impingement and entrainment of organisms from the Mississippi River. The EPA's recent Phase I ruling on new cooling water intake structures (see 40 CFR Parts 9, 122-125) requires new cooling water intake facilities to meet certain criteria designed to protect organisms from entrainment and impingement. In addition, years of operation by the existing Quad Cities reactors have not harmed the Higgins eye pearly mussel. Therefore, the potential for adverse impacts to aquatic resources, including Federally listed threatened and endangered species from operation of a new nuclear unit at Quad Cities would be SMALL.

8.5.4.5 Socioeconomics

This section evaluates the social and economic impacts to the surrounding region as a result of constructing and operating a new nuclear unit at the Quad Cities site. The evaluation assesses impacts of construction and operation and of those demands placed by the workforce on the surrounding region.

Physical Impacts

The physical impacts of the construction and operation of a new nuclear unit at Quad Cities are similar to those for the other alternative sites. They are discussed generically in Section 8.6.4.

Demography

The Quad Cities site is located in Rock Island County, Illinois, on the east bank of the Mississippi River, 6.4 km (4 mi) north of Cordova, Illinois, and 16 km (10 mi) southwest of Clinton, Iowa (Exelon 2003a). The site is approximately 800 km (500 mi) upstream from the Mississippi's confluence with the Ohio River (Exelon 2003) and approximately 264 km (165 mi) west of Chicago. The Quad Cities metropolitan area, consisting of the Cities of Davenport and Bettendorf, Iowa, and Rock Island, Moline, and East Moline, Illinois, is located 20 miles southwest of Quad Cities. The region within 6 miles of the site includes portions of Rock Island and Whiteside Counties in Illinois and Scott and Clinton Counties in Iowa. Rock Island County is a part of the Davenport-Moline-Rock Island, Iowa-Illinois Metropolitan Statistical Area (MSA) which also includes East Moline, Illinois and Bettendorf, Iowa. The 2000 Census population of the Metropolitan Statistical Area was 359,062 (USCB 2000e).

Some new jobs might result from the multiplier effect attributable to the construction and operations workforce and might result in some increase in population in the region. But these increases, when compared to the total population base in the region, would be minimal. Any multiplier effects resulting from construction and operation workers' expenditures would most likely mean that some residents would obtain new or higher paying jobs as a result of the increased economic activity. Most of the construction and operation workers would be expected to come from within the region. Even if all the construction and operation workforce were to relocate to the region, they would represent a small percentage increase in the total population base. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation on increases in population within the region would be SMALL.

Impacts to the Community - Social and Economic

This subsection discusses the site-specific impacts of construction and operation of a new nuclear unit at the Quad Cities site. Some of the impacts of construction and operation of a new unit that are generic are discussed in Section 8.6.4.

Economy

The recession of the early 1980s affected the agricultural sector and the smokestack industries that relied upon the farm business. During that recession, the region's workforce declined by 1.1 percent (Rock Island County 1998). The area is still recovering; however, a shift has taken place from an economy that was heavily reliant on agriculture to one centered on service providers (Rock Island County 1998).

The nonprofessional services sector realized a 121.1 percent increase in employment between 1980 and 1996. During that same period, manufacturing employment declined by 41 percent, durable goods production by 54.4 percent, and non-electrical machine production by 63.3 percent (Rock Island County 1998). For Rock Island County, the 1997 leading economic employment sectors and respective rankings were as follows: services (32 percent), retail trade (22 percent), and manufacturing (20 percent) (Exelon 2002b). For Scott County, Iowa, the leading sectors were services (34 percent), retail trade (24 percent), and manufacturing (19 percent). For Whiteside County, Illinois, the 1997 leading sectors were manufacturing (36 percent), services (28 percent), and retail trade (20 percent) (Exelon 2002b).

The annualized unemployment rate for the State of Illinois for 2000 was 4.3 percent. In comparison, Rock Island and Whiteside Counties had 2000 unemployment rates of 5.1 and 3.9 percent, respectively (IDES 2000a). For the State of Iowa, the annualized unemployment rate for 2000 was 2.6 percent. Scott County's 1999 unemployment rate was also 2.6 percent (not seasonally adjusted) (IWD 2000a, 2000b).

In summary, the magnitude of the economic impacts would be diffused within the larger economic base of the Quad Cities region. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the beneficial impacts of construction and operation on the economy of the region would be SMALL.

Taxes

Taxes collected as a result of constructing and operating a new nuclear unit at the Quad Cities site would be of benefit to the State and to local jurisdictions that collected and spent them. Following the construction period, a new facility located at the Quad Cities site would pay property taxes to Rock Island and other jurisdictions within the County. For the years 1997 to 2000, the QCGS property taxes provided approximately 2.8 percent of Rock Island County's total collections available for distribution (Exelon 2002b). Personal and corporate income taxes and sales and use taxes would also be collected over the construction and operating periods for a new facility. While large in absolute amount, the amounts collected would be small when compared to the total taxes collected by Illinois and Rock Island County. Similarly, while the total sales, use, and income taxes would be large in absolute amounts, they would be small when compared to the total taxes collected. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the beneficial impacts of construction and operation on taxes collected would be SMALL.

Impacts to the Community - Infrastructure and Community

This subsection discusses the site specific impacts of construction and operation of a new nuclear unit at the Quad Cities site concerning transportation, aesthetics and recreation, and housing. Some of the impacts of construction and operation of a new nuclear unit that are generic (such as public services) are discussed in Section 8.6.4.

Transportation

Road access to the Quad Cities site is via Illinois State Route 84, a two-lane paved road. Route 84 intersects with I-80 approximately 23 km (14 mi) south of the site. Other freeways transecting the area near Quad Cities include I-74 and I-88. The State of Illinois does not make LOS determinations in rural, nonmetropolitan areas such as at the Quad Cities site unless it is deemed necessary. Consequently, Route 84 and I-80 do not have LOS determinations calculated by the Illinois Department of Transportation (Exelon 2002b). During its site visit, the staff observed that the roads in the vicinity of the site were lightly traveled and well maintained.

The construction workforce would number 3150 (Exelon 2003a). This number is in addition to the 980 permanent and contract operating employees. Highway transport would be used in the conveyance of construction materials to the site. This would put more traffic on the roads leading to the site, resulting in congestion, particularly at shift changes. Corrective measures probably could be taken to minimize traffic congestion and safety hazards, such as using multi-shift workforces. Once the employees reached the vicinity of the Quad Cities site, they could easily disperse throughout the region on the interstates and state routes traversing the area. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction on transportation would be SMALL, if impacts are actively mitigated, to MODERATE, if mitigation does not take place.

With respect to the operations of the facility, an additional 580 cars on the road for operating employees of a new nuclear unit (assuming a single occupant per car) would not materially congest the highway except at shift changes. These impacts could be mitigated by staggering the shift changes between the plants (currently operating at the Quad Cities site and a new unit). Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of operation on transportation would be SMALL and could be mitigated.

Aesthetics and Recreation

Topographic relief at the Quad Cities site is low and relatively flat. The station elevation represented by the ground-floor level of the reactor building is 182 m (595 ft) above MSL. The ground surface drops off abruptly at the bank of the Mississippi River, forming a bluff about 9 m (30 ft) high. The station is located on a 331-ha (817-ac) tract of land[a] and has a 94-m (310-ft) cooling tower.

That part of the site that has not been developed has slightly undulating to flat terrain and is lightly wooded with scrub oak and other trees. The trees are of small diameter, which would indicate that at one time bigger trees were harvested from the site.

The Quad Cities site is in a predominantly agricultural area. The area around the site is sparsely populated. There are some residential homes on large lots along the Mississippi River due south of the plant boundary.

The upper Mississippi River's aquatic resources in the vicinity of the Quad Cities site are diverse and abundant. The overall fish biodiversity of the Upper Mississippi River has been persistent and resilient. Recreational fishing takes place on the river, and two popular gamefish, walleye and hybrid striped bass, have increased in the vicinity since 1985 as a result of a stocking program carried out by Southern Illinois University and Exelon (Exelon 2003a).

(a) It appears that when Exelon purchased the six reactor sites in Illinois that are now being considered as alternatives to the proposed ESP site, land deemed to be excess was sold off. In the case of the Quad Cities site, a fairly large parcel of land, located due east and across Route 84 from the Quad Cities site, was sold within the last 18 to 24 months (from the date of the March 4, 2004, site visit). The land is currently in agricultural production and, if not sold, could have been used for construction of a new facility. Even without this acreage, the staff's observations during the March 4, 2004, site visit suggested that sufficient land exists on the current site to construct and operate a new facility.

The Quad Cities generating facilities are not generally visible from the main-access highway, but the plume from the cooling tower is visible from some distance, given the right meteorological conditions. Exelon assumed that a new nuclear facility would have roughly the same general environmental impact as the existing facility (Exelon 2003a). An additional visible plume could result from the heat-dissipation system of a new facility (Exelon 2003a).

A new facility probably would have visual impacts similar to those of the existing QCGS. There would be minor impacts on aesthetic quality for nearby residences, which are located in an agricultural area. Cooling tower plumes from a new unit would be visible under certain meteorological conditions in addition to plumes from the existing cooling tower. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation on aesthetics and recreation would be SMALL and that additional mitigation would not be warranted.

Housing

Since 1970, Rock Island County has experienced a decline in population. The 10.4 percent population decline between 1980 and 1990 was directly related to the faltering economy of the region. There has been a shift from dependence on heavy industry and manufacturing to nonprofessional service provision and retail trade. Because the younger population is leaving the County and the area, accommodations for population growth through increases in available housing has not been a concern (Exelon 2002b). In 2000, in the three counties of Rock Island and Whiteside Counties, Illinois, and Scott County, Iowa, there were 155,163 housing units, 8433 of which were vacant (5.4 percent). In the Quad Cities metropolitan area, consisting of the cities of Davenport and Bettendorf, Iowa, and Rock Island, Moline, and East Moline, Illinois, there were 100,411 housing units, with 5663 vacant houses (5.6 percent) (USCB 2000f).

Most of the construction workers for a new unit are assumed to come from within the region and commute to the job site. Thus, relatively few workers would be expected to move and take up residence in the area, and those that did could find housing within the six-county area.

If built, the ESP facility would have 580 employees when operational (Exelon 2003). There are 980 permanent and contracting operating personnel, approximately 77 percent of whom live in Rock Island and Whiteside Counties (Illinois) or in Scott County (Iowa) (total population 368,695) (USCB 2000f; Exelon 2002b). If 77 percent (or approximately 445) of the new employees and their families were to locate in these three counties, there would be an increase in population of approximately 1780 (assuming a family of four for each worker), or an increase in the population of the three-county area of 0.46 percent.

Most of the construction and operation workforce is expected to already be in the region and have residences in the region. Should this be the case, there would be little increase in demand for housing as a result. If the workers were not already in the region and some decided to relocate, the area would have a sufficient number of housing units to accommodate any relocations. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation on the availability of housing would be SMALL and that mitigation would not be warranted.

8.5.4.6 Historic and Cultural Resources

The impacts of construction and operation of a new facility on historic and cultural resources are discussed generically in Section 8.6.5.

8.5.4.7 Environmental Justice

Exelon followed NRC guidance (NRC 2001) in applying environmental justice criteria in its ER for license renewal of the Quad Cities facility (Exelon 2002c). The NRC staff has reviewed the analysis using updated NRC guidance (NRC 2004; 69 FR 52040).

The 2000 Census and block groups were used for ascertaining environmental justice issues for minority populations for license renewal and the 1990 Census and census tracts were used for low-income environmental justice issues. No American Indian or Alaskan Native, Asian, Native Hawaiian or other Pacific Islander and no multi-racial minorities live in the geographic area. Black Races minority populations live in 23 block groups (out of 637). Hispanic Ethnicity minority populations live in 12 block groups low-income population percentage in the geographic area chosen for comparison (Exelon 2002c). For low-income populations, based on the "more than 20 percent" criterion, one census tract contains a low-income population (out of 202 census tracts) (Exelon 2002b).

The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which populations could be disproportionately affected. In addition, the staff did not identify or observe any location-dependent disproportionate impacts affecting these minority and low-income populations. Most of the minority and low-income populations are located in the Quad Cities, approximately 32 km (20 mi) south of Quad Cities, or at greater distances. Based on a review of the Quad Cities ER for license renewal and the staff's independent review of reconnaissance-level information, including a site visit on March 9, 2004, the staff concludes that the environmental justice consequences of the construction and operation of a new nuclear facility at the Quad Cities site would be SMALL and that mitigation would not be warranted.

8.5.5 Byron Generating Station

The Byron Generating Station is located in northern Illinois, 6 km (3.7 mi) south-southwest of the City of Byron (population 2917), 27 km (17 mi) southwest of Rockford, Illinois (population 150,115), and 3.5 km (2.2 mi) east of the Rock River, in Ogle County (USCB 2000g). DeKalb, Illinois (population 39,018), is approximately 45 km (28 mi) southeast of the plant (USCB 2000g). The site is situated in the approximate center of Ogle County in a predominantly agricultural area (Exelon 2003).

Byron occupies approximately 721 ha (1782 ac) of land. The main site area occupies approximately 566 ha (1398 ac), while the transmission line right-of-way occupies the remaining 155 ha (384 ac). Two nuclear units are in operation at the site and two 151-m (495-ft) cooling towers dominate the site. The total footprint for the plant itself is approximately 40 ha (100 ac). There are no industrial, institutional, commercial, recreational, or residential structures on the site, other than those used by Exelon in the normal conduct of its utility business. The development of the site for uses other than power generation and agriculture is not planned (Exelon 2002c). Exelon assumed that a new nuclear facility at the site would have roughly the same general environmental impact as the existing facility.

8.5.5.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

Land use within the 8-km (5-mi) radius of the Byron site is agricultural. There is little industry in the vicinity, and what exists primarily supports the agrarian economy. Wheat, corn, and soybeans are the primary products. The principal land use in the region of the site is also agriculture (Exelon 2002c; ComEd 1974b).

In its ER, Exelon states that the Byron site does not have additional available land within its boundaries to build a new nuclear unit. An operating unit would need to be decommissioned and dismantled so that the new nuclear unit could be constructed on the decommissioned unit's footprint (Exelon 2003).

The footprint of a new plant would be about 41 ha (100 ac) (Exelon 2003) and after visiting the Byron site on March 10, 2004, the NRC staff believes that the facility could be configured to fit within the existing 566 ha (1398 ac) of the main site. Overall, the land-use factors of construction and operation of a new nuclear unit are not particularly site-dependent. The staff concludes that potential land-use impacts associated with site-preparation and construction and operation of a new unit at the Byron site would be SMALL.

The impacts of construction and operation of a new nuclear unit on air quality would be similar at each of the alternative sites and would not be a significant factor in determination of environmental preferability. Therefore, these impacts are discussed generically in Section 8.6.1.

The existing transmission lines serving Byron are assumed not to have the capacity to carry the power that would be generated by a new nuclear unit at the site. It is likely that new transmission lines and possibly additional rights-of-way would be needed. The additional transmission lines could be installed via expansion of an existing right-of-way, which the staff believes to be the likely scenario, or could follow a new corridor. Assuming that any transmission system modifications would be expansions of existing rights-of-way for reasons similar to those discussed in Chapters 4 and 5 for expansion to support the Exelon ESP site, the staff concludes that the land-use impacts associated with the expansion would be SMALL. The procedures for adding the new transmission lines to connect a new nuclear unit at the Byron site to the transmission grid would be similar to those described in Section 3.3.

8.5.5.2 Hydrology, Water Use, and Water Quality

A new nuclear unit at Byron was assumed to withdraw makeup water from the Rock River. The staff estimated the 7Q10 (7-day average minimum annual flow) and 30Q2 (median 30-day minimum annual discharge) based on data from USGS stream gauge 05443500 on the Rock River at Como, Illinois. Data for the period of record from 1914 through 2003 were used to estimate the 7Q10 and 30Q2 values. This gauge is slightly downstream of Byron. The drainage area upstream of the gauge is reported by the USGS to be 22,670 km^2 (8753 mi^2), whereas the drainage area upstream of the site was estimated to be 20,717 km^2 (7999 mi^2). The 7Q10 and 30Q2 values estimated by staff are 26.2 m^3/s (927 cfs) and 47.3 m^3/s (1670 cfs), respectively. The net consumptive loss for a wet cooling tower, based on the PPE, is 2.0 m^3/s (70 cfs) or 7.6 and 4.2 percent of the 7Q10 and 30Q2, respectively.

Any releases of contaminants to the waters of the State of Illinois would be regulated by the IEPA through the NPDES permit process to ensure that water quality is protected. Based on the requirements of the current Byron NPDES permit and the above analysis, the staff concludes that the water use and water quality impacts of an additional unit at the Byron site would be SMALL.

8.5.5.3 Terrestrial Resources Including Endangered Species

Before construction of the existing plant, the Byron site was mainly an agricultural area (50 percent crop land), containing smaller areas of grassland and fallow fields (about 35 percent) and remnant forest (about 15 percent) (AEC 1974a). The staff assumes that structures for a new facility (power block structures, normal heat-sink cooling towers, switchyard expansion, new intake structures, and safety-related cooling towers) would be constructed primarily in agricultural/fallow field areas of the Byron site, where possible, with minimal impacts to remnant forest. Consequently, habitat impacts from construction of a new nuclear unit at the Byron site would be negligible.

There are four Federally listed threatened or endangered terrestrial species that might occur in the vicinity of the Byron site: the endangered Indiana bat (*Myotis sodalis*), the threatened bald eagle (*Haliaeetus leucocephalus*), the threatened eastern prairie fringed orchid (*Platanthera leucophaea*), and the threatened prairie bush clover (*Lespedeza leptstachya*) (FWS 2004a). Of these four species, designated critical habitat exists only for the Indiana bat (FWS 1976).

The Indiana bat potentially occurs throughout Illinois where forest habitat is present (FWS 2004a). The only critical habitat for the Indiana bat in Illinois is the Blackball Mine in LaSalle County (FWS 1976). It is unlikely that the Indiana bat occurs on the Byron site because the preponderance of the site is unforested (AEC 1974a). The bald eagle is known to nest and winter along large rivers, lakes, and reservoirs in Ogle County (FWS 2004a). However, there are no known bald eagle occurrences within 16 km (10 mi) of the Byron site (AEC 1974b; IDNR 2004). The eastern prairie fringed orchid occupies wet grassland habitats and may occur in Ogle County (FWS 2004a); however, it is not known to occur within 16 km (10 mi) of the Byron site (IDNR 2004). The prairie bush clover occupies dry to mesic prairies with gravelly soil (FWS 2004a) and is known to occur from 3.2 km (2 mi) to 16 km (10 mi) of the Byron site (IDNR 2004). It is unlikely that the prairie bush clover and the eastern prairie fringed orchid occur on the Byron site. Consequently, potential impacts to Federally listed species from construction of a new nuclear unit on the Byron site would be minimal.

There are 30 State-listed threatened or endangered terrestrial species known to occur from 3.2 km (2 mi) to 16 km (10 mi) of the Byron site, and one that occurs within 3.2 km (2 mi), i.e., redroot (*Ceanothus ovatus*) (IDNR 2004). Redroot occupies sandy or rocky plains, prairies, and slopes (Plants for a Future 2004). However, redroot likely does not occur on the Byron site because its habitat apparently does not occur there (AEC 1974b). Therefore, potential impacts to State-listed species from construction of a new nuclear unit on the Byron site would be minimal.

Byron is connected to the electric grid via 86 km (54 mi) of transmission line rights-of-way that cover about 800 ha (1977 ac) (NRC 1996). When the two existing nuclear units were constructed, these rights-of-way crossed primarily agricultural land (83 percent), mixed forest and field (9 percent), and forest (7 percent) (AEC 1974b). The existing transmission lines serving Byron are assumed not to have the capacity to carry the power that would be generated by a new nuclear unit. It is likely that new transmission lines and possibly additional rights-of-way would be needed. Assuming that any additional transmission lines would be installed via expansion of an existing right-of-way and that the expansion would consist of doubling the current right-of-way width, a loss of 72 ha (178 ac) of mixed forest and field and 56 ha (138 ac) of forest would be anticipated. Loss of these quantities of habitat over 86 km (54 mi) of corridor would have negligible impact.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that impacts to terrestrial resources, including threatened and endangered species, from construction and operation of a new nuclear unit at the Byron site and associated transmission lines would be SMALL.

8.5.5.4 Aquatic Resources Including Endangered Species

The two operating units at Byron draw makeup water from the Rock River for cooling system operation and discharge blowdown from cooling towers to the same river. Water from the Rock River would likely serve these functions for any new nuclear unit placed on the site (Exelon 2003). The Rock River contains populations of recreational sport fish, including channel catfish, walleye, northern pike, largemouth and smallmouth bass, sauger, white bass, bluegill, flathead catfish, drum, and bullheads. A limited number of commercial fishing contracts are available on the Rock River for carp, big mouth buffalo, freshwater drum, suckers, carpsuckers, gar, bowfin, grass carp, Asian carp, and gizzard shad (IDNR 2004a). No Federally listed aquatic species are found in the vicinity of the Byron site or in areas crossed by its transmission lines (Sackschewsky 2004).

The construction of a cooling-water intake structure and discharge might be necessary if a new nuclear unit were to be located at the Byron site. Sport and commercial fisheries and other aquatic organisms and habitats would only be temporarily affected by construction. It is expected that the disturbance to aquatic resources from construction would be localized and of relatively short duration.

The NRC staff reviewed the information provided by Exelon and concludes that the environmental impacts of construction of a new nuclear unit on aquatic resources, including Federally listed threatened and endangered species, at the Byron site would be SMALL.

The aquatic impact most likely to occur as a result of operation of a new nuclear reactor at the Byron site is impingement and entrainment of organisms from the Rock River. The EPA's recent Phase I ruling on new cooling water intake structures (see 40 CFR Parts 9, 122-125) require new cooling water intake facilities to meet certain criteria designed to protect organisms from entrainment and impingement.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the potential for adverse impacts to aquatic resources, including Federally listed threatened and endangered species, from operation of a new nuclear unit at the Byron site would be SMALL.

8.5.5.5 Socioeconomics

This section evaluates the social and economic impacts to the surrounding region as a result of constructing and operating a new nuclear unit at the Byron site. The evaluation assesses impacts of construction and operation and of those demands placed by the workforce on the surrounding region.

Physical Impacts

The physical impacts of the construction and operation of a new nuclear unit are similar for each of the alternative sites. They are discussed generically in Section 8.6.4.

Demography

There might be some new jobs in the construction and operations workforce at the site. However, the increases, when compared to the total population base in the region, would be minimal. Any multiplier effects resulting from construction and operations workers' expenditures would most likely mean that some residents would obtain new or higher paying jobs as a result of the increased economic activity. Most of the construction and operations workers are expected to come from within the region. Even if all the construction and operations workforce were to relocate to the region, they would represent a small percentage increase in the total population base. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation on population within the region would be SMALL and that no mitigation would be warranted.

Impacts to the Community - Economic and Social

This subsection discusses the site-specific impacts of construction and operation of a new nuclear unit at the Byron site. Some of the impacts of construction and operation of a new nuclear unit that are generic are discussed in Section 8.6.4.

Economy

Byron lies near the Rock River in Ogle County, Illinois. Ogle County's business profile is led by manufacturing (37 percent of the county's total employment), followed by retail trade (11 percent) and wholesale trade (8 percent) (USCB 2001d). The unemployment rate for Ogle County in 2000 was 4.3 percent, the same as for the State of Illinois (IDES 2000a, b).

In neighboring DeKalb County, the business profile is led by manufacturing (24 percent of the county's total employment), followed by retail trade (17 percent), and health care and social assistance (15 percent) (USCB 2001e). The unemployment rate in DeKalb County was 3.2 percent in 2000 (IDES 2000b).

The magnitude of the economic impacts would be diffused within the larger economic base of the surrounding counties. In Ogle County, the existing Byron units contribute significantly to the tax base (see discussion under "Taxes" below). By inference, the same would be expected in the other economic contributions to the county's economy. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the beneficial impacts of construction and station operation on the economy of the region would be SMALL in all counties, except Ogle County where it could be MODERATE.

Taxes

Taxes collected as a result of constructing and operating a new nuclear unit at the Byron site would be of benefit to the State and to the local jurisdictions that collected and spent them. Following the construction period and at the start of operations, a new nuclear unit would pay annual property taxes to Ogle County. For the tax year 2003 to 2004, the Byron Generating Station was responsible for about 30 percent of the total property taxes paid in Ogle County.[a]

Personal and corporate income taxes and sales and use taxes would also be collected over the construction and operating period a new nuclear unit. While large in absolute amount, the amounts collected would be small when compared to the total taxes collected by Illinois and by Ogle County. Therefore, based on the staff's independent review of reconnaissance-level information, the staff concludes that the beneficial impacts of station construction on taxes collected would be SMALL. The staff also concludes that the beneficial impacts of station operations on taxes collected would be SMALL to MODERATE for Ogle County, depending on the impacts of deregulation.[b]

(a) Personal communication, John Coffman, Ogle County, Illinois, Treasurer, May 28, 2004.
(b) The MODERATE impact is based on the impact of deregulation at Clinton Power Station (see Section 2.8.2.3). While the facility would potentially operate in a deregulated environment, the impacts of deregulation on the facility's value, and thus property taxes paid by the facility, are not fully known. Given the facility's potential value and property taxes paid to Ogle County, the staff assumed that the facility's impact on collected property taxes would, at a minimum, be SMALL and could be MODERATE when compared to the taxes the facility could pay and the total property taxes collected by the county.

Impacts to the Community - Infrastructure and Community

This subsection discusses the site specific impacts of construction and operation of a new nuclear unit at the Byron site concerning transportation, aesthetics and recreation, and housing. Some of the impacts of construction and operation of a new nuclear unit that are generic (such as public services) are discussed in Section 8.6.4.

Transportation

Illinois SR 2, which is the closest major highway to the site, is located 4 km (2.5 mi) west of the plant and has an annual average traffic flow per 24-hour period that ranges from 4000 cars between the cities of Byron and Oregon to 8800 cars in Oregon. SRs 72 and 64 are also well traveled, having 24-hour annual averages of approximately 2000 cars. A railroad spur to the site exists. Interstate-39 (U.S. Highway 51) runs near the site, connecting LaSalle to the south with Rockford. U.S. Highway 51 continues south from LaSalle to the Bloomington-Normal area and Decatur.

The construction workforce would number 3150 (Exelon 2003a). This number is in addition to the 1000-plus estimated operating employees at the currently operating Byron Units 1 and 2. If the construction of a new nuclear unit at Byron were to follow past practices (when Byron Units 1 and 2 were constructed), then heavy loads could be expected to be transported to the site by rail, with highway transport the most widely used. Corrective measures, such as using multi-shift workforces, traffic control zones, and flagging, probably would need to be taken to minimize traffic congestion and safety hazards.

The NRC staff observed highway traffic around Byron during its site visit. The addition of approximately 3150 cars (assuming a single occupant per car), in addition to the approximately 1000 cars of the existing operations workforce, on the road leading to the site could cause congestion, particularly at shift changes, and could be exacerbated with the addition of trucks carrying construction materials to the site. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction on transportation would be SMALL if the impacts are actively mitigated to MODERATE if they are not.

With respect to the operation of a new nuclear unit, adding an additional 580 cars (assuming a single occupant per car) to the existing 1000 cars on the road would not congest the highway except at shift changes. These impacts could be mitigated by staggering the shift changes between the current units and the new unit. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of operation on transportation would be SMALL.

Aesthetics and Recreation

The topography of the site is characterized by the northern half being dissected and sloping generally to the north. In the southern half of the site, the land is more dissected and rolling; it slopes to the southwest. The northern portion of the site is generally wooded, with some crop land near the boundary; the southern half is largely crop land. During the site visit on March 10, 2004, the staff observed that the topography of the site was generally sloping toward the Rock River.

There are several recreational facilities in the low-population zone, which for the Byron site is defined as a 4.8-km (3-mi) radius around the site. Peak daily usage of these facilities occurs on the weekends. The Rock River is the major waterway for the area surrounding the Byron site and is a popular recreation spot (Exelon 2003a).

Construction of a new nuclear unit is not expected to have major impacts on the Rock River due to the distance of the site from the river (over 3.2 km [2 mi]). Any impacts to the river due to construction of an additional cooling-water structure, if needed, would be transitory. The main visual impacts of the site are the cooling towers for Units 1 and 2. Given certain meteorological conditions, the plumes from the towers can be seen for miles. The addition and operation of a new nuclear unit at Byron would most likely also require a cooling tower. This would add marginally to the visual impacts of the existing towers. Therefore, based on the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of station construction and operation on aesthetics and recreation would be SMALL and that mitigation would not be warranted.

Housing

In 2000, in the three-county area around Byron (Ogle, Winnebago, and DeKalb Counties), there were a total 167,812 housing units, of which 8880 units were vacant (5 percent) (USCB 2000g). Winnebago County, where the City of Rockford is located, had 6424 vacant units in 2000. If the past experience of the construction of Byron holds, most of the construction workers would come from within the region and commute to the job site. The site is fairly close to northwest metropolitan Chicago and Rockford and accessible via major highways and interstates. Relatively few workers would be expected to move and take up residence in the area, and those who did could find housing within the 3-county area.

If built, a new nuclear unit at Byron would have 580 employees when operational (Exelon 2003). As with the other alternative sites, the operations workforce is assumed to come from within the region. If all 580 employees decided to live in one of the counties, which is highly unlikely, there would be a discernable impact on housing availability, rental rates, and housing values. Should the employees scatter out over the three counties of Ogle, Winnebago, and DeKalb, which is a likely scenario, then the chances of these impacts occurring would be lessened.

Therefore, based on the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation on housing would be SMALL and that mitigation would not be warranted.

8.5.5.6 Historic and Cultural Resources

The impacts of construction and operation of a new nuclear unit at the Byron site on historic and cultural resources are discussed generically in Section 8.6.5.

8.5.5.7 Environmental Justice

The staff used the Geographical, Environmental, and Siting Information (GEN&SIS) database to develop maps of minority and low-income populations around the Byron site (GEN&SIS 2004). The data used are based on the 2000 Census, used census blocks, and followed the NRC criteria for determining the presence of minority or low-income populations (NRC 2001; 69 FR 52040). Maps were created showing census blocks of minority and low-income populations within 80 km (50 mi) of the site.

There is a concentration of minority populations located west of the Byron site, near the Town of Ridot. Another concentration of minority populations lies in Rockford, Illinois, and another directly east of Rockford at Harvard. The Chicago area to the northeast has numerous concentrations of minority populations. There is a concentration of low-income populations around Malta, southeast of Byron, and in Rockford.

The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which populations could be disproportionately affected. In addition, the staff did not identify or observe any location-dependent disproportionate impacts affecting minority and low-income populations. Therefore, based on the staff's independent review of reconnaissance-level information, including a site visit to Byron on March 9, 2004, the staff concludes that the environmental justice consequences of construction and operation of a new nuclear unit would be SMALL and that mitigation would not be warranted.

8.5.6 Zion Generating Station

Both units at Zion Generating Station permanently ceased operation in 1998. The units are currently in SAFSTOR with active decontamination and decommissioning scheduled to begin in 2014. The generators are still in place and have been converted to synchronous condensers to stabilize system voltage (Exelon 1998). The Zion site is located at the extreme eastern edge of the City of Zion (population 22,866) in Lake County Illinois, on the west shore of Lake Michigan. It is approximately 5 km (3 mi) south of the Illinois-Wisconsin state line, 68 km (42 mi) south of Milwaukee, Wisconsin (population 596,574), about 13 km (8 mi) south of

Kenosha, Wisconsin (population 90,352), and 10 km (6 mi) north-northeast of Waukegan, Illinois (population 87,901). Lake County (population 644,356) is in the northern suburb region of the Chicago metropolitan area (AEC 1972; Exelon 2003a; USCB 2000h).

8.5.6.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

Land use at the Zion site and surrounding vicinity is expected to remain industrial; however, the residential and business districts of the City of Zion are close to the site. Exelon states that Zion has enough land for a new nuclear unit, assuming the existing units are decommissioned and removed (Exelon 2003). Exelon assumes that a new nuclear unit in the area would have roughly the same general environmental impact that the Zion Generating Station had when it was operating (Exelon 2003). Based on observations made during its site visit on March 1, 2004, the staff assumes that there is not sufficient land at the existing Zion site to support use of cooling towers for normal cooling.

The terrain in the area consists of low marsh lands isolated 30 to 600 m (100 to 2000 ft) inland from the shoreline, sand beaches, and dunes. Illinois Beach State Park stretches for 10.5 km (6.5 mi) along the shore of Lake Michigan at Zion. It encompasses the only remaining beach ridge shoreline left in the state. The 1683-ha (4160-ac) park, consisting of two separate areas north and south of the Zion site, accommodates swimming, boating, picnicking, hiking, fishing, and camping (IDNR 2004b).

The staff concludes that the potential land-use impacts associated with site-preparation and construction and operation of a new unit at Zion would be SMALL (assuming that the existing units are decommissioned and removed).

The impacts of construction and operation of a new nuclear unit on air quality would be similar at each of the alternative sites and would not be a significant factor in the determination of environmental preferability. Therefore, these impacts are discussed generically in Section 8.6.1.

The transmission lines serving Zion were constructed to carry the load from the two Zion units, which had a combined design rating of 6500 MW(t) (ComEd 1972). These transmission lines are still in place and operational. Therefore, the staff assumes that if a new nuclear unit were constructed at the Zion site, the existing transmission lines would be capable of carrying the load from the new nuclear unit. Should modifications to the transmission system involving new transmission lines be required, the transmission lines could be installed via an expansion of an existing right-of-way, which the staff believes is the most likely scenario, or could require new rights-of-way. Assuming that any transmission system modifications would be expansion of existing rights-of-way for reasons similar to those discussed in Chapters 4 and 5 for expansion of the Exelon ESP site, the staff concludes that the land-use impacts associated with expansion would be SMALL. The procedures for adding the new transmission lines to connect a new nuclear unit at the Zion site to the transmission grid would be similar to those described in Section 3.3.

8.5.6.2 Hydrology, Water Use, and Water Quality

The staff assumed a new nuclear unit at Zion would withdraw water for cooling from Lake Michigan. Any release of contaminants to the waters of the State of Illinois would be regulated by the IEPA through the NPDES permit process to ensure that water quality is protected. Based on the requirements of the NPDES permit and the volume of Lake Michigan, the staff concludes that the water-use and water quality impacts of an additional unit at the Zion site would be SMALL.

8.5.6.3 Terrestrial Resources Including Endangered Species

More than 650 species of plants have been recorded in the dunes area alone around the Zion site, including dozens of types of colorful wildflowers. Prickly pear cactus thrives in large colonies in the dry areas, and the wet prairies are carpeted with a wide variety of grasses and sedges. Large expanses of marsh in the swales support dense stands of cattail, blue joint grass, prairie cordgrass, reed grass, big bluestem, and sedges. The sandy ridges are crowned by black oak forests with an open, savanna-like appearance, and several kinds of fragrant pines, introduced a century ago, also grow in the southern area (IDNR 2004b).

The terrestrial environment at the Zion site is a beach succession series, consisting of dunes, swales, peat bogs, and marsh, as well as zones of prairie and forest, each with its distinctive flora and fauna. The terrain in general consists of a series of low dunes and sand ridges (former Lake Michigan sand bars) running parallel with the lake shore and interspersed with marshes. Further inland, there is a residuum of a tall grass prairie. The Zion site borders Illinois Beach State Park, which serves as an outdoor laboratory for ecological research. The area comprising the Zion site and Illinois Beach State Park is unique in being the only remaining dune area in Illinois (AEC 1972). The staff assumes that the existing structures at the Zion site would be decommissioned and removed and that the new nuclear unit (power block structures, normal and safety-related cooling systems, switchyard expansion, and new intake and discharge structures) would occupy the footprint of the former structures. Consequently, habitat impacts, if any, from construction of a new nuclear unit at the Zion site would be negligible.

There are three Federally listed threatened or endangered terrestrial species that are known or believed to occur in the near vicinity of the Zion site: the endangered Karner blue butterfly (*Lycaeides melissa samuelis*), the threatened eastern prairie fringed orchid (*Platanthera leucophaea*), and the threatened Pitcher's thistle (*Cirsium pitcheri*) (FWS 2004b). There is no designated critical habitat for any of these three species (FWS 2004b). Although the endangered piping plover (*Charadrius melodus*) is not currently known from the site vicinity, designated critical habitat for the piping plover occurs adjacent to the Zion site (FWS 2004b).

The Karner blue butterfly is believed to occur in Illinois Beach State Park (FWS 2004b) and is known to occur within 3.2 km (2 mi) of the Zion site (IDNR 2004a). This species is associated with remnant barrens and savanna ecosystems, and other areas that have soils and/or management (soil disturbance or suppression of perennial shrubs and herbaceous vegetation [e.g., transmission line rights-of-way]) suitable for wild lupine (*Lupinus perennis*) growth. Lupine is the sole food source for the Karner blue butterfly (FWS 2004b). The eastern prairie fringed orchid is located in Illinois Beach State Park. Its habitat includes, but is not restricted to, mesic prairie, sedge meadows, marsh edges, and bogs (FWS 2004b). Pitcher's thistle is also located in Illinois Beach State Park, and is part of a dynamic dune ecosystem. Its habitat includes beach, foredune, interdunal trough, and secondary dune areas (FWS 2004b). Portions of the lake shoreline within Illinois Beach State Park, including shoreline adjacent to the Zion site, are designated critical habitat for the Great Lakes breeding population of the piping plover. The critical habitat, being located adjacent to but not on the Zion site, lies outside any areas that could be impacted by construction. However, the Karner blue butterfly, eastern prairie fringed orchid, and Pitcher's thistle could occur on the Zion site. It is assumed, however, that the existing structures at the Zion site would be decommissioned and removed and that the new nuclear unit would be constructed so as to occupy the footprint of the former structures. Consequently, potential impacts to Federally listed species, even if they were to occur onsite, from construction and operation of a new nuclear unit at the Zion site would be minimal.

There are 52 State-listed threatened or endangered terrestrial species known to occur from 3.2 km (2 mi) to 16 km (10 mi) of the Zion site, and 38 that occur within 3.2 km (2 mi) (IDNR 2004a). Given the unique natural habitat of the Zion site and the likely affinity of many of the State-listed species for such habitat, at least some of these could occur onsite. It is assumed, however, that the existing structures at the Zion site would be decommissioned and removed and that the new nuclear unit would be constructed so as to occupy the footprint of the former structures. Consequently, potential impacts to State-listed species, even if they were to occur onsite, from construction of a new nuclear unit at the Zion site would be minimal.

Zion transmission line rights-of-way cover 59 ha (146 ac) (NRC 1996) and traverse farmland, unused fields and marshes, industrial land, and in some instances residential areas (AEC 1972). The staff assumes that if a new nuclear unit were constructed at the Zion site, the existing transmission lines would be capable of carrying the load from the facility. However, should modifications to the existing transmission system involving installation of new transmission lines be required, it is assumed that any additional transmission lines would be installed via expansion of existing rights-of-way. It is also assumed that the expansion would consist of doubling the existing right-of-way width. In the unlikely event that right-of-way expansion would be needed, it is apparent that primarily habitats of little value to wildlife (with the possible exception of unused marshes) would be affected, and loss of such habitats would be considered negligible.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that impacts to terrestrial resources, including Federally listed threatened and endangered species, from construction and operation of a new nuclear unit at the Zion site and associated transmission lines would be SMALL.

8.5.6.4 Aquatic Resources Including Endangered Species

The Zion site is located on the western shore of Lake Michigan. Lake Michigan is characterized by low nutrient concentrations and biological productivity. Near the Zion site, inshore waters are characterized as mesotrophic or intermediate, with respect to nutrients. Although substantial declines in fish populations have occurred in Lake Michigan due to pollution and other impacts, Lake Michigan has the largest sport fishery on the Great Lakes, valued at more than $250 million annually (UW Sea Grant Institute 1998). Besides its world-class trout and salmon fisheries, the lake also supports substantial commercial whitefish and yellow perch fisheries (UW Sea Grant Institute 1998). Inshore regions that have sand-gravel bottoms are potential spawning areas for a number of fish species (ComEd 1972). However, no Federally listed aquatic species are found in the vicinity of the site.

The construction of a new cooling water intake structure and discharge might be necessary if a new nuclear unit were to be located at Zion. While aquatic biota, including commercial and recreational fish, would be temporarily displaced during the construction period, they would be expected to recolonize the region after construction is complete. As no Federally listed aquatic species are found in the vicinity of the site, impacts to threatened or endangered species are not anticipated. The timing of the construction and in-water work window could help mitigate the impacts, especially if fish are spawning on the inshore sand-gravel bottom regions (ComEd 1972). It is expected that the disturbance to aquatic resources from construction would be localized and of relatively short duration.

The NRC staff reviewed the information provided by Exelon and concludes that the environmental impacts of construction of a new nuclear unit on aquatic resources, including Federally listed threatened and endangered species, would be SMALL, assuming that appropriate mitigative actions are employed.

With respect to operations of a new nuclear unit at the Zion site, no Federally listed aquatic species are found in the vicinity of the site, so impacts to Federally listed threatened or endangered species are not anticipated. Nothing in Zion's environmental statement or the decommissioning safety analysis report indicates that operation of a new facility at the site would adversely affect aquatic environments (ComEd 1972; Exelon 1998). However, because fish may spawn in areas near Zion, there is the potential for adverse impacts to local aquatic habitat and biota due to impingement and entrainment. However, EPA's recent Phase I ruling on new cooling water intake structures (see 40 CFR Parts 9, 122-125) requires new cooling water intake facilities to meet certain criteria designed to protect organisms from entrainment and impingement. Therefore, the staff concludes that the environmental impacts due to operations of a new nuclear unit at the Zion site would be SMALL.

8.5.6.5 Socioeconomics

This section evaluates the social and economic impacts to the surrounding region as a result of constructing and operating a new unit at the Zion site. The evaluation assesses impacts of construction and station operation and of those demands placed by the workforce on the surrounding region.

Physical Impacts

The physical impacts of the construction and operation of a new nuclear unit are similar for each of the alternative sites. They are discussed generically in Section 8.6.4.

Demography

There may be some new jobs in the construction and operations workforce at Zion that may increase population in the region. But these increases, when compared to the total population base in the region, would be minimal. Any multiplier effects resulting from construction and operations workers' expenditures would most likely mean that some residents would obtain new or higher paying jobs as a result of the increased economic activity. Most of the construction and operations workers are expected to come from within the region. Even if all the construction and operations workforce were to relocate to the region, they would represent a small percentage increase in the total population base. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation on population within the region would be SMALL.

Impacts to the Community - Social and Economic

This subsection discusses the site-specific impacts of construction and operation of a new nuclear unit at the Zion site. Some of the impact of construction and operation of a new nuclear unit that are generic are discussed in Section 8.6.4.

Economy

Zion is located in Lake County, Illinois, where manufacturing comprises 17 percent of the county's total employment, followed by retail trade (13 percent) and health care and social assistance (9 percent) (USCB 2001f). The unemployment rate for Lake County in 2000 was 3.5 percent, while that for Illinois was 4.3 percent (IDES 2000a, b).

Zion is less than 80 km (50 mi) from Chicago, with a current population of more than 5 million. Additionally, the Waukegan-North Chicago area is predominantly an industrial region with 144 manufacturing establishments. The product of the largest of these manufacturing firms is pharmaceuticals and chemicals. The most predominant product of the remainder is in the metallurgical and fabricated metal products field. The Zion-Winthrop Harbor area is a small industrial region. A portion of this industry, which involves light manufacturing, is located between the western boundary of the Zion site and the Chicago and Northwestern railroad tracks, approximately 1.3 km (0.8 mi) west of the plant location (Exelon 2003a).

The magnitude of the economic impacts of a new nuclear plant would be diffused within the larger economic base of Lake County and the Chicago Metropolitan area. Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the beneficial impacts of construction and operation on the economy of the region would be SMALL.

Taxes

Taxes collected as a result of constructing and operating a new nuclear unit at Zion would be of benefit to the State and local jurisdictions collecting and spending them. Following the construction period and at the start of operations, a new nuclear unit at Zion would pay annual property taxes to Lake County. Personal and corporate income taxes and sales and use taxes would also be collected over the construction and operating period for a new nuclear unit. While large in absolute amount, the amounts collected are small when compared to the total taxes collected by Illinois and Lake County. Therefore, based on the staff's independent review of reconnaissance-level information, the staff concludes that the beneficial impacts of construction and operation on taxes would be SMALL.

Impacts to the Community - Infrastructure and Community

This subsection discusses the site specific impacts of construction and operation of a new nuclear unit at the Zion site concerning transportation, aesthetics and recreation, and housing. Some of the impacts of construction and operation of a new nuclear unit that are generic (such as public services) are discussed in Section 8.6.4.

Transportation

The major transportation routes near the site include Lake Michigan, which has ship and barge traffic. Due west of the site is Interstate (I) 94, which runs north-south and connects Chicago on the south with Milwaukee to the north. U.S. Route 41 parallels I-80 and SR 173 runs east to west and connects the City of Zion to Rockford, Illinois, to the west. Access to Zion is off SR 137 via Shilo Road. There is a railroad spur leading to Zion, which would need upgrading if a new nuclear unit were constructed at the site.

The construction workforce would number 3150 (Exelon 2003a). If the construction of a new nuclear unit were to follow past practices when other nuclear units were constructed by Commonwealth Edison, the construction jobs would attract a large number of construction workers, who would commute to the site from the surrounding area (AEC 1972). Highway transport would be used in the conveyance of construction materials to the site. Railroad transportation would probably be employed for some of the heavier construction equipment and materials. There will be more traffic on the roads leading to the site, resulting in more congestion, particularly at shift changes. Corrective measures, such as using multi-shift workforces, probably could be taken to minimize traffic congestion and safety hazards.

The NRC staff observed highway traffic around Zion during its site visit. Shilo Boulevard exits onto a very busy SR 137. An additional 3150 cars (assuming a single occupant per car) on the road leading to the site could cause congestion, particularly at shift changes, and could be exacerbated with the addition of trucks carrying construction materials to the site. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction of a new unit on transportation would be MODERATE, if impacts are actively mitigated, to LARGE, if they are not.

With respect to the operations of a new unit at Zion, 580 cars (assuming a single occupant per car) would not congest the highway except at shift changes. These impacts could be mitigated by staggering the shift changes so that shift changes would not all occur at the same time. Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of station operation on transportation would be SMALL and could be mitigated through minor actions.

Aesthetics and Recreation

Lake Michigan is the major waterway for the area and is immediately east of the Zion site. The topography of the site is generally flat. Most of the site is open. The site is bordered on the north and south by Illinois Beach State Park. There is both recreational and commercial fishing on Lake Michigan.

At Zion, commercial and recreational fish would be temporarily displaced during the construction period, although they would be expected to recolonize the area after the construction was completed. Fish spawning areas may occur around the site. If there are spawning areas, construction activities could have an economic impact on the recreational and commercial fishery if stocks of fish decline as a result of construction. The timing of construction and the in-water work window would determine the significance of this impact. Mitigation measures, such as avoiding construction activities during the spawning period, could reduce potential impacts. Based on the staff's independent review of reconnaissance level information, the staff concludes that the impacts of construction on aesthetics and recreation would be SMALL, if in-water construction takes place when there is not spawning, to MODERATE, if in-water construction takes place when there is spawning.

Assuming that once-through cooling would be used, the main visual impacts of an operating ESP facility would be marginal. The land on the site and around the site is industrial. A new nuclear unit would go into the footprint (approximately 18 ha [45 ac]) of the existing Zion units, once they are decommissioned and removed. Exelon does not anticipate that any additional land would be preempted if the site were used for a new nuclear unit (Exelon 2003). If this is the case, the wetlands and low marsh lands of the site would not be impacted.

Based on the information provided by Exelon and the staff's independent review, the staff concludes that the impacts of station operation on aesthetics and recreation would be SMALL, and that mitigation is not warranted.

Housing

In Lake County, there are 225,919 housing units, of which 9622 units (4.3 percent of the total) are vacant. To the south, Cook County (Chicago) has 2,096,121 total housing units of which 121,940 are vacant, or 5.8 percent (USCB 2000h). Most of the construction workers (if the past experience holds on the construction of several other nuclear power plants that Exelon owns) would come from within the region and commute to the job site. Most of the construction workers hired for the initial construction of Zion probably came from the Chicago, Milwaukee, and Kenosha metropolitan areas and commuted to the Zion site. Thus, with the construction of a new nuclear unit, relatively few workers would be expected to move and take up residence in the area, and those who did could find housing within the metropolitan areas. However, housing in the immediate vicinity of the Zion site might be difficult to acquire (USCB 2000h).

If built, a new nuclear unit at the Zion site would have 580 employees when it was operational (Exelon 2003). If all employees decided to live in either Lake or Cook County, the staff would not expect to see a discernable impact on housing availability, rental rates, or housing values. Therefore, based on the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operation on housing would be SMALL and that mitigation would not be warranted.

8.5.6.6 Historic and Cultural Resources

The impacts of construction and operation of a new nuclear unit on historic and cultural resources at the alternative sites are discussed generically in Section 8.6.5.

8.5.6.7 Environmental Justice

The staff used the Geographical, Environmental, and Siting Information (GEN&SIS) database to develop maps of minority and low-income populations around the Zion site (GEN&SIS 2004). The data used are based on the 2000 Census, used census blocks, and followed the NRC criteria for determining the presence of minority or low-income populations (NRC 2001; 69 FR 52040). Maps were created showing census blocks of minority and low-income populations within 80 km (50 mi) of Zion.

There are concentrations of minority populations located north of the Zion site in Milwaukee, Racine, and Kenosha, Wisconsin. One concentration of minority populations lies due west of the Zion site, another due south of the site toward Waukegan and North Chicago, and a third, a very large concentration, along Lake Michigan and near the Illinois-Indiana State line.

For low-income populations, there are large concentrations in Milwaukee and within the Chicago metropolitan area, particularly along Lake Michigan and near the Illinois-Indiana State line. Another concentration is located due west of the Zion site.

The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately affected. In addition, the staff did not identify or observe any location-dependent disproportionate impacts affecting these minority and low-income populations. Therefore, based on the staff's independent review of reconnaissance-level information, including a site visit to Zion on March 1, 2004, the staff concludes that environmental justice consequences of construction and operation of a new nuclear unit at Zion would be SMALL and that mitigation would not be warranted.

8.6 Issues Among Sites Handled Generically

In evaluating the alternative sites, the NRC staff identified several areas where the potential impacts of construction and operation of new nuclear power plants would be sufficiently similar to the proposed and alternative sites that detailed site-specific evaluation of the potential impacts would be unlikely to contribute to the determination that one or more of the alternative sites is environmentally preferable to the proposed site. These areas, which include nonradiological health impacts, radiological impacts of normal operation, cultural and historic resources, and impacts on public service facilities are addressed in this section.

8.6.1 Land Use and Air Quality

Land use has been covered in the sections for each of the alternative sites because the variation among the sites is sufficiently large that a generic discussion was not appropriate.

Air quality impacts of construction and operation of a new nuclear unit would likely be similar at the proposed ESP site and the alternative sites. The construction impacts would include dust from disturbed land, roads, and construction activities and emissions from construction equipment. These impacts would be similar to the impacts associated with any large construction project. Exelon has discussed measures that it would take to mitigate air quality impacts at the proposed ESP site. The staff assumes that the same or similar measures would be taken if a new nuclear unit were to be constructed at any of the alternative sites. The staff concludes that air quality impacts of construction of a new nuclear unit at the alternative sites likely would be SMALL.

For purposes of the evaluation of alternative sites, the staff assumes that the air quality impacts of emissions from vehicles used for construction worker transportation likely would be SMALL at all sites. However, the Braidwood, Dresden, and Zion sites are located in areas that have been designated by the EPA as "nonattainment" relative to both the 1-hour and 8-hour national ambient air quality standards for ozone (40 CFR 81.314). Additional analysis would be required to verify that the significance level for air quality impacts of construction worker transportation would be SMALL should one of these sites be determined to be environmentally preferable to the proposed ESP site.

Impacts of operation of a new nuclear plant on air quality are related primarily to the operation of standby generators, boilers, and cooling towers. The operation of standby generators and boilers is independent of the site. Similarly, the quantity of cooling tower drift is a function of cooling tower design, not the site. The staff assumes that Exelon would comply with all regulations related to emissions from generators and boilers and that cooling towers would use current technology to minimize drift. On these bases, the staff concludes that the impacts of operation of a new nuclear unit at the alternative sites on air quality would be SMALL.

8.6.2 Terrestrial Ecology

Terrestrial ecological impacts that may result from operation of a new nuclear unit at the alternative sites include those associated with cooling towers and transmission lines. A detailed evaluation of impacts resulting from operation of a new nuclear unit, including cooling towers at some of the sites, cannot be reasonably conducted due to missing information. Impacts on crops and ornamental vegetation and native plants from cooling tower drift cannot be evaluated in detail in the absence of information on the type (mechanical or natural draft), number, and specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information on the type (mechanical or natural draft for a wet cooling system; dry for a dry system) and number of cooling towers at each alternate site. However, all of the alternative sites are the sites of existing power plants. The impacts of cooling tower drift and bird collisions for existing power plants were evaluated in NUREG-1437 (NRC 1996) and found to be SMALL for all plants. In addition, the staff concluded that no additional mitigation was warranted for the existing cooling towers. These conclusions have not been challenged in any of the site-specific supplements to NUREG-1437 that have been prepared since 1996. On this basis, the staff concludes, for the purposes of consideration of alternative sites, that the impacts of cooling tower drift and bird collisions with cooling towers resulting from operation of a new nuclear unit at any of the alternative sites likely would be SMALL.

For both natural and mechanical draft cooling towers, the anticipated noise level from cooling tower operation is anticipated to be 55 decibels at 305 m (1000 ft) (Exelon 2003). The noise level for dry cooling towers is somewhat higher. Thus, noise from operating cooling towers at any of the alternative sites would not be likely to disturb wildlife beyond 305 m (1000 ft) from the source. Further, impacts within this distance are considered negligible because no important terrestrial species (as defined in NRC 2000) are known to occur on any of the alternate sites. Consequently, the staff concludes that the impacts of cooling tower noise on wildlife would be SMALL at all the alternative sites.

The impacts usually associated with transmission line operation consist of bird collisions with transmission lines and electromagnetic field effects on flora and fauna. The impacts usually associated with right-of-way maintenance are loss of habitat due to cutting and herbicide application, and similar impacts where rights-of-way cross floodplains and wetlands. The impacts of transmission line operation and right-of-way maintenance at the alternative sites can be readily estimated, assuming that any new transmission line rights-of-way would be an expansion of existing rights-of-way. It is reasonable to assume that right-of-way management would be conducted where and how it currently is, only in a wider right-of-way, and that transmission line effects would not change except that they would cover a wider area. The effects of transmission line operation and right-of-way maintenance were evaluated in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996) and were found to be of small significance at operating nuclear power plants. The effects of transmission line operation and right-of-way maintenance would be only somewhat greater (in aerial extent) than they currently are with operation of a new nuclear unit at the alternative sites. Therefore, the staff concludes that the effects of transmission line operation (bird collisions with transmission lines and electromagnetic field effects on flora and fauna) and right-of-way maintenance (cutting and herbicide application, and similar impacts where rights-of-way cross floodplains and wetlands) at the alternative sites would be SMALL.

8.6.3 Aquatic Ecology

Because the potential impacts on aquatic ecosystems depend on site-specific factors and on factors related to specific features of the design and construction of intakes and discharge structures, no issue was identified for which a generic discussion was appropriate.

8.6.4 Socioeconomics

There are several socioeconomic areas where generic treatment of issues related to construction and operation of a new nuclear unit is reasonable. These areas fall within the general categories of physical impacts and community characteristics. Demography and the remaining areas relating to physical impacts and community characteristics are discussed separately for each of the alternative sites.

Physical Impacts

Many of the physical impacts of construction and operation would be similar regardless of the sites.

Workers and Local Public

The physical impacts of construction would be similar at all six alternative sites. People who work or live around the alternative sites could be exposed to noise, fugitive dust, and gaseous emissions from construction activities. Construction workers and personnel working onsite could be the most impacted. Air pollution emissions are expected to be controlled by applicable best management practices and Federal, State, and local regulations. All sites are zoned industrial.

During station operation, standby diesel generators used for auxiliary power would have air-pollution emissions. It is expected that these generators would see limited use and, if used, would be used for only short time periods. Applicable Federal, State, and local air-pollution requirements would apply to all fuel-burning engines. At the site boundary for most sites, the annual average exposure from gaseous emission sources is anticipated not to exceed applicable regulations during normal operations. The impacts of station operations on air quality are expected to be minimal. As with construction impacts, potential offsite receptors are generally located well away from the site boundaries.

Residential and commercial areas are located well away from the alternative site boundaries, applicable air-pollution regulations would have to be met by Exelon, and applicable best management practices would be put in place. Therefore, based on information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the physical impacts of station construction and operation on workers and the local public would be SMALL.

Buildings

Construction activities and station operations are not expected to impact any offsite buildings. Most buildings not located onsite are well removed from the site boundaries. Buildings most vulnerable to shock and vibration from pile-driving and other related activities are those located on the alternative sites. No physical impacts to structures, including any residences near the site boundaries, would be expected. Therefore, based on the staff's independent review of reconnaissance-level information, including visits to all the alternative sites during the period March 1 through 11, 2004, the staff concludes that the physical impacts of station construction and operation on offsite buildings would be SMALL.

Roads

During construction, an additional 3150 cars and 100 trucks per day were assumed to use the roads in the vicinity of each alternative site. Heavy loads of construction materials and equipment and the increased traffic might necessitate additional maintenance and repair of roads. Railroad spurs leading to some of the sites could be used for delivery of the heavier construction materials and equipment, alleviating some road damage and increased maintenance expenses. The rail spurs would need upgrading to accommodate these loads. Based on the staff's independent review of reconnaissance-level information, including visits to the alternative sites, the staff concludes that the impacts of construction on roads in the vicinity of the alternative sites would be SMALL if railroad spurs were used for delivery of heavy construction materials and equipment and MODERATE if they are not.

During station operations, the roads and highways within the vicinity of the alternative sites would experience an increase of approximately 580 cars per day from the addition of operations personnel. This is in addition to the existing operations workforce for the current operating units at each of the sites, except Zion where the new units would replace existing units that are no longer operational. It is expected that increased commuter traffic from station operations would not place undo wear and tear on the roads or cause them to physically deteriorate at a faster rate than they do now. Therefore, based on the staff's independent review of reconnaissance-level information, including visits to the alternative sites, the staff concludes that the impacts of operations on roads would be SMALL, and that mitigation would not be warranted.

Aesthetics

Construction at all the alternative sites could be viewed from outside the sites at certain locations. All sites, except Zion, are located in rural areas with sparse residential or commercial development near the site. Construction of cooling-water intake structures could impact the body of water within which the construction takes place. The impacts could increase suspended solids concentrations in the water bodies and fish species might be temporarily displaced as a result of minor disturbances associated with construction activities, including noise, dredging, etc. This in turn could impact recreation and recreational opportunities such as fishing. However, such impacts are transitory and are not expected to have any long-term, permanent consequences. Onsite erosion and stormwater runoff control measures would be expected to be implemented in accordance with Illinois and Federal regulations.

The sites, except for Zion, are located in rural areas. Any construction impacts on the view would be temporary. Based on the staff's independent review of reconnaissance-level information, including visits to the alternative sites, the staff concludes that the impacts of construction on aesthetics would be SMALL at all sites.

The aesthetic impacts of station operations would be influenced by the type of nuclear reactor and cooling system Exelon chooses. The facility might have a power block structure that is 72 m (234 ft) tall. The heat dissipation system could have a height up to 168 m (550 ft). An off-gas structure that would range in height between the power-block structure and the height of the heat dissipation system might also be required. An additional visible plume might result where cooling towers were used, particularly during cold weather (Exelon 2003). At sites already having cooling towers, the additional cooling towers would be a marginal addition to an already visually disturbed site. Based on the staff's independent review of reconnaissance-level information, including visits to the alternative sites, the staff concludes that the physical impacts of station operation on aesthetics would be SMALL, and that mitigation would not be warranted.

Demography

Because of the dissimilarities among the sites, the demography of each of the alternative sites has been covered in the site-specific discussions.

Impacts to the Community - Infrastructure and Community

Two aspects related to infrastructure and community impacts are sufficiently similar for all of the alternative sites that they can be discussed as generic issues: public services and education.

Public Services

Public services include water supply and waste water treatment facilities; police, fire, and medical facilities; and social services. Both construction and station operating personnel are expected to come from within the region. Those workers living outside the region would most likely commute to the job site from their residences. Any new construction employees relocating to the region would most likely be scattered throughout the region where there is available housing. New operations employees relocating from outside the region would most likely live in residentially developed areas. It is not expected that public services would be materially impacted by these workers.

There might be an increased demand for some social services for construction workers moving to the area and looking for work either at a new nuclear unit or in secondary jobs created by the construction. However, the construction and operation of the facility would have a beneficial economic impact to the economically disadvantaged, which would likely lessen the demand for social services.

Therefore, based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the impacts of construction and operations on public services would be SMALL, and that mitigation would not be warranted.

Education

The majority of the construction workers would be expected to come from the region, with little anticipated in-migration of construction workers from outside the region. Should there be construction workers coming in from outside the region, chances are they would commute to the construction site, stay for the week, and go back to their permanent residence on weekends. Should that be the case, there would be minimal impact from additional children being placed in the educational systems within the region.

Exelon assumes that the majority of the operations workforce would come from within the region where their educational requirements are already being met. As such, the school systems in these areas would not experience any major influx of students because of the operation of a new nuclear unit (Exelon 2003). Even if some of the operating workforce were to come from outside the region, the majority of the new workers likely would move to the more populous areas in the surrounding communities, having access to the more developed public services. Workers with school-aged children would be interested in communities with good school districts, for example.

Based on the information provided by Exelon and the staff's independent review of reconnaissance-level information, the staff concludes that the potential impacts of the facility construction and operations on education would be SMALL and that mitigation would not be warranted.

8.6.5 Historic and Cultural Resources

The alternative sites do not appear to present significant issues concerning historic and cultural resources. Information about each alternative site was obtained from a review of each final environmental statement, Supplements 16 and 17 to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437), and records review at the Illinois Historic Preservation Agency (IHPA). If one of the alternative sites were selected, consultation with the IHPA would be required to identify additional measures to be taken. Based on (1) the staff's reconnaissance-level review of information obtained from IHPA, (2) previous environmental reports, and (3) the protective measures that would be in place before and during construction and operation, the staff concludes that the impacts of construction and operation of a new nuclear unit at any of the alternative sites would be SMALL.

8.6.6 Environmental Justice

The staff evaluated the environmental justice consequences of locating a new nuclear unit at each of the alternative sites and concludes that the environmental justice impacts are SMALL for each site. However, because of the importance of the site-specific factors considered in reaching these conclusions, environmental justice has been discussed for each alternative site.

8.6.7 Nonradiological Health Impacts

Nonradiological health impacts from construction of a new nuclear unit on the construction workers at the alternative sites would be similar to those evaluated in Section 4.8. They include occupational injuries, noise, odor, vehicle exhaust, and dust. Applicable Federal and State regulations on air quality and noise would be complied with during the plant construction phase. None of the alternative sites has site characteristics that would be expected to lead to fewer or more construction accidents than would be expected for any of the other alternative sites. All the alternative sites, except Zion, are in rural areas and construction impacts would likely be minimal on the surrounding population. The staff concludes that health impacts to construction workers resulting from the construction of a new nuclear unit at any of the alternative sites would be SMALL.

Occupational health impacts to operational employees would likely be the same for all the alternative sites. Thermophilic microorganisms would not be a concern at the alternative sites using either a wet or hybrid wet/dry cooling process. Health impacts to workers from occupational injuries, noise, and electric fields would be similar. None of the alternative sites has site characteristics that would be expected to lead to fewer or more operational accidents than would be expected for any of the other alternative sites. Noise and electric fields would be monitored and controlled in accordance with applicable Occupational Safety and Health Administration (OSHA) regulations.

The staff expects that the occupational health impacts to operations employees of a new nuclear unit at any of the alternative sites would be SMALL. Similarly, impacts to public health of a new nuclear unit's operation at the Clinton site or any of the alternative sites would be expected to be minimal. The staff concludes that the public health impacts would be SMALL.

8.6.8 Radiological Impacts of Normal Operations

Exposure pathways for gaseous and liquid effluents from a new nuclear unit the ESP site or an alternative site would be similar. Gaseous effluent pathways include external exposure to the airborne plume, external exposure to contaminated ground, inhalation of airborne activity, and ingestion of contaminated agricultural products. Liquid effluent pathways include ingestion of aquatic foods, ingestion of drinking water, external exposure to shoreline sediments, and external exposure to water through boating and swimming.

Section 5.9 discusses the estimates of doses to the maximally exposed individual and the general population for a new nuclear unit at the proposed Exelon ESP site for both liquid-effluent and gaseous-effluent pathways. The estimated doses to the maximally exposed individual were well within the design objectives of 10 CFR Part 50, Appendix I. The same bounding liquid and gaseous effluent releases would be used to evaluate doses to the maximally exposed individual and the population at each alternative site. Even with differences in pathways, atmospheric and water dispersion factors, and population, doses estimated to the maximally exposed individual for the alternative sites would be expected to be well within the Appendix I design objectives. Population doses within 80 km (50 mi) of the proposed facility would be higher for those alternative sites closer to major population centers (i.e., Braidwood, Dresden, and Zion); however, they would still be small compared to the population dose from natural background radiation. Therefore, the staff concludes that radiation doses and resultant health impacts from a new nuclear unit's operations would be SMALL at all of the alternative sites.

Occupational doses to workers at a new unit would be the same for the alternative sites as they are for the proposed site. The advanced reactor design of a new unit would likely result in less occupational exposure annually than from current operating plants. The staff concludes that the occupational radiation doses from a new nuclear unit's operation would be SMALL for all of the alternative sites.

Table 5-5 provides the annual total body dose estimates to surrogate biota species for a new nuclear unit. Annual dose to algae and heron surrogate species exceeded the dose standard in 40 CFR Part 190. The 40 CFR 190 standards apply to members of the public in unrestricted areas and not specifically to biota. The estimates are conservative as they not do consider any dilution or decay of liquid effluents during transit. Actual doses to biota are likely to be much lower. The staff reviewed the available information relative to the radiological impact on biota other than humans, and performed an independent estimate of dose to the biota. The staff concludes that no measurable radiological impact on biota is expected from the radiation and radioactive material released to the environment as a result of the routine operation of a new nuclear unit and that the impacts to biota of radiation doses at any one of the alternative sites would be SMALL.

8.6.9 Postulated Accidents

In Section 5.10, the staff considered a suite of design-basis accidents for a new nuclear unit at the proposed Clinton ESP site. The evaluation involved calculation of doses for specified periods at the exclusion area and low-population zone boundaries, and comparison of those doses with doses based on regulatory limits and guidelines. Similar analyses have not been conducted for the alternative sites. Had such evaluations been conducted, the differences in the results would only have been due to meteorological conditions and the distances to the site boundaries. The release characteristics would have been the same at all sites.

For the Clinton site and meteorology, the doses for each accident sequence considered were well below the corresponding regulatory limits and guidelines. The general climatological conditions at the proposed site are sufficiently similar to the conditions at the alternative sites that it is highly unlikely that differences in local meteorological conditions would be sufficient to cause doses from design-basis accidents for a new nuclear unit at any of the alternative sites to exceed regulatory limits or guidelines. Similarly, because each of the alternative sites is located at an existing nuclear power site, it is unlikely that differences in distances to the exclusion area and low-population zone boundaries would be sufficient to cause doses from design-basis accidents for a new nuclear unit at any of the alternative sites to exceed regulatory limits or guidelines. Therefore, the staff concludes that for the purposes of consideration of alternative sites, the impact of design basis accidents at each of the alternative sites would be SMALL.

Section 5.10 also includes a detailed analysis of the potential consequences of severe accidents for the postulated plants for the Clinton site. Similar analyses have not been conducted for the alternative sites. Had such evaluations been conducted, the differences in the results would only have been due to site-specific factors such as meteorological conditions, population distribution, and land-use distribution. The release characteristics would have been the same at all sites.

The probability-weighted consequences estimated for severe accidents for a new nuclear unit at the proposed site are well below the consequences estimated for severe accidents at current generation reactors (see Section 5.10). This result suggests that the consequences of severe accidents at the any of the alternative sites would be less than the consequences of a severe accident at an existing plant at the site. The Commission has determined that the probability-weighted consequences of severe accidents are SMALL for all existing plants (10 CFR 51, Subpart B, Table B-1). On this basis, the staff concludes that, for the purposes of consideration of alternative sites, the impact of severe accidents at each of the alternative sites likely would be SMALL.

8.7 Summary of Alternative Site Impacts

A summary of the impacts of construction and operation of a new nuclear unit at each of the six alternative sites selected by Exelon is presented in Tables 8-5 and 8-6. Discussion of the stated impacts is presented in the individual site sections (Sections 8.5.1 through 8.5.6) and the generic impacts section (Section 8.6). A comparison of the alternative site impacts with impacts at the proposed ESP site at Clinton and with impacts of the no-action alternative is presented in Chapter 9.

Table 8-5. Characterization of Construction Impacts at the Alternative ESP Sites

Category	Dresden	Braidwood	LaSalle	Quad Cities	Byron	Zion
Land-Use Impacts						
The site and vicinity	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Transmission line rights-of-way	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water-Related Impacts						
Water use	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological Impacts						
Terrestrial ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic ecosystems	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE[g]
Threatened and endangered species	SMALL[a] to LARGE[b]	SMALL	SMALL	SMALL[a] to MODERATE[b]	SMALL	SMALL
Socioeconomic Impacts						
Physical Impacts						
Workers and local public	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Buildings	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Roads	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]
Aesthetics	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Demography	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Impacts to the Community - Social and Economic						
Economy[c]	SMALL[d] to MODERATE	SMALL	SMALL[e] to MODERATE	SMALL	SMALL[h] to MODERATE	SMALL
Taxes[c]	SMALL[d] to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL

Table 8-5. (contd)

Category	Dresden	Braidwood	LaSalle	Quad Cities	Byron	Zion
Impacts to the Community - Infrastructure and Community						
Transportation	SMALL[f] to MODERATE	SMALL[f] to MODERATE	SMALL[f] to MODERATE	SMALL[f] to MODERATE	SMALL[f] to MODERATE	MODERATE to LARGE[i]
Aesthetics and recreation	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE[g]
Housing	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Public and social services and infrastructure	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Education	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

(a) Small, in general.
(b) Moderate or Large, if threatened or endangered species are present in transmission-line rights-of-way.
(c) Beneficial impact.
(d) Small except for Grundy County.
(e) Small except for LaSalle County where the impact could be moderate.
(f) Small if active mitigation measures are taken, otherwise moderate.
(g) Small if intake and discharge construction activities take place at times when there is no spawning activity in the area; Moderate otherwise.
(h) Small except in Ogle County, where it could be Moderate
(i) Site located on the edge of the City of Zion. The road leading to the plant exist onto a vert busy highway running through the city.

Table 8-6. Characterization of Operational Impacts at the Alternative ESP Sites

Category	Dresden	Braidwood	LaSalle	Quad Cities	Byron	Zion
Land-Use Impacts						
The site and vicinity	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Transmission-line rights-of-way	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water-Related Impacts						
Water use	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological Impacts						
Terrestrial ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE[h]
Threatened and endangered species	SMALL[a] to LARGE[b]	SMALL	SMALL	SMALL to MODERATE[b]	SMALL	SMALL
Socioeconomic Impacts						
Physical Impacts						
Workers and local public	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Buildings	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Roads	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aesthetics	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Demography	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Impacts to the Community - Social and Economic						
Economy[c]	SMALL[d] to MODERATE	SMALL	SMALL[e] to MODERATE	SMALL	SMALL[g] to MODERATE	SMALL
Taxes[c]	SMALL[d] to MODERATE	SMALL	SMALL[e] to MODERATE	SMALL	SMALL[g] to MODERATE	SMALL

Table 8-6. (contd)

Category	Dresden	Braidwood	LaSalle	Quad Cities	Byron	Zion
Impacts to the Community - Infrastructure and Community						
Transportation	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aesthetics and recreation	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE[h]
Housing	SMALL[d] to MODERATE	SMALL to MODERATE[d]	SMALL	SMALL	SMALL	SMALL
Public and social services and infrastructure	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Education	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Postulated Accidents						
Design-basis accidents	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Severe accidents	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

(a) Small, in general.
(b) Moderate or large, if threatened or endangered species present in transmission-line rights-of-way.
(c) Positive impact.
(d) Small except for Grundy County, where it could be MODERATE.
(e) Small except for LaSalle County where the impact could be moderate.
(f) Small if active mitigation measures are taken, otherwise moderate.
(g) Small except in Ogle County where it could be Moderate.
(h) Moderate impacts could occur depending on design of intake and discharge structures and spawning practice.

8.8 References

5 NRC 503, 516. Public Service Company of New Hampshire. 1977. Seabrook Station, Units 1 and 2. CLI-77-8.

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities." Appendix I. Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.

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

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

40 CFR Parts 9, 122-125. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 9, "OMB Approvals Under the Paperwork Reduction Act," Subpart 122, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System," Subpart 123, "State Permit Requirements," Subpart 124, "Procedures for Decision Making," Subpart 125, "Criteria and Standards for the National Pollutant Discharge Elimination System."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

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9.0 Comparison of the Impacts of the Proposed Action and the Alternative Sites

The need to compare the proposed Exelon Generation Company, LLC (Exelon) early site permit (ESP) site with alternative sites arises from the requirement in Section 102(2)(c)(iii), 42 USC 4332(c)(iii) of the National Environmental Policy Act of 1969 (NEPA) that environmental impact statements include an analysis of alternatives to the proposed action. The test to be employed in assessing whether a proposed ESP site is to be rejected in favor of an alternative site is based on whether the alternative site is "obviously superior" to the site proposed by the applicant (*Public Service Co. of New Hampshire 1977*). An alternative site is "obviously superior" to the proposed site if it is "clearly and substantially" superior to the proposed site (*Rochester Gas & Electric Corp. 1978*).

The standard of obvious superiority "is designed to guarantee that a proposed site will not be rejected in favor of an alternate unless, on the basis of appropriate study, the Commission can be confident that such action is called for" (*New England Coalition on Nuclear Pollution 1978*). The "obviously superior" test is appropriate for two reasons. First, the analysis performed by the U.S. Nuclear Regulatory Commission (NRC) in evaluating alternative ESP sites is necessarily imprecise. Key factors considered in the alternative site analysis, such as population distribution and density, hydrology, air quality, aquatic and terrestrial ecological resources, aesthetics, land use, and socioeconomics are difficult to quantify in common metrics. Given this difficulty, any evaluation of a particular site must necessarily have a wide range of uncertainty. Second, Exelon's proposed ESP site has been analyzed in detail, with the expectation that most adverse environmental impacts associated with the site have been identified. The alternative sites have not undergone a comparable level of detailed study. For these reasons, a proposed ESP site may be rejected in favor of an alternative site not when the alternative is "marginally better" than the proposed site, but only when it is "obviously superior" (*Rochester Gas & Electric Corp. 1978*). NEPA does not require that a nuclear plant be constructed on the single best site for environmental purposes. Rather, "all that NEPA requires is that alternative sites be considered and that the effects on the environment of building the plant at the alternative sites be carefully studied and factored into the ultimate decision" (*New England Coalition on Nuclear Pollution 1978*).

The NRC staff's review of alternative sites consists of a two-part sequential test for obvious superiority (NRC 2000). The first part of the test determines whether there are "environmentally preferred"[a] sites among the candidate ESP sites. The staff considers whether Exelon has (1) reasonably identified alternative sites, (2) evaluated the likely environmental impacts of construction and operation at these sites, and (3) used a logical means of comparing sites that led to Exelon's selection of the proposed site. Based on the staff's independent review, the staff then determines whether any of the alternative sites are environmentally preferable to Exelon's proposed ESP site.

If the staff determines that one or more alternative ESP sites are environmentally preferable, it then compares the estimated costs (environmental, economic, and time) of constructing the proposed plant at the proposed site and at the environmentally preferable site or sites (NRC 2000). To find an alternative site obviously superior, the staff must determine that (1) one or more important aspects, either singly or in combination, of a reasonably available alternative site are obviously superior to the corresponding aspects of the applicant's proposed site and (2) the alternative site does not have offsetting deficiencies in other important areas. A staff conclusion that an alternative site is obviously superior to Exelon's proposed site would normally lead to a recommendation that the application for the ESP be denied.

9.1 Comparison of the Proposed Site with the Alternative Sites

The staff reviewed the Environmental Report submitted by Exelon (Exelon 2003) and supporting documentation and conducted site visits at the Exelon ESP site and the alternative sites. The staff found that Exelon had reasonably identified alternative sites, evaluated the environmental impacts of construction and operation, and used a logical means of comparing sites. The following section summarizes the staff's independent assessment of the proposed and alternative sites.

The staff's characterization of the expected environmental impacts of constructing and operating a new nuclear unit at the proposed ESP site and alternative sites within the bounds of Exelon's plant parameter envelope are summarized in Tables 9-1 and 9-2. Explanations for the particular characterizations are in Chapters 4 and 5 for the proposed site and in Sections 8.5 and 8.6 for the alternative sites.

Some environmental impacts considered for the Exelon ESP site or for the alternative sites are generic to all sites and, therefore, do not influence the comparison of impacts between the

(a) An "environmentally preferred" alternative site is one for which the environmental impacts are sufficiently less than for the proposed site so that environmental preference for the alternative site can be established (NRC 2000).

Exelon ESP site and the alternative sites. The generic environmental impacts common to all sites are: air quality, nonradiological and radiological health impacts, environmental impacts from postulated accidents, and historic and cultural resources, as well as some aspects of ecology and socioeconomics.

The environmental impact areas shown in Tables 9-1 and 9-2 have been evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10 of the Code of Federal Regulations (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 staff determined the impact level from construction for most of the environmental issues at most of the sites is SMALL (see Table 9-1). For some ecological and socioeconomic issues, there are factors related to a site that could cause the impact level to increase from SMALL to MODERATE and, in the case of transportation at Zion, to LARGE. These issues and sites are identified in the table by footnotes that briefly describe the factor. More detailed information on these issues is presented in Chapter 4 for the Clinton Power Station (CPS) site, and Chapter 8 for the alternative sites. It is the staff's expectation that, if Exelon chooses to undertake activities permitted by an ESP, it would exercise due diligence to evaluate the potentially adverse impacts and take appropriate measures to mitigate the impacts.

Similarly, the staff determined that the impact level from operations for most of the environmental issues at most of the sites is SMALL (see Table 9-2). Again, there are a few ecological and socioeconomic issues for which the level of significance could rise to MODERATE. These issues and sites are identified in Table 9-2 by footnotes that briefly describe the factor. More detailed information on these issues is presented in Chapter 4 for the CPS site, and Chapter 8 for the alternative sites.

The socioeconomic impact category reflects only the potential adverse impacts. Positive impacts (that is, tax receipts to local government and public support of the proposed project) would occur but are not addressed here. Significance levels for the positive impacts are given in Chapters 4 and 8.

Table 9-1. Comparison of Construction Impacts at the Exelon ESP Site and Alternative Sites

Impact Category	Clinton	Dresden	Braidwood	LaSalle	Quad Cities	Byron	Zion
Land-use							
The site and vicinity	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Transmission line rights-of- way	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water use and quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological							
Terrestrial ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL[a] to MODERATE	SMALL	SMALL[b] to MODERATE
Threatened and endangered species	SMALL	SMALL[c] to LARGE	SMALL	SMALL	SMALL[a] to MODERATE	SMALL	SMALL
Socioeconomic							
Physical impacts[e]	SMALL[d] to MODERATE	SMALL to MODERATE	SMALL[d] to MODERATE	SMALL[d] to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL[f] to MODERATE
Demography	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

Table 9-1. (contd)

Impact Category	Clinton	Dresden	Braidwood	LaSalle	Quad Cities	Byron	Zion
Impacts to the Community - Social and Economic (beneficial)	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL
Impacts to the Community - Infrastructure and Community	SMALL[g] to MODERATE	SMALL[h] to MODERATE	SMALL[h] to MODERATE	SMALL[h] to MODERATE	SMALL[h] to MODERATE	SMALL[h] to MODERATE	SMALL[i] to LARGE
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

(a) The impact is SMALL, but there is a potential for MODERATE impact because of Higgins eye mussel downstream from the Quad Cities site. The construction and operation of the existing plant do not appear to have had an adverse impact on the mussel.

(b) Fish may spawn in the area. If so, the impacts from construction could be MODERATE, depending on timing of in-water activities relative to spawning.

(c) The potential for MODERATE impacts exists if habitat for State-listed species exists onsite or State-listed species exist in transmission-line rights-of-way.

(d) The impact is rated SMALL except for impacts to roads and transportation may be moderate.

(e) Construction traffic may increase road deterioration to the point that cost of additional maintenance has a MODERATE impact.

(f) Zion is located in an urban/suburban setting. Thus, construction activities would be seen by more individuals than at the other sites. However, the visual impacts of construction would be similar at all sites.

(g) The impacts are SMALL, assuming that construction workers are drawn from within the region, as has occurred in the past. However, the housing impacts could rise to the level of MODERATE in the smaller communities if there is a large influx of construction workers from outside the region.

(h) The impacts could rise to the level of MODERATE if measures are not taken to mitigate the impacts of construction workers on transportation.

(i) The impacts could rise to the level of LARGE if measures are not taken to mitigate the impacts of construction workers on transportation.

Table 9-2. Characterization of Operational Impacts at the Exelon ESP Site and Alternative Sites

Impact Category	Clinton	Dresden	Braidwood	LaSalle	Quad Cities	Byron	Zion
Land-use impacts							
The site and vicinity	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Transmission line rights-of-way	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water-use and quality							
Water use and quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water use in drought years	MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological							
Terrestrial ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic ecosystems	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL[a] to MODERATE
Threatened and dangered species	SMALL	SMALL to LARGE	SMALL	SMALL	SMALL[b] to MODERATE	SMALL	SMALL
Socioeconomic							
Physical	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

Table 9-2. (contd)

Category	Clinton	Dresden	Braidwood	LaSalle	Quad Cities	Byron	Zion
Demography	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Impacts to the Community - Social and Economic (beneficial)	SMALL to LARGE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL
Impacts to the Community - Infrastructure and Community	SMALL[c][d] to MODERATE	SMALL[e] to MODERATE	SMALL[e] to MODERATE	SMALL	SMALL	SMALL	SMALL
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Postulated accidents	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

(a) Fish may spawn in the area. If so, the impacts of operation could be MODERATE, depending on the design of the intake and discharge structures.
(b) The impact is rated SMALL, but there is a potential for MODERATE impact because of Higgins eye mussel downstream from the Quad Cities site. The construction and operation of the existing plant do not appear to have had an adverse impact on the mussel.
(c) Under normal conditions, the impacts on aesthetics and recreation will be SMALL. However, in severe drought years, the additional consumption of water may have MODERATE impacts on recreational use of Clinton Lake.
(d) There may be MODERATE impacts on housing if operational employees locate in the smaller towns in the area.
(e) There may be MODERATE impacts on housing if operational employees locate in Grundy County.

9.2 Environmentally Preferable Sites

Construction

The impacts of construction at the Exelon ESP site are SMALL for all impact categories. However, as noted in Section 4.5, there are two impact areas under Physical and Community Characteristics for which the impacts could rise to the MODERATE level. These areas are the impact of construction traffic on roads and the potential impact of construction workers on housing. The SMALL to MODERATE impact of construction traffic on roads is common to the CPS site and the alternative sites. The potential MODERATE impact of construction on housing could occur if the construction workers relocated to the CPS area rather than commute from their present residences.

There are SMALL to potentially MODERATE impacts on aquatic ecosystems and/or threatened and endangered species at three of the alternative sites: Dresden, Quad Cities, and Zion. In addition to the SMALL to MODERATE impact of construction traffic on roads at all sites, construction workers would be expected to have potentially MODERATE impacts on transportation at five of the alternative sites: Dresden, Braidwood, LaSalle, Quad Cities, and Byron. Mitigation measures would be available to limit the impact. At the sixth alternative site, Zion, the impact of construction workers on transportation would be expected to be MODERATE as a result of the location of the access road to the site. Without mitigation measures, this impact could become LARGE.

While there are some differences in the environmental impacts of construction at the Exelon ESP site and the alternative sites, the staff concludes that none of these differences is sufficient to determine that any of the alternative sites is environmentally preferable to the proposed Exelon ESP site.

Operations

The impacts of operations at the Exelon ESP site would be SMALL for all impact categories except for the recreation and housing areas under the Community Characteristics. Under normal water availability, the impact of operation of a new nuclear unit at the Exelon ESP site on recreation would be SMALL. However, in severe drought years, the water use of the unit could cause the level of Clinton Lake to drop enough to limit use of the lake for recreational purposes. In those periods, the impact level would be MODERATE. The residences of the workforce required to operate a nuclear unit at the ESP site are expected to be distributed throughout the area. In this case, the impact on housing would be SMALL. However, should the workforce locate predominately in the smaller towns in the area, the impacts on housing in those towns could be MODERATE.

Most of the impacts of operating a new nuclear unit at the alternative sites would be SMALL. Should a unit be located at either the Dresden or Braidwood sites, there could be MODERATE impacts on housing if the operational workforce located predominantly in Grundy County. These impacts would be similar to the housing impacts that could occur in small towns near the CPS site. There would be potentially MODERATE impacts to the threatened Higgins eye pearly mussel from operation of a new nuclear unit at the Quad Cities site and to aquatic ecology at the Zion site. However, nuclear power plants have operated at both of these sites without the impacts postulated.

Although there would be some differences in the environmental impacts of operation at the Exelon ESP site and the alternative sites, the staff concludes that none of these differences is sufficient to determine that any of the alternative sites is environmentally preferable to the Exelon ESP site.

9.3 Obviously Superior Sites

None of the alternative sites was determined to be environmentally preferable to the Exelon ESP site. Therefore, none of the alternative sites is obviously superior to the Exelon ESP site.

9.4 Comparison with the No-Action Alternative

The no-action alternative refers to a scenario in which NRC denies the ESP request. If the ESP application for the Exelon ESP site were denied, the impacts of the site preparation activities would not occur. Further, denial of the ESP application would prevent early resolution of safety and environmental issues for the site. These issues would have to be addressed during a future licensing action (ESP, construction permit, or combined license), should an applicant decide to pursue construction and operation activities for a nuclear facility at the site at a later time.

In the event that NRC denies the ESP application, Exelon could follow any of several paths to satisfy its electric power needs: (1) reapplying for an ESP at the Exelon ESP site using a revised plant parameter envelope or a specific reactor design, (2) seeking an ESP, a construction permit, or combined license for a new nuclear unit for a different location, (3) purchasing of power from other electricity providers, (4) establishing conservation and demand-side management programs, (5) constructing new generation facilities other than nuclear at the Exelon ESP site, (6) constructing new generation facilities at other locations, (7) delaying retirement of existing Exelon generating facilities, or (8) reactivating previously retired Exelon generating facilities. The preceding paths could be pursued individually or in combination. Each of the paths would have associated environmental impacts.

No significant environmental impacts would be avoided by the no-action alternative because no such impacts are caused by a site-suitability determination. The activities that are permissible under an ESP are limited to site preparation activities allowed by 10 CFR 50.10(e)(1). Site preparation activities are permissible only if the final environmental impact statement concludes that the activities would not result in any significant environmental impacts that could not be redressed. The results of the staff's assessment of the site redress plan are discussed in Section 4.11. As discussed in that section, the staff preliminarily concludes that the potential site-preparation activities described in Exelon's site redress plan would not result in any significant adverse impacts that could not be redressed.

9.5 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). 2003. *Exelon Generation Company, LLC, Early Site Permit Application: Environmental Report.* Exelon Nuclear, Kennett Square, Pennsylvania.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321 et seq.

New England Coalition on Nuclear Pollution. 1978. *New England Coalition on Nuclear Pollution v. NRC,* 582 F.2d 87 (1st Circuit 1978).

Public Service Co. of New Hampshire. 1977. *Public Service Co. of New Hampshire* (Seabrook Station, Units 1 & 2). CLI-77-8, 5 NRC 503, 526 (1977), *affirmed, New England Coalition on Nuclear Pollution v. NRC,* 582 F.2d 87 (1st Circuit 1978).

Rochester Gas & Electric Corp. 1978. *Rochester Gas & Electric Corp.* (Sterling Power Project Nuclear Unit No. 1), ALAB-502, 8 NRC 383, 397 (1978), *affirmed* CLI-80-23, 11 NRC 731 (1980).

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan (ESRP).* NUREG-1555, Vol. 1, NRC, Washington, D.C.

10.0 Conclusions and Recommendations

On September 25, 2003, the U.S. Nuclear Regulatory Commission (NRC) received an application from Exelon Generation Company, LLC (Exelon) for an early site permit (ESP) for a location identified as the Exelon ESP site, adjacent to the Clinton Power Station, Unit 1 (Exelon 2003a). The site is located in DeWitt County, Illinois, approximately 10 km (6 mi) east of the City of Clinton. An ESP is a Commission approval of a location for the siting of one or more nuclear power facilities, and is a separate action from the filing of an application for a construction permit (CP) or combined construction permit and operating license (combined license or COL) for such a facility. An ESP application may refer to a reactor's or reactors' characteristics or plant parameter envelope (PPE), which is a set of postulated design parameters that bound the characteristics of a reactor or reactors that might be built at a selected site; alternatively, an ESP may refer to a detailed reactor design. The ESP is not a license to build a nuclear power plant; rather, the application for an ESP initiates a process undertaken to assess whether a proposed site is suitable should the applicant decide to pursue a CP or COL.

Section 102 of the National Environmental Policy Act of 1969 (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. Subpart A of Title 10 of the Code of Federal Regulations (CFR) Part 52 contains the NRC regulations related to ESPs. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. As set forth in 10 CFR 52.18, the Commission has determined that an EIS will be prepared during the review of an application for an ESP. The purpose of Exelon's requested action, issuance of the ESP, is for the NRC to determine whether the Exelon ESP site is suitable for a new nuclear unit by resolving certain safety and environmental issues before Exelon incurs the substantial additional time and expense of designing and seeking approval to construct such facilities at the site. Part 52 of Title 10 describes the ESP as a "partial construction permit." An applicant for a CP or COL for a nuclear power plant or plants to be located at the site for which an ESP was issued can reference the ESP, thus reducing the need to review siting issues at that stage of the licensing process. However, issuance of a CP or COL to construct and operate a nuclear power plant is a major Federal action and will require an EIS to be issued in accordance with 10 CFR Part 51.

Three primary issues – site safety, environmental impacts, and emergency planning – must be addressed in the ESP application. Likewise, in its review of the application, the NRC assesses the applicant's proposal in relation to these issues and determines if the application meets the requirements of the Atomic Energy Act of 1954 and the NRC regulations. This EIS addresses the potential environmental impacts resulting from the construction and operation of a new nuclear unit.

In its application, Exelon requested authorization to perform certain site preparation activities after the ESP is issued. The application, therefore, includes a site redress plan that specifies how the applicant would stabilize and restore the site to its preconstruction condition (or conditions consistent with an alternative use) in the event a nuclear power plant is not constructed on the approved site. Pursuant to 10 CFR 52.17(a)(2), the applicant did not address the benefits of the proposed action (e.g., the need for power). In accordance with 10 CFR 52.18, the EIS is focused on the environmental effects of construction and operation of a reactor, or reactors, that have characteristics that fall within the postulated site parameters.

Upon acceptance of the Exelon ESP application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent (68 FR 66130) to prepare an EIS and conduct scoping. The staff held a public scoping meeting in Clinton, Illinois on December 18, 2003, and visited the Exelon ESP site in March 2004. Subsequent to the site visit and the scoping meeting and in accordance with NEPA and 10 CFR Part 51, the staff has determined and evaluated the potential environmental impacts of constructing and operating a new nuclear unit at the Exelon ESP site. Included in this EIS are (1) the results of the NRC staff's preliminary analyses, which consider and weigh the environmental effects of the proposed action (issuance of the ESP) and of constructing and operating a new nuclear unit at the ESP site, (2) mitigation measures for reducing or avoiding adverse effects, (3) the environmental impacts of alternatives to the proposed action, and (4) the staff's preliminary recommendation regarding the proposed action.

During the course of preparing this EIS, the staff reviewed the Environmental Report (ER) submitted by Exelon (Exelon 2003a), consulted with Federal, State, Tribal, and local agencies, and followed the guidance set forth in review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004), to conduct an independent review of the issues. The review standard draws from the previously published NUREG-0800, (NRC 1987), and NUREG-1555, *Environmental Standard Review Plans* (NRC 2000). In addition, the NRC considered the public comments related to the environmental review received during the scoping process. These comments are provided in Appendix D of this EIS.

Following the precedent of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) (NRC 1996) and supplemental license renewal EISs, environmental issues are evaluated using the three-level standard of significance – SMALL, MODERATE, or LARGE – developed by NRC using guidelines from the Council on Environmental Quality. Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

> 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.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections. During its environmental review, the staff considered planned activities and actions that Exelon indicates it and others would likely take should Exelon decide to apply for a CP or COL. In addition, Exelon provided estimates of the environmental impacts resulting from the construction and operation of a new nuclear unit on the ESP site. Key information considered by the staff in determining the level of impacts to a resource is discussed throughout the report and is listed in Appendix K.

NEPA requires that an EIS include information on:

- any adverse environmental effects that cannot be avoided should the proposal be implemented
- any irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented
- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Activities permitted under an ESP that includes a site redress plan include preparation of the site for construction of the facility, installation of temporary construction facilities, excavation for facility structures, construction of service facilities, and construction of certain structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents. These activities are identified in the site redress plan. However, the following discussion of the NEPA requirements addresses the impacts of construction and operation of a new nuclear unit at the Exelon ESP site. The construction impacts bound any impacts of the site preparation activities and preliminary construction activities allowed under 10 CFR 52.25(a).

10.1 Unavoidable Adverse Environmental Impacts

Section 102(C)(ii) of NEPA requires that an EIS include information on any adverse environmental effects that cannot be avoided should the proposal be implemented. Unavoidable adverse environmental impacts are those potential impacts of construction and operation of the proposed new units that cannot be avoided and for which no practical means of mitigation are available.

There will be no unavoidable adverse environmental impacts associated with the granting of the ESP with the exception of impacts associated with the limited site-preparation and preliminary construction activities allowed under the site redress plan. The impacts associated with the site-preparation and preliminary construction activities are bounded by the construction activities. However, there are unavoidable adverse environmental impacts associated with the construction and operation of a new nuclear unit at the Exelon ESP site.

If granted, the only activities authorized by the ESP would be the following site-preparation activities sought by Exelon, which are described in the volume of the application titled "Administrative Information, Emergency Plan, Site Redress Plan" (Exelon 2003b) and enumerated in 10 CFR 50.10(e)(1):

- preparation of the site for construction of the facility (including such activities as clearing, grading, and construction of temporary access roads and borrow areas)

- installation of temporary construction support facilities (including such items as warehouse and shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and construction support buildings)

- excavation for facility structures

- the construction of service facilities (including such facilities as roadways, paving, railroad spurs, fencing, exterior utility and lighting systems, and sanitary sewage treatment facilities)

- the construction of structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents, which could cause undue risk to the health and safety of the public.

If the ESP is granted to Exelon and if Exelon performs any or all of the activities above, but does not, in the future, seek a CP under 10 CFR Part 50 or a COL under 10 CFR Part 52, Exelon would need to redress the site according to the site redress plan included in the application (Exelon 2003b). The staff reviewed the list of allowed site-preparation and preliminary construction activities in the event that the ESP is granted and reviewed the full site redress plan submitted by Exelon. In accordance with 10 CFR 52.17, the application demonstrated that there is reasonable assurance that redress carried out under the plan will achieve an environmentally stable and aesthetically acceptable site suitable for whatever non-nuclear use may conform with local zoning laws. As a result of the staff's independent review, the staff, in accordance with 10 CFR 52.25(a), preliminarily concludes that the potential site preparation and preliminary construction activities described in Exelon's site redress plan would not result in any significant adverse impacts that could not be redressed.

Unavoidable Adverse Impacts During Construction

Chapter 4 discusses the impacts from construction of a new nuclear unit at the Exelon ESP site in detail. The unavoidable adverse impacts related to construction are listed in Table 10-1 and summarized below. The primary unavoidable adverse environmental impacts during construction would be related to land use. All construction activities for a new nuclear unit, including ground-disturbing activities, would occur within the existing Clinton Power Station site boundary. According to Exelon, the area that would be affected on a long-term basis as a result of permanent facilities is approximately 39 ha (96 ac). Additional areas would be disturbed on a short-term basis as a result of temporary activities and facilities and laydown areas (Exelon 2003a).

The construction impacts on the terrestrial ecology of the site would be short-term. Construction of a new nuclear unit would result in the removal of approximately 1.45 ha (3.5 ac) of forested habitat within the site. The Exelon ESP site does not contain any old-growth timber, nor any unique or sensitive plants or communities. Therefore, construction activities would not noticeably reduce the local or regional diversity of plants or plant communities. There are no important animal species or habitats on the ESP site. No areas designated by the U.S. Fish and Wildlife Service as critical habitat for endangered or threatened species exist at or near the site, nor are threatened or endangered plants or animals known to exist at the site. Therefore, construction would likely have no impact on any threatened or endangered species, or other important species or habitats. Socioeconomic impacts of construction include an increase in traffic. Atmospheric and meteorological impacts include fugitive dust from construction activities that can be mitigated by the dust control plan. Radiological doses to construction workers from the adjacent unit are expected to be well below regulatory limits. Regarding environmental justice, there are no unusual resource dependencies by minority or low-income populations.

Unavoidable Adverse Impacts During Operation

Chapter 5 provides a detailed discussion of the impacts from operation of a new nuclear unit at the Exelon ESP site. The unavoidable adverse impacts related to operation are listed in Table 10-2 and summarized below. The unavoidable adverse impacts from operation for land use would be small and further mitigation would not be warranted. Hydrological, water use, and water quality impacts during operation would primarily be the result of the operation of the proposed wet cooling power system during periods of reduced water supply in Clinton Lake and

Table 10-1. Unavoidable Adverse Environmental Impacts from Construction

Impact Category	Adverse Impacts Based on Applicant's Proposal	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land use	Yes	Comply with requirements of applicable Federal, State, and Local permits	39 ha (96 ac) disturbed on a long-term basis; additional land disturbed on a temporary basis
Hydrological and water use	Yes	Obtain a 401 Certification prior to site-preparation activities	Dewatering systems would depress the water table in the general vicinity, but the impacts would be localized and temporary
Ecological			
Terrestrial	No		
Aquatic	Yes		
Socioeconomic	Yes		
Radiological	Yes	Use of as low as reasonably achievable (ALARA) principles	Dose to site preparation workers
Atmospheric and meteorological	Yes	Implement actions to reduce fugitive dust	Equipment emissions and fugitive dust from operation of earth-moving equipment are sources of air pollution
Environmental justice	No	Not applicable	Not applicable

downstream. In normal water years, the impacts from the cooling system would be SMALL and in low-water years the impacts would be MODERATE. These water impacts are readily mitigated through the State of Illinois authority to regulate water use and water quality. Water impacts would be reversed once the precipitation patterns returned to normal. Socioeconomic impacts would primarily be increased demand for services, with the increase in tax revenue to support the increase in services. It is expected that meteorological impacts would be negligible and that pollutants emitted during operations would be insignificant.

10.2 Irreversible and Irretrievable Commitments of Resources

Section 102(C)(v) of NEPA requires that an EIS include information on any irreversible and irretrievable commitments of resources that would occur if the proposed action is implemented. The only irreversible and irretrievable commitments of resources that would be expended if the proposed action is implemented would be resources used by Exelon for site-preparation activities. If not used during the ESP, any such resource commitments for site-preparation

Table 10-2. Unavoidable Adverse Environmental Impacts from Operation

Impact Category	Adverse Impacts Based on Applicant's Proposal	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land use	Yes	Local land management plans	Possible new housing and retail space added in vicinity due to potential growth
Hydrological and water use	Yes	Comply with State permit limits	Decrease in lake level and reduction in available water released from the dam
Ecological			
Terrestrial	No	None	None
Aquatic	No	None	None
Socioeconomic	Yes	Increased tax revenues will offset impacts	Increased use of services
Radiological	Yes	Use of as low as reasonably achievable (ALARA) principles	Dose to workers, the public, and biota
Atmospheric and meteorological	No	None	None
Environmental justice	No	None	None

activities would be used at the CP or COL stage or could be used for other activities even if Exelon does not eventually seek a CP or a COL for the ESP location.

Irretrievable commitments of resources during construction of the proposed new units generally would be similar to that of any major construction project. The actual commitment of construction resources (concrete, steel, and other building materials) would depend on the reactor design selected at the CP or COL stage. Hazardous materials such as asbestos would not be used, if possible. If materials such as asbestos were used, it would be in accordance with safety regulations and practices. The actual estimate of construction materials would be performed at the CP or COL stage when the reactor design is selected.

The staff expects that the use of construction materials in the quantities associated with those expected for the new ESP unit, while irretrievable, would be of small consequence, with respect to the availability of such resources.

The main resource that would be irretrievably committed during operation of a new nuclear unit would be uranium. The availability of uranium ore and existing stockpiles of highly enriched uranium in the United States and Russia that could be processed into fuel is sufficient, so that the irreversible and irretrievable commitment would be of small consequence.

10.3 Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

Section 102(C)(iv) of NEPA requires that an EIS include information on the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. The only short-term use of the environment that could occur if the proposed action is implemented would be site preparation activities conducted by Exelon that would be authorized in an ESP. Any such activities are unlikely to adversely affect the long-term productivity of the environment. The evaluation of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity for the construction and operation of the ESP unit can only be performed by discussing the benefits of operating the unit. The benefit is the production of electricity. In accordance with 10 CFR 52.18, an EIS for an ESP does not need to include an assessment of the benefits of the proposed action. Therefore, an assessment of the evaluation of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity for the construction and operation of a new nuclear unit will be performed at the CP or COL stage.

10.4 Cumulative Impacts

The staff considered the potential cumulative impacts resulting from construction and operation of the ESP unit with past, present, and reasonably foreseeable future actions in the Exelon ESP site area in Chapter 7 of this EIS. For each impact area, the staff's determination is that the potential cumulative impacts resulting from construction and operation would be SMALL and that mitigation would not be warranted. Several issues have the potential for MODERATE impacts, most of which would occur under temporary circumstances or as the result of a larger-than-expected concentration of construction workers settling near the Exelon ESP site.

10.5 Staff Conclusions and Recommendations

The staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued. The staff's evaluation of the safety and emergency preparedness aspects of the proposed action have been addressed in the staff's draft safety evaluation report dated February 10, 2005.

This preliminary recommendation is based on (1) the ER submitted by Exelon, (2) consultation with Federal, State, Tribal, and local agencies, (3) the staff's independent review, (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process, and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and in the EIS. In addition, in making its preliminary recommendation, the staff has determined that there are no environmentally preferable or *obviously superior sites*. Finally, the staff has preliminarily concluded that the site-preparation and preliminary construction activities allowed by 10 CFR 50.10(e)(1) will not result in any adverse significant impact that cannot be redressed.

A comparative summary showing the environmental impacts of locating a new nuclear unit at the Exelon ESP site and at any of the alternative sites is shown in Table 10-3. Impacts of the no-action alternative, or denial of the ESP application, are also shown. Table 10-3 shows that the significance of the environmental impacts of the proposed action is SMALL for all impact categories with the exception of water use, water quality, and certain socioeconomic categories. The alternative sites may have environmental effects in at least some categories that reach MODERATE significance. The staff concludes that none of the alternative sites assessed are *obviously superior* to the Exelon ESP site.

Table 10-3. Summary of Environmental Significance of Station Location at the Exelon ESP Site and at Alternative Sites and for the No-Action Alternative

	Proposed Action	No-Action Alternative						
Impact Category	**ESP Site**	**Denial of ESP**	**Dresden**	**Braidwood**	**LaSalle**	**Quad Cities**	**Byron**	**Zion**
Land use	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Water use and quality	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Ecology	SMALL to MODERATE	SMALL	SMALL to LARGE	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Socioeconomics	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE
Historic and archaeological resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Human health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

10.6 References

10 CFR Part 50. Code of Federal Regulations, Title 10 *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

68 FR 66130. "Exelon Generation Company, LLC, Clinton Early Site Permit; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*. Vol. 68, No. 227. November 25, 2003.

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Appendix A

Contributors to the Environmental Impact Statement

Appendix A

Contributors to the Environmental Impact Statement

The overall responsibility for the preparation of this environmental impact statement was assigned to the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission (NRC). The statement was prepared by members of the Offices of Nuclear Reactor Regulation with assistance from other NRC organizations and Pacific Northwest National Laboratory.

Name	Affiliation	Function or Expertise
	NUCLEAR REGULATORY COMMISSION	
Tom Kenyon	Nuclear Reactor Regulation	Project Manager, Socioeconomics, Environmental Justice
John Tappert	Nuclear Reactor Regulation	Section Chief
James Wilson	Nuclear Reactor Regulation	Backup Project Manager, Ecology, Land Use
Jennifer Davis	Nuclear Reactor Regulation	Project Management Support, Cultural Resources, Air Quality
Andrew Kugler	Nuclear Reactor Regulation	Project Management, Section Chief, Water Quality & Use
Richard Emch	Nuclear Reactor Regulation	Radiological Impacts, Severe Accidents, DBAs
Barry Zalcman	Nuclear Reactor Regulation	Alternative Energy Sources
Charles Hinson	*Nuclear Reactor Regulation*	*Radiological Impacts*
Steve Klementowicz	Nuclear Reactor Regulation	Radiological Impacts
Jay Lee	Nuclear Reactor Regulation	Severe Accidents, Design Basis Accidents
Robert Palla	Nuclear Reactor Regulation	Severe Accidents
Andrew Barto	Nuclear Materials Safety and Safeguards	Spent Fuel Transportation
James Park	Nuclear Materials Safety and Safeguards	Fuel Cycle Impacts
	PACIFIC NORTHWEST NATIONAL LABORATORY[a]	
Eva Eckert Hickey		Task Leader
Kimberly Leigh		Deputy Task Leader
Amanda Stegen		Deputy Task Leader
James V. Ramsdell		Air Quality, Alternatives
Dennis Strenge		Severe Accidents
John Jaksch		Socioeconomics, Environmental Justice, Alternatives
Susan Sargeant		Aquatic Ecology
James Becker		Terrestrial Ecology
Gregory Stoetzel		Radiation Protection
Philip Daling		Transportation
Maha Mahasenan		*Transportation*
Darby Stapp		Cultural Resources
Dave Anderson		Land Use, Related Federal Programs
Doug Elliott		Geographical Information System Support
Lance Vail		Water Use, Hydrology
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James Weber		Technical Editing
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Debra Schulz		Document Production
Susan Tackett		Document Production
Rose Urbina		Document Production

(a) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute

Appendix B

Organizations Contacted

Appendix B

Organizations Contacted

During the course of the staff's independent review of potential environmental impacts from siting one new nuclear unit at the Exelon ESP site, the following Federal, State, regional, Tribal and local organizations were contacted:

Advisory Council on Historic Preservation, Washington, D.C., Director, Don Klima

Brady Weaver Real Estate, Clinton, Illinois, General Manager, Camill Tedrick

Chamber of Commerce, Monticello, Illinois, Sue Gorton

Chicago Ecological Field Service Office, U.S. Fish and Wildlife Service, Barrington, Illinois, John Rogner

Chief Deputy to the LaSalle County Treasurer, Ottawa, Illinois, Gary Kleinhans

City of Clinton, Illinois, Administrative Assistant, Tim Followell

Clinton Community Schools, District 15, Clinton, Illinois, Superintendent, Roger Little

Community and Economic Development Director, Monticello, Illinois, Mary Jo Hetrick

Cooperative Extension Service, University of Illinois, Clinton, Illinois, Argriculturalist, Pat Toohill

Dean Enrollment Services, Richland Community College, Decatur, Illinois, Nancy Cooper

Delaware Nation, NAGPRA Office, Anadarko, Oklahoma, Phyllis Wahahrockah

Delaware Tribe of Indians of Oklahoma, Brice Obermeyer

Delaware Tribe of Western Oklahoma, Anadardo, Oklahoma, Honorable Lawrence F. Snake

DeWitt County Board Administrative Assistant, Clinton, Illinois, Dee Dee Rentmeister

DeWitt County Treasurer, Christy Long, and Supervisor of Assessments, Clinton, Illinois, Sandy Moody

DeWitt County Planning and Zoning, Clinton, Illinois, Sherrie Brown

Director of Public Works, Clinton, Illinois, Steve Lobb

Director of Public Works, Mt. Pulaski, Illinois, Michael Partridge

Eastern Delaware Tribe, Bartllesville, Oklahoma, Honorable Dee Ketchum

Economic Development County Board Office Manager, Clinton, Illinois, Brady Weaver

Economic Development Director, Clinton, Illinois, Stephen Vandiver

Executive Director Dewitt Human Resource Center, Clinton, Illinois, Cheryl Lietz

Illinois Department of Natural Resources, Springfield, Illinois, Mike Garthaus

Illinois State Historic Preservation Officer (SHPO), Springfield, Illinois

Illinois Governor's Office, Springfield, Illinois

Illinois Power Company, Decatur, Illinois

Illinois Historic Preservation Agency, Springfield, Illinois, Maynard Crossland

Kickapoo of Oklahoma Business Committee, McCloud, Oklahoma, Honorable Kendall Scott

Kickapoo Tribe of Texas, Miami, Oklahoma, Honorable Raul Garza, Jr.

Kickapoo Kansas Tribal Council, Horton, Kansas, Honorable Carol Anske

Mayor of Monticello, Illinois, Floyd Allsop

Mayor of Clinton, Illinois, Roger Cyrulik

Monticello School District 23, Monticello, Illinois, School Superintendent, Lawrence McNabb

Mt. Pulaski, Illinois, Mayor, Bill Glaze

National Oceanic and Atmospheric Administration Fisheries, Gloucester, Massachusetts, Patricia Kurkul

Ogle County Treasurer, Oregon, Illinois, John Coffman

Peoria Tribe of Indians of Oklahoma, Miami, Oklahoma, Honorable John P. Froman

Rick Island Ecological Field Service Office, U.S. Fish and Wildlife Service, Rock Island, Illinois, Richard Nelson

Sandi Thayer Real Estate, Clinton, Illinois, Sandi Thayer

Town of Monticello, Illinois, Bill Mitze, Mayor

U.S. Ecological Survey, Urbana, Illinois, Gary Johnson

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Exelon Generation Company, LLC's (Exelon's) Application for an Early Site Permit at the Exelon ESP Site in Clinton, Illinois

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Exelon Generation Company, LLC's (Exelon's) Application for an Early Site Permit at the Exelon ESP Site in Clinton, Illinois

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and Exelon Generation Company, LLC (Exelon) and other correspondence related to the NRC staff's environmental review, under 10 CFR Part 51, of Exelon's application for an early site permit (ESP) at the Exelon ESP site in Clinton, Illinois. All documents, with the exception of those containing proprietary information, have been placed in the Commission's Public Document Room, at One White Flint North, 11555 Rockville Pike (first floor), Rockville, MD, and are available electronically from the Public Electronic Reading Room found on the Internet at the following web address: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to the NRC's Agencywide Document Access and Management Systems (ADAMS), which provides text and image files of the NRC's public documents in the Publicly Available Records (PARS) component of ADAMS. The ADAMS accession numbers or *Federal Register* citation for each document are included below.

February 28, 2003	NRC meeting notice announcing a public meeting in Clinton, Illinois, on March 20, 2003, to discuss the review process for Exelon's ESP application for the Clinton site (Accession No. ML030580509).
March 3, 2003	*Federal Register* notice of public pre-application ESP meeting for the Exelon site in Clinton, Illinois (68 FR 10052).
April 3, 2003	Summary of public pre-application ESP meeting held in Clinton, Illinois, to discuss the ESP review process (Accession No. ML030910535).
April 11, 2003	E-mail from Mr. Matthew Hindman, regarding the potential application for an ESP at the Exelon site in Clinton, Illinois (Accession No. ML031210693).
April 11, 2003	E-mail from Mr. Anthony DiMaggio, regarding the potential application for an ESP at the Exelon site in Clinton, Illinois (Accession No. ML031210709).

June 17, 2003	NRC staff letter to Mr. Tom Rudasill, Vespasian Warner Public Library, regarding the maintenance of reference material for public access related to the Exelon ESP review (Accession No. ML031640019).
June 26, 2003	Response from Mr. Tom Rudasill, Vespasian Warner Public Library, regarding the maintenance of reference material for public access related to the Exelon ESP review (Accession No. 032450430).
July 31, 2003	NRC staff letter to Mr. Matthew Hindman, regarding the potential application for an ESP at the Exelon site in Clinton, Illinois (Accession No. ML031910652).
July 31, 2003	NRC staff letter to Mr. Anthony DiMaggio, regarding the potential application for an ESP at the Exelon site in Clinton, Illinois (Accession No. ML031260019).
September 25, 2003	Letter from Ms. Marilyn C. Kray, Exelon, to NRC submitting the application for an ESP at the Exelon site in Clinton, Illinois (Accession No. ML032721594).
October 15, 2003	NRC Press Release No. 03-133 announcing the availability of the ESP application for the Exelon site in Clinton, Illinois (Accession No. ML032880335).
October 24, 2003	*Federal Register* notice of receipt and availability of the application for an ESP at the Exelon site in Clinton, Illinois (68 FR 61020).
October 27, 2003	Letter from NRC staff to Ms. Marilyn Kray, Exelon, regarding the receipt and availability of the application for an ESP at the Exelon site in Clinton, Illinois (Accession No. ML032930051).
October 27, 2003	Summary of September 24, 2003, tele-conference with Exelon to discuss the scheduling of the staff's technical review of Exelon's ESP application (Accession No. ML033000489).
October 30, 2003	*Federal Register* notice of acceptance of the application for an ESP at the Exelon site in Clinton, Illinois (68 FR 61835).
November 19, 2003	Letter from NRC staff to Ms. Marilyn Kray, Exelon, forwarding the *Federal Register* notice of intent to prepare an environmental impact statement

	and conduct scoping process for an ESP at the Exelon site in Clinton, Illinois (Accession No. ML033250261).
November 25, 2003	*Federal Register* notice of intent to prepare an environmental impact statement and conduct scoping process for an ESP at the Exelon site in Clinton, Illinois (68 FR 66130).
December 3, 2003	NRC meeting notice announcing a public meeting in Clinton, Illinois, on December 18, 2003, to discuss the environmental scoping process for the application for an ESP at the Exelon site in Clinton, Illinois (Accession No. ML033380526).
December 8, 2003	NRC Press Release No. 03-160, "NRC Announces Hearing on Early Site Permit for Clinton Site; Opportunity to Request Participation" (Accession No. ML033420171).
December 12, 2003	*Federal Register* notice of hearing and opportunity to petition for leave to intervene regarding an ESP at the Exelon site in Clinton, Illinois (68 FR 69426).
December 15, 2003	NRC Press Release No. III-03-076, "NRC to Hold Public Meeting December 18 on Environmental Scoping Process for Clinton Early Site Permit" (Accession No. ML033490522).
December 16, 2003	NRC staff letter to Clinton Area Local Public Officials providing notification of receipt and review of the Exelon ESP application (Accession No. ML033421293).
December 18, 2003	NRC Public Meeting Feedback Form from Dr. Donald Gruber providing scoping comments regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230516).
December 18, 2003	NRC Public Meeting Feedback Form from a member of the public providing scoping comments regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230499).
December 18, 2003	NRC Public Meeting Feedback Form from Mr. Kevin Heiden providing scoping comments regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230495).

December 18, 2003	NRC Public Meeting Feedback Form from Ms. Tina Prudhomme, providing scoping comments regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230491).
December 18, 2003	NRC Public Meeting Feedback Form from Ms. Helen Pavlak, providing scoping comments regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040190060).
December 18, 2003	NRC staff letter to Mr. Don Klima, Director, Advisory Council on Historic Preservation, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML033520358).
December 19, 2003	E-mail from Mr. Donald Dieker, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230464).
December 22, 2003	Letter from Ms. Phyllis Wahahrockah-Tasi, NAGPRA Director, Delaware Nation, providing comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040080737).
December 23, 2003	NRC staff letter to Mr. Maynard Crossland, Director, Illinois Historic Preservation Agency, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML033630476).
December 30, 2003	NRC staff letter to the Honorable Kendall Scott, Chairman, Kickapoo of Oklahoma Business Committee, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML033650531).
December 30, 2003	NRC staff letter to the Honorable Raul Garza, Jr., Chairman, Kickapoo Traditional Tribe of Texas, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML033650530).
December 30, 2003	NRC staff letter to the Honorable Carol Anske, Chairperson, Kickapoo of Kansas Tribal Council, regarding the ESP review at the Exelon site in Clinton, Illinois (Accession No. ML033650527).
December 30, 2003	NRC staff letter to the Honorable Lawrence F. Snake, President, Delaware Tribe of Western Oklahoma, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML033650456).

December 30, 2003	NRC staff letter to the Honorable John P. Froman, Chief, Peoria Tribe of Indians of Oklahoma, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML033650305).
December 30, 2003	NRC staff letter to the Honorable Dee Ketchum, Chief, Eastern Delaware Tribe, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML033650325).
January 4, 2004	E-mail from Mr. Robb Hoover, *providing scoping comments related to the* ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230468).
January 4, 2004	E-mail from Mr. Kevin Murphy, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230466).
January 8, 2004	Letter from Ms. Julie Gowen, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230457).
January 8, 2004	E-mail from Mr. Dan Moriarity, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230471).
January 9, 2004	E-mail from Mr. Ryan Doyle, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230473).
January 9, 2004	E-mail from Mr. Roy C. Treadway, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230475).
January 9, 2004	Letter from Mr. Paul Gunter, Nuclear Information and Resource Service; Ms. Michelle Boyd, Public Citizen; and Ms. Janet Zeller, Blue Ridge Environmental Defense League; providing comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230487).

January 9, 2004	Letter from Ms. Patricia Arbuckle, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230455).
January 9, 2004	E-mail from B. Barber, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230481).
January 9, 2004	Letter from Shannon Fisk, Attorney, Environmental Law and Policy Center, providing comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230460).
January 13, 2004	Letter from the Honorable John P. Froman, Chief, Peoria Tribe of Indians of Oklahoma, providing comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230461).
January 13, 2004	Letter from Mr. Brice Obermeyer, NAGPRA Director, Delaware Tribe of Indians of Oklahoma, providing comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040480535).
January 15, 2004	Letter from Mr. Gregg Brown, providing comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040230458).
January 21, 2004	NRC summary of public scoping meeting to support review of the ESP application for the Exelon site in Clinton, Illinois (Accession Nos. ML040330445 [Package], ML040330375 [Meeting Summary], and ML040230643 [Meeting Handouts and Transcript]).
January 23, 2004	E-mail from Mr. Dale Holtzscher, providing scoping comments related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040330833).
February 9, 2004	NRC staff letter to Ms. Cynthia Sauer, providing information related to the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040410223).
February 13, 2004	NRC staff e-mail to Mr. Bill Maher, Exelon, forwarding the proposed agenda for alternate site visits for the Exelon ESP site audit review (Accession No. ML041830102).

February 18, 2004	NRC staff e-mail to Mr. Bill Maher, Exelon, forwarding agenda items for the Clinton site audit (Accession No. ML041830095).
February 24, 2004	NRC staff e-mail to Mr. Bill Maher, Exelon, regarding an additional question concerning spent fuel storage for the Clinton site audit (Accession No. ML041820385).
February 25, 2004	NRC staff e-mail to Mr. Bill Maher, Exelon, forwarding additional agenda items for the Clinton site audit (Accession No. ML041830104).
February 26, 2004	NRC staff e-mail to Mr. Bill Maher, Exelon, forwarding discussion items on worker dose for the Clinton site audit (Accession No. ML041830124).
March 17, 2004	NRC staff letter to Ms. Patricia Kurkul, Regional Administrator, NOAA Fisheries, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040770284).
March 17, 2004	NRC staff letter to Mr. John Rogner, Field Supervisor, Chicago Ecological Field Services Office, U.S. Fish and Wildlife Service, regarding the ESP review for the Clinton Power Station site (Accession No. ML040770948).
March 17, 2004	NRC staff letter to Mr. Richard Nelson, Field Supervisor, Rock Island Ecological Field Services Office, U.S. Fish and Wildlife Service, regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040770896).
April 6, 2004	NRC staff letter to Ms. Marilyn Kray, Exelon, regarding the revised date for transmitting environmental requests for additional information regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040920584).
April 6, 2004	Letter from Mr. Richard C. Nelson, U.S. Fish and Wildlife Service, Rock Island Field Office, to NRC, providing a response to a letter requesting a list of species in the vicinity of the Exelon ESP site, Ogle, Grundy, LaSalle, and Rock Island Counties (Accession No. ML041180181).
April 8, 2004	NRC summary of site visits to alternative sites for the Exelon ESP site in Clinton, Illinois (Accession No. ML041000222).

April 12, 2004	Letter from Mr. John D. Rogner, U.S. Fish and Wildlife Service, Chicago Ecological Field Services Office, to NRC, providing a response to a letter requesting a list of species regarding alternate sites in Will and Lake Counties, Illinois (Accession No. ML041200545).
April 15, 2004	NRC staff letter to Ms. Marilyn C. Kray, Exelon, submitting a request for additional information regarding the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML040930400).
May 11, 2004	NRC staff letter to Ms. Marilyn C. Kray, Exelon, submitting a request for additional information regarding the environmental portion of the ESP review for the Exelon site in Clinton, Illinois (Accession No. ML041330188).
May 17, 2004	Note to file: Comments received by Member of Public regarding the staff's review of the Exelon ESP site in Clinton, Illinois (ML041420233).
May 18, 2004	NRC staff e-mail to Mr. Bill Maher, Exelon, forwarding clarification items regarding the Clinton site audit (Accession No. ML041830135).
May 26, 2004	Note to file: Docketing of references obtained during the site audit conducted in support of the environmental review of the Exelon ESP site in Clinton, Illinois (Accession No. ML041470397).
May 26, 2004	Summary of staff audit to support review of the Exelon ESP site in Clinton, Illinois (Accession No. ML041560266).
June 18, 2004	NRC staff e-mail to Mr. Bill Maher, Exelon, forwarding files for lake modeling for the Exelon ESP Clinton site review (Accession No. ML041830154).
June 22, 2004	NRC staff letter to Ms. Marilyn C. Kray, Exelon, requesting comments on the early site permit template (Accession No. ML041400206).
July 9, 2004	NRC staff letter to Ms. Marilyn C. Kray, Exelon, forwarding the environmental scoping summary report associated with the ESP review for the Exelon site in Clinton, Illinois (Accession Nos. ML041950214 [letter], ML041950227 [report]).

July 23, 2004	Letter from Ms. Marilyn C. Kray, Exelon, forwarding responses to NRC staff's requests for additional information for the Exelon ESP site in Clinton, Illinois (Accession No. ML042180079).
August 23, 2004	NRC staff letter to Ms. Marilyn C. Kray, Exelon, requesting additional information regarding the Exelon site in Clinton, Illinois (Accession No. ML042370551).
September 7, 2004	Note to file: Availability of Geographical Information Systems (GIS) files concerning the environmental review of the Exelon ESP site in Clinton, Illinois (Accession No. ML042510446).
September 17, 2004	Letter to NRC staff from Ms. Marilyn C. Kray, Exelon, delay in responding to requests for additional information regarding the Exelon ESP site in Clinton, Illinois (Accession No. ML042730435).
September 23, 2004	Letter to NRC staff from Ms. Marilyn C. Kray, Exelon, forwarding response to requests for additional information regarding the Exelon ESP site in Clinton, Illinois (Accession No. ML042730012).
October 6, 2004	Telecommunication summary to clarify responses to NRC requests for additional information regarding the Exelon ESP site in Clinton, Illinois (Accession No. ML042800504).
November 15, 2004	Letter from NRC staff to Ms. Marilyn C. Kray, Exelon, forwarding request for additional information regarding the environmental portion of the Exelon ESP site in Clinton, Illinois (Accession No. ML043210579).
November 15, 2004	Letter from NRC staff to Ms. Marilyn C. Kray, Exelon, providing revised schedule for the environmental review of the Exelon ESP site in Clinton, Illinois (Accession No. ML043090029).
November 16, 2004	Letter to NRC staff from Ms. Marilyn C. Kray, Exelon, forwarding corrections/clarifications to the Exelon ESP Application Environmental Report for the Exelon ESP site in Clinton, Illinois (Accession No. ML043290006).
November 18, 2004	E-mail from Mr. Bill Maher, Exelon, regarding ER corrections for the Exelon ESP Clinton site review (Accession No. ML043410062).

Appendix D

Scoping Meeting Comments and Responses

Appendix D

Scoping Meeting Comments and Responses

On November 25, 2003, the U.S. Nuclear Regulatory Commission (NRC) published a Notice of Intent in the *Federal Register* (68 FR 66130) to notify the public of the staff's intent to prepare an environmental impact statement (EIS) to support the early site permit (ESP) application for the Exelon Generation Company, LLC (Exelon) ESP site. This EIS has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), Council on Environmental Quality guidelines, and Title 10 of the Code of Federal Regulations (CFR) Parts 51 and 52. As outlined by NEPA, the NRC initiated the scoping process with the issuance of the *Federal Register* Notice. The NRC invited the applicant; Federal, Tribal, State, and local government agencies; local organizations; and individuals to participate in the scoping process by providing oral comments at the scheduled public meeting and/or submitting written suggestions and comments no later than January 9, 2004.

The scoping process included a public scoping meeting, which was held at the Vespasian Warner Public Library in Clinton, Illinois, on December 18, 2003. Approximately 100 members of the public attended the meeting. This session began with NRC staff members providing a brief overview of the ESP process and the NEPA process. Following the NRC's prepared statements, the meeting was open for public comments. Thirty-seven attendees provided either oral comments or written statements that were recorded and transcribed by a certified court reporter. The transcript of the meeting can be found as an attachment to the scoping meeting Summary, which was issued on January 21, 2004. The meeting summary is available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS) under accession number ML040330445. ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room). Note: the URL is case-sensitive. Additional comments received later are also available.

The scoping process provides an opportunity for public participants to identify issues to be addressed in the EIS and highlight public concerns and issues. The Notice of Intent identified the following objectives of the scoping process:

- Define the proposed action which is to be the subject of the EIS

- Determine the scope of the EIS and identify significant issues to be analyzed in depth

- Identify and eliminate from detailed study those issues that are peripheral or that are not significant

- Identify any environmental assessments and other EISs that are being prepared or will be prepared that are related to, but not part of, the scope of the EIS being considered

- Identify other environmental review and consultation requirements related to the proposed action

- Indicate the relationship between the timing of the preparation of the environmental analyses and the Commission's tentative planning and decision-making schedule

- Identify any cooperating agencies and, as appropriate, allocate assignments for preparation and schedules for completing the EIS to the NRC and any cooperating agencies

- Describe how the EIS will be prepared and include any contractor assistance to be used.

At the conclusion of the scoping period, the NRC staff and its contractor reviewed the transcripts and all written material received and identified individual comments. Twelve letters and nine e-mail messages containing comments were received during the scoping period. All comments and suggestions received orally during the scoping meeting or in writing were considered. Each set of comments from a given commenter was given a unique alpha identifier (commenter ID letter), allowing each set of comments from a commenter to be traced back to the transcript, letter, or e-mail in which the comments were submitted.

Table D-1 identifies the individuals providing comments and the commenter ID letter associated with each person's set(s) of comments. The commenter ID letter is preceded by EGCESP (short for Exelon Generation Company Early Site Permit). For oral comments, the individuals are listed in the order in which they spoke at the public meeting. Accession numbers indicate the location of the written comments in ADAMS.

Comments were consolidated and categorized according to the topic within the proposed EIS or according to the general topic if outside the scope of the EIS. Comments with similar specific objectives were combined to capture the common essential issues that had been raised in the source comments. Once comments were grouped according to subject area, the staff and contractor determined the appropriate action for the comment. The staff made a determination on each comment that it was one of the following:

- A comment that was actually a question and introduced no new information

Table D-1. Individuals Providing Comments During Scoping Comment Period

Commenter ID	Commenter	Affiliation (if stated)	Comment Source (ADAMS Accession #)
EGCESP-01	Shannon Fisk	Environmental Law and Policy Center	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-02	Steve Davenport	Farmer	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-03	Sandy Moody	DeWitt County	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-04	Kathleen Frick	Citizens Advisory Panel	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-05	Mr. Frank		12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-06	Oscar Shirani	Q-A Consultants	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-07	Kevin Calna		12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-08	Kim Gaff	Clinton Resident	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-09	Gregg Brown	No New Nukes	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-10	Mayor Cyrulik	Mayor of Clinton	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-11	Bryan Hickman	City of Clinton	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-12	Terry Ferguson	DeWitt County Board	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-13	Bob Bement	Exelon	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-14	Carolyn Treadway	No New Nukes	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-15	Pat Allison	Clinton School District	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-16	Roger Little	Clinton School District	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-17	Steve Vandiver	Economic Development Director	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-18	Ken Bjelland	DeWitt County Economic Development Committee	12/18/03 Scoping Meeting Transcript (ML040330445)

Table D-1. (contd)

Commenter ID	Commenter	Affiliation (if stated)	Comment Source (ADAMS Accession #)
EGCESP-19	Corey Conn	Board of Nuclear Energy Information Service	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-20	Ruth Ann Lowers	Board of Education	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-21	Ted Lowers	Clinton Businessman	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-22	Harold Weinberg	Clinton Resident	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-23	Robert Adcocit	Welding Inspector	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-24	C. Lee Baker	Past President of Intervenor of ILP Development	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-25	Phil Huckleberry	Illinois Green Party	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-26	Geoff Ower	Illinois State University Chapter of the Student Environmental Action Coalition	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-27	Elizabeth Burns	Illinois Stewardship Alliance	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-28	Karen Lowery	Citizen	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-29	John Workman	IBEW 146	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-30	Dick Baldwin	Clinton Resident	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-31	Monte Campbell	Clinton Resident	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-32	Richard Douglas	Clinton Resident	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-33	Matt Reeder	Illinois Green Party	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-34	Dr. Samuel Galusky	No New Nukes	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-35	Rachel Goad	Student Peace Action Network	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-36	Given Harper	Professor, Illinois Wesleyan University	12/18/03 Scoping Meeting Transcript (ML040330445)
EGCESP-37	Robert Bishop	Nuclear Energy Institute	12/18/03 Scoping Meeting Transcript (ML040330445)

Table D-1. (contd)

Commenter ID	Commenter	Affiliation (if stated)	Comment Source (ADAMS Accession #)
EGCESP-38	Phyllis Wahahrochah-Tasi	Delaware Nation NAGPRA Office	Letter (ML0400807370)
EGCESP-39	Patricia Arbunkle		Letter (ML0402304550)
EGCESP-40	Julie Gowen		Letter (ML0402304570)
EGCESP-41	Gregg Brown	No New Nukes	Letter (ML0402304580)
EGCESP-42	Shannon Fisk	Environmental Law and Policy Center	Letter (ML0402304600)
EGCESP-43	John Froman	Peoria Tribe of Indians of Oklahoma	Letter (ML0402304610)
EGCESP-44	Donald Deiker	Resident of Clinton	E-mail (ML0402304640)
EGCESP-45	Kevin Murphy		E-mail (ML0402304660)
EGCESP-46	Robb Hoover		E-mail (ML0402304680)
EGCESP-47	Dan Moriarity		E-mail (ML0402304710)
EGCESP-48	Ryan Doyle		E-mail (ML0402304730)
EGCESP-49	Roy and Carolyn Treadway		E-mail (ML0402304750)
EGCESP-50	Brooke Barber		E-mail (ML0402304810)
EGCESP-51	Paul Gunter	Nuclear Information and Resource Service	E-mail (ML0402304870)
EGCESP-52	Tina L. Prudhomme	IBEW Local 51	Letter (ML0402304910)
EGCESP-53	Kevin Heiden		Letter (ML0402304950)
EGCESP-54	Unknown		Letter (ML0402304990)
EGCESP-55	Donald Gruber	Clinton Community Schools	Letter (ML0402305160)
EGCESP-56	Dale Holtzscher		E-mail (ML0403308330)
EGCESP-57	Brice Obermeyer	NAGPRA Director, Delaware Tribe of Indians	Letter (ML0404805350)
EGCESP-58	Helen PavLak	Clinton Junior High School	Letter (ML0411900600)

- A comment that was either related to support or opposition of early site permitting in general (or specifically the Exelon ESP) or that made a general statement about the early site permit process. In addition, it provided no new information and did not pertain to 10 CFR Part 52.

- A comment about an environmental issue that
  - provided new information that would require evaluation during the review, or
  - *provided no new information*

- A comment that was outside the scope of the ESP, which included, but was not limited to
  - a comment regarding the need for, or cost of, power

- a comment regarding alternative energy sources
- a comment on the safety of the existing units.

The comments that are considered in the evaluation of environmental impacts in this EIS are summarized in the following pages. All comments received during scoping are included in the meeting summary (ML040330445). For reference, the unique identifier for each comment (commenter ID letter listed in Table D-1 plus the comment number) is provided. The responses provided here have been updated to provide the appropriate section in the EIS where the subject is addressed.

Preparation of the EIS will take into account all the relevant issues raised during the scoping process. The EIS will be made available for public comment. The comment period for the EIS will offer the next opportunity for the applicant; interested Federal, Tribal, State, and local government agencies; local organizations; and members of the public to provide input to the NRC's environmental review process. The comments received on the draft EIS will be considered in the preparation of the final EIS. The final EIS, along with the staff's Safety Evaluation Report (SER), will provide much of the basis for the NRC's decision on whether to grant the Exelon ESP.

D.1 Comments and Responses

This section summarizes the in-scope comments and suggestions received as part of the scoping process, and discusses their disposition. Parenthetical numbers after each comment refer to the commenter's ID letter and the comment number. Comments can be tracked to the commenter and the source document through the ID letter and comment number listed in Table D-1.

Comments are grouped by the following categories:

D.1.1 Comments Concerning National Environmental Policy Act Compliance
D.1.2 Comments Concerning Land Use
D.1.3 Comments Concerning Air Quality
D.1.4 Comments Concerning Surface Water Use and Quality
D.1.5 Comments Concerning Aquatic Ecology
D.1.6 Comments Concerning Terrestrial Ecology
D.1.7 Comments Concerning Socioeconomic Issues
D.1.8 Comments Concerning Cultural Resources
D.1.9 Comments Concerning Human Health Issues
D.1.10 Comments Concerning the Uranium Fuel Cycle and Waste Management Issues

D.1.1 Comments Concerning National Environmental Policy Act Compliance

Comment: Maybe you can tell me what to read out there but how big is your environment that you're looking at? Is it southern United States? Northern United States? Southern DeWitt County? DeWitt County? I don't know how big your environment is that you're looking at (EGCESP-S-03-1).

Response: *The area of review by the NRC in this EIS depends upon the environmental resource being reviewed. For example, the northern transmission line runs toward Bloomington, Illinois, for 37 km (23 mi). The southern transmission lines run south through DeWitt County for 13 km (8 mi). The NRC's assessment of the environmental impacts associated with the 50 km (31 mi) of transmission lines is discussed in Sections 4.1.2 and 5.1.2 of this EIS.*

Comment: On that transmission line, you're talking about the owners of the plant, those transmission lines?...So it's transmission lines of that power (EGCESP-S-03-2).

Response: *The transmission lines are not owned by Exelon. They are owned and maintained by Illinois Power Company. Exelon has an agreement to use the Illinois Power transmission lines. The environmental review will include the environmental impacts associated with the transmission lines. This is discussed in Sections 4.1.2 and 5.1.2 of this EIS.*

D.1.2 Comments Concerning Land Use

Comment: But from 14,750 head of cattle diminishing to 750 from the time that the Illinois Power Plant was starting to go and land being purchased. We lost that much in agriculture. And today that is still, and this isn't my figures, this comes from the Extension Office and people where we had to get in order to testify before the Nuclear Regulatory Commission (EGCESP-S-24-1).

Response: *The impacts on land use resulting from construction and operation of the proposed facility is discussed in Sections 4.1.1 and 5.1.1 of this EIS.*

D.1.3 Comments Concerning Air Quality

Comment: Nuclear power makes global warming worse. "Whether nuclear can beat coal does not matter because neither of them can beat other options that are free of carbon dioxide," such as wind and solar power (EGCESP-S-09-13).

Comment: Nuclear power is clean. It does not emit greenhouse gases, sulfur dioxide or nitrogen oxide (EGCESP-S-13-5).

Comment: It is the only large-scale, emission-free electricity source that can be readily expanded. Nuclear power plants avoid the emission of sulphur dioxide and nitrogen oxides...the major greenhouse gas, carbon dioxide (EGCESP-S-37-10) Note: This comment was provided in writing and is in addition to the comments taken from the transcript.

Comment: It does produce emissions into our air and water - coal plants are used to create the energy needed in the uranium enrichment process, and so they do pollute contrary to popular belief (EGCESP-S-47-4).

Comment: It seems that the nuclear industry is not held to clean up any facilities after they are built. And of course, safety is another key reason why the proposed plant should not be constructed. Any nuclear facility has the ability to leak out contaminants into the air and water, even through openings as small as 1/16 of an inch. And as it happens, the first Clinton reactor did not have a clean safety record-and now to build another?? (EGCESP-S-50-3).

Comment: There will be drifting of some solid materials from the plume associated with the cooling towers. These "salts" or minerals will deposit on downwind areas and could have an impact on residential and agricultural activities. The impact of this deposition should be evaluated for nearby areas (EGCESP-S-56-1).

Response: *This information will be considered in the staff's evaluation of air quality impacts in the EIS. The results of the analysis are presented in Sections 4.2 and 5.2 of this EIS.*

D.1.4 Comments Concerning Surface Water Use and Quality

Comment: My question is the lake capacity adequate now for the second unit? Do you've got enough water already? (EGCESP-S-05-1).

Response: *The NRC is evaluating the impacts of the additional direct and indirect evaporative losses of a wet cooling tower for the early site permit unit. The results of the assessment are provided in Sections 4.3 and 5.3 of the EIS.*

Comment: I would imagine part of your environmental impact would have to be measuring the temperature fluctuation of the Clinton Lake in means of the cooling capability. What input does that have on the final design submittal for the cooling aspect of it? That it would be acceptable to use a lake or would it be necessary the design to have a cooling tower? (EGCESP-S-07-1).

Comment: It is presumed that Clinton Lake will be used as a cooling lake for the second nuclear power plant. What affects will this additional heated water have on the fish and other organisms inhabiting the lake? (EGCESP-S-36-2).

Response: *The impact from any cooling system using the parameters identified in the plant parameter envelope (PPE) was reviewed in accordance with the Environmental Standard Review Plan (NUREG-1555) and discussed in the EIS in Sections 5.3 and 5.4.2. At this time, Exelon has indicated that a closed cooling system employing a cooling tower will be used and not a once-through cooling system. Therefore, the staff did not consider once-through cooling. If the applicant were subsequently to decide that they were interested in once-through designs, it would be required to revise its application.. The particular cooling system ultimately chosen by the applicant will have to fall within the PPE submitted by the applicant or, if it does not, that portion of the review will need to be reassessed at the combined license stage. The environmental impacts of a cooling tower and any temperature fluctuations it would have on Clinton Lake are assessed in Section 5.3 of this EIS.*

Comment: The water quality impacts, Clinton Lake, which serves as a cooling source for Clinton 1 is formed by damming up Salt Creek in the north fork of Salt Creek. Salt Creek itself is part of a much larger watershed being part of the head waters of the Sangiman River. The waters of this creek pass through numerous small to medium sized communities as they make their way to the Sangiman River and eventually to the Illinois River. The lake itself is used for recreational purposes, boating and swimming and managed by the Illinois Department of Natural Resources. The fisheries of the lake are used by people from throughout Illinois as well as visitors from other states.

According to the National Pollution Discharge Elimination System, NPDES, the permit that is in place for Clinton 1, there is a limit on the temperature change that can occur to the affluent water discharged from the plant (EGCESP-S-27-1).

Comment: Siting a second nuclear plant at the Clinton site could create adverse water supply and quality impacts. First, as acknowledged in Section 5.2 of the Environmental Report, most of the potential designs for a new Clinton 2 nuclear plant would require more water for cooling than would be available in Clinton Lake during drought periods. Second, the additional effluent discharge from the proposed Clinton 2 could increase water temperatures in Clinton Lake, thereby harming aquatic life. These water-related issues must be thoroughly addressed by the NRC in the EIS (EGCESP-S-42-3).

Comment: The EIS for the Clinton nuclear power station is therefore required to address all of the following environmental impacts, including but not limited to: 1. All impacts on the water levels in Clinton Lake arising from increased intake of reactor cooling water for the operation of any proposed new nuclear power units (EGCESP-S-51-1).

Comment: 4. All impacts arising from the increase in the routine discharge of chemicals, heavy metals, cleaning solvents, biocides and radioactive isotopes into Clinton Lake arising from the operation of additional nuclear power units (EGCESP-S-51-4).

Comment: The cooling towers will be discharging stream of about 12,000 gpm into the discharge canal so as to control the concentration of dissolved minerals in the closed cooling water system that runs from the main condenser to the cooling towers. The water in the discharge canal will eventually end up in the lake. The lake has been characterized as a large body of water which has a small inflow and small outflow as compared to lake volume. Such a configuration can lead to a build-up in the lake when a material is constantly being discharged into it. The EIS should review the impact of the cooling tower "blow-down" on the concentration of dissolved solids in the lake and any potential impact on aquatic life in the lake (EGCESP-S-56-2).

Response: *This information is considered in the staff's evaluation of surface water impacts. The results of the analysis are presented in Sections 4.3 and 5.3 of this EIS.*

D.1.5 Comments Concerning Aquatic Ecology

Comment: By adding a second plant to this location, there's a possibility for significant increases in lake temperatures, which will in turn result in significant impacts on a water body that's already listed on the Illinois Environmental Protection Agency's list of impaired waters (EGCESP-S-27-3).

Comment: 2. All impacts on the aquatic environment of Clinton Lake arising from the increase in thermal discharge of reactor cooling water as result of the operation of additional nuclear power units (EGCESP-S-51-2).

Comment: 3. All impacts on Clinton Lake arising from the increased impingement and entrainment of fish, fish spawn, other aquatic life and nutrients arising from the increased reactor cooling water intake for any proposed additional nuclear power units (EGCESP-S-51-3).

Response: *The NRC staff has assessed potential impacts from the cooling system and resulting aquatic and terrestrial impacts during its evaluation of the ESP application. The results of the analysis are presented in Sections 5.3, 5.4.2, and 5.4.3 in this EIS.*

D.1.6 Comments Concerning Terrestrial Ecology

Comment: One of the gauges I like to use to determine a healthy environment is the amount of wildlife there is in the area. It seems each year we have more pheasants, more quail, more deer, excellent fishing. You know, I would have to gauge that as a testimony that, you know, the Clinton Power Station is not being very detrimental to the environment (EGCESP-S-12-2).

Response: *The NRC staff assessed aquatic and terrestrial impacts during its evaluation of the ESP application, and the results of the analysis are presented in Sections 4.4 and 5.4 in this EIS.*

D.1.7 Comments Concerning Socioeconomic Issues

Comment: Of course, jobs, lower real estate taxes that would come with the second unit, of course (EGCESP-S-02-5).

Comment: Last year we paid a little over 10 million dollars in taxes. We contribute thousands of dollars to organizations. There are some recent – we got the opportunity to participate in the Clinton Ultimate Play Space that was drawn up by children from Clinton. And we got to participate financially and some of our workers helped build that. We also participated in the last United Way campaign, increasing our contributions to the county. Over $10,000 to this county, which is one of the three counties we split our money with. And as part of the larger companies, larger nuclear company that we are a part of, the company nuclear employees contributed over a million dollars to United Way. I take great pride in the recent contribution or gifting or donation of the Clinton Lake Marina to the county this past September. We're pleased to have the DeWitt County Board receive the ownership of the marina. The marina is a big part of DeWitt County. Over a million people use the lake annually. And it helps keep revenue coming into this county and we're proud to be a part of gifting that to DeWitt County (EGCESP-S-13-3).

Comment: I also am concerned about funding for schools. Our funding is decreasing and even though I'm going to be retiring in a few years, I would like to see our school system be as good as it has been in the past few years.

Also, I'm very interested in economic development. I have seen our people move out. I've seen our unemployment increase tremendously. I would like for us to have a way to increase our economic development again (EGCESP-S-15-1).

Comment: I have found the power plant to be a partner in the education of the children in the community. A lot of the people that work there have children in our schools. And therefore they have concerns as all of us do (EGCESP-S-16-1).

Comment: This plant has meant a lot to this school district obviously financially. That's not all, though. It's been more important than that because it has been a place for people in the community to have a job and raise children and that's our concern (EGCESP-S-16-3).

Comment: And speaking economically, the Clinton Power Station has been a socioeconomic work horse in DeWitt County for over 30 years, for almost 30 years. Through that time it's provided hundreds of jobs for our area. But it's not just the jobs that it's done for our community. There's a tremendous amount of people the plant has brought to us who have become valuable Clinton DeWitt County residents. Several are friends of mine personally. They are now volunteers, church members and other contributing citizens for the Clinton area. The taxes paid by the plant have improved our schools, making them some of the finest in the state and helped our county services. And although it doesn't sit within the city limits, it continues to help our city tax base. The plant has purchased fire trucks for our city and helps us cultivate a highly qualified fire and emergency personnel with experience not found in municipalities of our size or even larger because of the extra emergency planning for natural disasters for which they train (EGCESP-S-17-1).

Comment: I'm here tonight representing the DeWitt County Economic Development Committee. And the Committee has discussed this and does support the expansion, the second unit and we feel that the problems that we've had with our local economy, with the loss from Revere, the loss of Troll, and the loss of Imperial China, we really need another opportunity to provide some work in the county for our available work force. And we would welcome the second unit if it's sought to be available (EGCESP-S-18-1).

Comment: But it has provided many construction and permanent jobs in DeWitt County and in the surrounding counties. Our power plant has been a good neighbor and has helped, as we've heard, in many community and civic organizations. Myself and the 600 construction electricians that I represent strongly support the construction of Unit 2 and thank you for your time (EGCESP-S-29-2).

Comment: That it is recognized that the better the economy in a area, the more care is given to the environment. The addition of a second unit at Clinton will provide short-term and long term support to the local economy (EGCESP-S-44-2).

Comment: On behalf of all teachers and staff (about 175 people) of the Clinton Community School District, I would like to express our enthusiastic support of a second nuclear power station at Clinton. We are eternally grateful for the economic benefits our district received from Unit One- as well as those enjoyed by the local economy (EGCESP-S-55-1).

Comment: So I know a few things about living in an area where the unemployment rate is very high, where jobs are leaving and not arriving, about going to a school district that's rural and that doesn't seem to have enough money to actually take care of its students. So I really sympathize with a lot of the things that you're dealing with at Clinton and it really sickens me to see the way that the Exelon Corporation is taking care of people by using them. This is the same Exelon Corporation that just last month tried to jack rate hikes through the State Legislature for no particular reason in the process of attempting to buy out Illinois Power. Doesn't seem to be a friend to the taxpayer. Doesn't seem to be a friend to the consumer. This is also the same company that not only near where I lived at the Byron plant but also here, in the process of buying out the plant, human victims of a devaluation scheme that significantly lowered the property tax revenue from the plant before. There is no reason to believe that this wouldn't happen again and again with a new reactor as well (EGCESP-S-25-1).

Comment: We don't need the tax dollars in terms of property taxes. We have a tax structure that needs to be changed significantly any way to support poor and more rural districts and we've known that for decades (EGCESP-S-25-8).

Comment: I also know of socioeconomic problems. And I, as well as anybody else, wants food on my table and I want electricity. But I also want to be healthy (EGCESP-S-28-4).

Comment: And I think the negative consequences of building a new plant completely outweigh new jobs that could be brought in from some other source or some other company that's willing to move in here (EGCESP-S-33-3).

Comment: And I understand anxiety and the difficulty that the community is in, any local community that is in economic distress I can appreciate your concerns (EGCESP-S-19-3).

Comment: Now, we have had the change of a marina. In the beginning the Illinois Power would not have gotten their construction permit unless they presented an analysis of the cost of the recreation plan for Clinton Lake to be executed. And that was one of the last questions and it was 30 days before they were given their construction permit until they did supply that analysis. And they did. So they were responsible then for the recreation on Clinton Lake. What's happened? That's been changed. The plant's been sold to another firm, organization and who ends up then with the liability of the recreation plan for Clinton Lake? You, the DeWitt County people (EGCESP-S-24-3).

Comment: 10. All potential socio-economic impacts from the elevated national security requirements and countermeasures to protect a larger target of terrorism with the expansion of the nuclear power station site including the indefinite and possibly permanent closure of Clinton Lake to public access for sporting, recreation and other means of community economic livelihood (EGCESP-S-51-10).

Comment: Also, how will the recent sale affect the plant to move forward with the new unit (EGCESP-S-58-2).

Response: *These comments discuss socioeconomic issues. The NRC staff assessed the socioeconomic impacts of the proposed action in Sections 4.5 and 5.5 of the EIS, including impacts related to taxes, property values, and recreational use of the lake.*

D.1.8 Comments Concerning Cultural Resources

Comment: Given the location of the proposed project, we request that you conduct a file search in conjunction with the State Office of Historic Preservation and the state's Archaeological Survey. These state agencies will advise you of the potential for archaeological resources, particularly sites of significant cultural interest or sites that contain human remains. Should either of these agencies determine that there are potentially significant archaeological sites in the area and that these sites are related to the tribe's heritage, the Delaware Nation requests that you contact our offices. Together with the SHPO and State Archaeologist we will develop a plan to best protect these archaeological resources. Should either of these agencies recommend an archaeological survey or test excavation of the proposed construction site, we ask that the Delaware Nation be informed of the results of the survey. The Delaware Nation also requests copies of any accompanying site forms or reports. Also, any changes to the above referenced project should be resubmitted to the NAGPRA Director of the Delaware Nation for review. Should this project inadvertently uncover an archaeological site and/or human remains, even after an archaeological survey, we request that you immediately contact the appropriate state agencies, as well as the Delaware Nation. Also, we ask that you halt all construction activities until the tribe and these state agencies are consulted (EGCESP-S-38-1).

Comment: The Peoria Tribe of Indians of Oklahoma is currently unaware of any documentation directly linking Indian Religious Sites to the proposed construction. In the event any items falling under the Native American Graves Protection and Repatriation Act (NAGPRA) are discovered during construction, the Peoria Tribe request notification and further consultation. The Peoria Tribe has no objection to the proposed construction. However, if any human skeletal remains and/or any objects falling under NAGPRA are uncovered during construction, the construction should stop immediately, and the appropriate persons, including state and tribal NAGPRA representatives contacted (EGCESP-S-43-1).

Comment: Our review indicates that this project is located in an area that was not inhabited by the Delaware Tribe. As such, there is little potential for impacting unknown archaeological sites culturally affiliated with the Delaware Tribe and we have no particular objection to the proposal (EGCESP-S-57-1).

Response: *As part of its environmental review of historic and cultural resources, the staff met with the Illinois State Historic Preservation Office (SHPO) and other appropriate information sources. The results of the analysis are presented in Sections 2.9, 4.6, and 5.6 of this EIS, and the staff will take any appropriate action called for as a result of this review.*

D.1.9 Comments Concerning Human Health Issues

Comment: Breast cancer rates in communities within 50 miles of a nuclear reactor increase by an average of 14-40% while the reactor is operating. Areas with more than one reactor have higher cancer rates than single-reactor sites. The increases cannot be attributed to fallout from nuclear weapons tests. Nationally, breast cancer increases by an average of 1% per year in areas without nuclear reactor exposure (Radiation and Public Health Project) (EGCESP-S-09-21).

Comment: Babies born within 50 miles of a reactor have a higher risk of suffering low birth weights or newborn death. While health experts hoped these figures would fall as U.S. neonatal and natal care improved, our country's figure have actually gone up significantly, by 4-8% over expected cases. Thyroid cancer and hypothyroidism rates are also increasing in areas near nuclear reactors. No New Nukes hopes to work with the Radiation and Public Health Project to get current figures for the existing Clinton reactor (EGCESP-S-09-22).

Comment: By analyzing 50 years of U.S. National Cancer Institute data, Dr. Gould showed that "of the 3,000-odd counties in the United States, women living in about 1,300 nuclear counties (located within 100 miles of a reactor) are at the greatest risk of dying of breast cancer." Dr. Gould found similar risks for prostate cancer among men living in nuclear counties (EGCESP-S-09-7).

Comment: The Radiation and Public Health Project (RPHP) Baby Teeth Study is the first to measure radioactivity in the bodies of Americans living near nuclear reactors. It will also help determine whether this radioactivity raises the risk of cancer in children and adults. The study grew out a Jay M. Gould's book "The Enemy Within: The High Cost of Living Near Nuclear Reactors, " which found that women living within 100 miles of nuclear reactors are at greatest risk of dying of breast cancer. An earlier study showed that radioactivity in baby teeth rose rapidly due to fallout from atomic bomb tests above the Nevada desert in the 1950s and 1960s, a time when childhood cancer rates were also rising. This information was instrumental in the 1963 ban of above-ground tests by the United States and Soviet Union. The federal government withdrew funding for the study in 1970, and no longer collects information on how much radioactivity is entering our bodies (EGCESP-S-09-10).

Comment: This plant is a danger to our health. And if we allow it to not only stay, but also to grow, it is a danger to our conscience.

Any source of energy that causes tremendous amounts of death and suffering is immoral. End of story.

And this damage is not just a local problem. According to the speaker last Monday night, infant mortality as well as breast cancer rates caused by the plant, are up all the way into Indiana. These statistics are similar for all of the 11 plants in Illinois, and the 113 in America. This is a lot of death we're talking about.

In order to gauge the severity of nuclear contamination in humans, the Radiation and Public Health Project has put together an experiment to see how much Strontium-90 is in baby teeth. Strontium-90 is produced only by atomic bombs and nuclear reactors, and is chemically similar to calcium. So when the body finds the poison, it uses it as calcium and stores it in teeth and bones.

Earlier studies showed that radioactivity levels were raised in the 1950s and 1960s, and were continued until the government withdrew funding in 1970.

The government no longer does any research on Americans to find out how much radioactivity is entering our bodies.

Well, let me get this straight. The U.S. government allows and even encourages the production of nuclear energy, even though there is solid proof people are dying because of it? We are allowed to live in towns surrounding these plants, but I highly doubt citizens of and around, Braidwood, Byron, Clinton, Dresden, LaSalle County, Limerick, Oyster Creek, Peach Bottom, the Quad Cities, Rock Island and Zion know precisely what they're up against. Do they know why their babies are dying?

Probably not. I highly doubt the families who suffer this tremendous loss would just let the perpetrator go on committing the crime if they did (EGCESP-S-09-11).

Comment: Reactors currently in operation cause cancer, heart disease, immune deficiency disorders, fetal deformities, and still births every day. Legal radiation releases harm us. We don't need to add to our radiation burden by building another reactor (EGCESP-S-09-17).

Comment: Most citizens believe that reactors don't routinely release radiation and radioactive particles into the air and water. By the Nuclear Regulatory Commission's (NRC) own calculations, U.S. reactors released 370 curies, or about 1.6 curies per million persons during the 1970-1987 period. ("The Enemy Within") Those living closest to reactors got the highest doses. Because anything released from a nuclear reactor is considered "background radiation" after one year, the NRC can make yearly releases look very small. Unfortunately, some radioactive releases accumulate over time, increasing our health risks in the process (EGCESP-S-09-20).

Comment: We do know that radiation is destructive to persons, to living creatures and to the environment. Why then would we ever possibly risk destruction of our lives and the web of life? Notice I said risk. I didn't say we would. I said we would risk it. Why would we even consider unleashing the power of the atom in ways that allow incomprehensible risks. I say incomprehensible because we have not even yet begun to comprehend those risks or to take them seriously (EGCESP-S-14-2).

Comment: We also know it's not clean because we have evidence that suggest that in DeWitt and Pyatt County that when the Clinton Reactor No. 1 has been running in the '90's as opposed to when it has not been running, the infant mortality rates rise. There's also evidence to suggest that cancer rates rise. A lot of people have spoken saying that they haven't seen any environmental concerns. These are concerns that leap right out in your face. Certainly everyone in the room knows someone who has suffered from cancer, possibly even died from it. You don't know what caused that cancer. Why would you take that risk that cancer might have been somehow related to the operation of a nuclear power plant near you?

That's a risk that isn't going to go away. And we're never going to be able to convincingly prove one way or the other, perhaps, that it was actually nuclear power that did it. So those problems are visible (EGCESP-S-25-5).

Comment: Building a new reactor in Clinton, Illinois would pose a threat to our national food supply. Even during normal operation, nuclear reactors knowingly release radioactive fission products that fall out over surrounding lands. In the case of central Illinois that means agriculture lands. The proposed site for the new reactor is located in the midst of some of the richest agricultural land in the world...One of the radioactive daughter products find its way into our food is strontium-90, which falls onto broad leaves which in turn are consumed by either people or animals. We see greens of all kinds absorb high doses of radioactive particles, as do grasses that are fed to livestock. There are a myriad of ways that radioactive particles enter the food chain. They can also fall out onto fresh water lakes and streams or be released into these water bodies in coolant water (EGCESP-S-26-4).

Comment: I would like to address environmental concerns affecting infant mortality that we've been discussing. The Clinton Nuclear Reactor was off line, shut down during the period of 1996 to 1998. Using State of Illinois Health Department data on infant mortality, and this is defined as deaths in children under one year of age, infant mortality data for calculated for the three years prior to the shut down, 1993 to 1995, the three-year period surrounding the shut down of '96 to '98 and the three years after restart, '99 to '01. Based on the prevailing winds, the following counties were considered downwind of the Clinton Reactor plume. And I might note that it is more than just DeWitt and Pyatt County. These counties include DeWitt, Pyatt, Champaign, Moltry, Douglas, Coles and Vamilia. Two other counties as well in Indiana were considered but I won't be using those in terms of our data discussion this evening. The surrounding counties in the north, south and west are considered up wind. They are Taswell, Christian, Ford, McClain, Megan, Logan and Sangiman. And every studied county downwind to the Clinton Reactor, infant mortality dramatically decreased during the shut down period from 9.04 deaths per 1,000 live births in the period prior to the restart to 4.6 deaths per 1,000 live births during the period where the reactor was shut down.

During the same period infant mortality rates in the surrounding upwind counties remain statistically unchanged; 8.5 deaths per 1,000 live births down to 8.35 deaths per 1,000 live births. After restart, infant mortality rates soared upwards all of the downwind counties from 4.6 deaths per 1,000 live births to 9.8 deaths per 1,000 live births. But it continued to drop in the upwind counties.

This study strongly suggests the presence of the Clinton Reactor when it is on line is decreasing infant health. Additionally, this study is not alone in its findings. The Radiation Public Health Project studied infant mortality in cancer rates in counties surrounding eight reactors across the country after shut down. In all eight cases, infant deaths and childhood cancers dropped dramatically two years after shut down (EGCESP-S-34-1).

Comment: There is a hidden health cost to nuclear power. The NRC regulation regarding low level radiation releases into the environment need to be re-examined. What will the health costs continued operations of power station be and what will the health cost of a second reactor be? (EGCESP-S-34-2).

Comment: And so that this observation is made in public, I want to point out just one underhanded use of language that the NRC and the nuclear industry uses over and over again to lull concerned citizens in to believe that the NRC is, in fact, safeguarding the public's interest. We are told repeatedly that radiation emissions from a nuclear reactor are far lessor, far less radiation that – exposed to background radiation. What the NRC does not point out is that background radiation includes emissions from radioactive chemicals which occur naturally and those which result in a nuclear effluent process itself, whereas part of the munitions manufacturing or nuclear energy reactors. In fact, emissions release by a nuclear reactor are considered background radiation after one year, whether this one year old particulate is still dangerous or not. NRC guidelines also say that should a second reactor open in Clinton, each reactor would be entitled to count emissions from the plant next door as background radiation. So, the citizens of central Illinois would never know exactly how much radiation is being released from the two plants unless they calculated themselves if they could even find the data necessary for such a calculation given the fact the NRC has stopped publishing its yearly report on radioactive particular emissions from U.S. reactors. What citizens need to realize is the NRC never talks about natural background radiation, which includes emissions from radioactive chemicals which are not man made. The NRC can't talk about natural background radiation because there's nothing natural about their standards of background radiation though they will make it sound like their standards are as safe as living in a basement apartment with a radon remediation system in place (EGCESP-S-34-6).

Comment: In your booklet "Citizen's Guide to US Nuclear Regulator Commission Information" I found two disturbing quotes on page seven. The first, in the section on high-level waste states "The disposal of high-level radioactive waste requires a determination of acceptable health and environmental impacts over thousands of years." Who gave you the right to determine what is "acceptable" harm to inflict on the future? If we can't create something without harming the future, we shouldn't create it at all (EGCESP-S-41-2).

Comment: 6. All impacts on the public health and environment arising out of the increase in routine and accidental radioactive emissions to the air and to the water as the result of the operation of additional nuclear power units. The analysis should consider work by Dr. John Gofman, showing that low-level radiation, at levels considered to be safe for medical use, is a significant contributor to deaths from heart disease and cancer. See Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease (Committee for Nuclear Responsibility: 1999) (EGCESP-S-51-6).

Comment: And I want to tell you all that I was this size before the nuclear power plant was built. So, that had no affect on me that I know of (EGCESP-S-02-3).

Comment: Reasons for this include the possible negative impacts on aquatic life and possible increase in the populations of N. fowleri (Naegleria fowleri) (EGCESP-S-27-2).

Comment: In addition, should a significant event occur at the plant or plants and a radioactive release occurs to the lake, the impacts will be far reaching not only to those in the immediate area but to a significant portion of central Illinois. Water supplies and land use will be negatively impacted possibly for decades to come (EGCESP-S-27-4).

Comment: They send the survey that one guy's talking about that checks my quality of life, my animals, my garden. I've never heard of any negative impacts of that (EGCESP-S-31-2).

Comment: According to the NRC's own guidelines, NRC 10 CFR 52.18, Part 100 regarding this ESP scoping meeting, the NRC must evaluate the nature and proximity of human related hazards at the proposed reactor site. Proximity of the current Clinton Reactor No. 1 is a human related hazard that should be sufficiently investigated before any plans for an ESP for a second Clinton Reactor is approved (EGCESP-S-34-9).

Comment: There is clear evidence that nuclear reactors adversely affect public health. As a society we have a moral obligation to our present and future citizens to prevent these hazards if at all reasonably possible (EGCESP-S-40-2).

Comment: I want to tell you that infant mortality rates that they're spouting up here are not only incorrect, what they're telling you is absolutely and totally wrong and I can tell you why. I happen to be the Birth through Three Teacher for the Clinton School District and I work with 84 families right now and 92 babies. I work in concert with the DeWitt Fl County Health Department, which means I have to gather information for them to compile and report through the state. You need to know this. The babies that have died in Clinton have not died as a result of radiation or any other hazard such as that. However, I'd like to tell you what they have died from. We happen to have one of the highest rates of domestic abuse and violence in the state. I also happen to have one of the highest teen pregnancy rates in the state. And we also have a very high unemployment rate. Now, if you know anything about socioeconomic factors, that certainly plays into what has happened to these young babies (EGCESP-S-08-3).

Comment: Second, I have the envelope put out by the Tooth Fairy Project, which is measuring the level of radioactive isotopes strontium in our baby's teeth. Since the government is no longer monitoring the level of radioactivity that is entering our bodies, at least not in an official way, it seems to me that someone has to do it. And the new information on the infant mortality rates downwind of the Clinton facility makes the Tooth Fairy Project Study even more important (EGCESP-S-09-3).

Due to a 60 percent rise in radioactive isotope Strontium-90 in our babies' teeth since the late 1980s, with the counties closest to nuclear reactors having the highest levels, I urge you to avoid using a second nuclear reactor at the Clinton, Illinois facility (EGCESP-S-39-1). Radioactive Sr-90 [Strontium-90] is one of the deadliest elements release by nuclear facilities. The chemical structure of Sr-90 is so similar to that of calcium that the body gets fooled and deposits Sr-90 in the bones and teeth where it remains, continually emitting cancer-causing radiation. Most of the strontium in the baby teeth is transferred to the fetus by the mother during pregnancy. Because we know when and where the baby was born, and where the mother lived while carrying, we can accurately determine when and where radioactivity was absorded from the environment (EGCESP-S-09-9).

The Radiation and Public Health Project has found a 60 percent rise in radioactive isotope Strontium-90 in our babies' teeth since the late 1980s, with the counties closest to nuclear reactors having the highest levels. It is important to understand that Strontium-90 doesn't occur in nature. It is produced by the fission of either nuclear bombs or nuclear power plants. It is also important to understand that it doesn't take an accident for a nuclear power plant to release radioactive material: That material is released during the routine operation of those facilities. RPHP has found significant elevations in the infant mortality rates of counties downwind of the Clinton facility during the years the plant is operating and reductions of that rate when the plant is shut-down. That data has been previously published in The Pantagraph. Our babies' bodies weren't meant to hold Strontium-90. That was not part of the creator's plan. The NRC must hear from us. Tell them you don't want Strontium-90 in our children's bodies. Tell them that is too high a price (EGCESP-S-41-6).

Response: *The NRC's regulatory limits for radiological protection are set to protect workers and the public from the harmful health effects of radiation on humans. The limits, including effluent release limits, are based on the recommendations of standards-setting organizations. Radiation standards reflect extensive ongoing study by national and international organizations (e.g., the International Commission on Radiological Protection [ICRP], the National Council on Radiation Protection and Measurements, and the National Academy of Sciences) and are conservative to ensure that the public and workers at nuclear power plants are protected. The NRC radiation exposure standards are presented in 10 CFR Part 20, "Standards for Protection Against Radiation," and are based on the recommendations in ICRP Publications 26 and 30. In addition, the U.S. Environmental Protection Agency has established a whole body dose limit of 25 millirem per year (see 40 CFR Part 190). Finally, Appendix I to 10 CFR Part 50 provides dose design objectives for exposure of the public to radioactive effluents from nuclear reactors. Numerous scientifically designed, peer-reviewed studies of personnel exposed to occupational levels of radiation (versus life-threatening accidental doses or medical therapeutic levels) have shown minimal effect to human health, and any effect was from exposures well above the* *exposure levels of the typical member of the public from normal operation of a nuclear power plant.*

Regarding health effects to populations around nuclear power plants, NRC relies on the studies performed by the National Cancer Institute (NCI). NCI conducted a study in 1990, "Cancer in Populations Living Near Nuclear Facilities," to look at cancer mortality rates around 52 nuclear power plants, 9 U.S. Department of Energy facilities, and 1 former commercial fuel-reprocessing facility. The NCI study concluded from the evidence available that there is no suggestion that nuclear facilities may be linked causally with excess deaths from leukemia or from other cancers in populations living nearby. Additionally, the American Cancer Society has concluded that although reports about cancer case clusters in such communities have raised public concern, studies show that clusters do not occur more often near nuclear plants than they do by chance elsewhere in the population.

Strontium-90 (Sr-90) is produced in roughly 5.8% of nuclear fissions in a reactor's fuel elements and undergoes radioactive decay with a half-life of almost 29 years. Sr-90, and its radioactive decay product yttrium-90 (Y-90), are not harmful unless they are near or inside the body. They are easily shielded if outside the body, resulting in no radiation exposure. The statement is made in one of the comments that the government does not require environmental measurements of Sr-90. On the contrary, NRC licensees perform environmental monitoring for radionuclides in the vicinity of each nuclear reactor. Based on the results of their environmental monitoring program, no elevated levels of radionuclides in the environment attributed to plant operation have been detected. Compared to other radionuclides, both natural and human-made, Sr-90 is not one of the more toxic. For example, naturally occurring thorium-230 is 700 times more radiotoxic for inhalation.

The issue of radioactive effluents and their impacts on human health are assessed in Sections 4.9 and 5.9 of this EIS.

Comment: A particular concern is the potentially pathogenic amoeba, Naegleria fowleri that resides in Clinton Lake. And actually the fact that it does reside in Clinton Lake has been documented in a study published in a scientific journal applied in environmental microbiology. When exposed to warm water this amoeba can become pathogenic and can cause a deadly type of encephalitis in humans. Will the construction of the additional nuclear power plant increase the likelihood of the presence of the deadly form of this amoeba in Clinton Lake? And finally, what affects will this have on the people swimming and skiing in the lake? (EGCESP-S-36-3),

Response: *The NRC assessed human health impacts of the proposed action and presents the results in Section 5.8.1 of this EIS.*

Comment: The Federal Government no longer collects information on how much radioactivity is entering our bones. Yet this information is crucial for determining whether nuclear power plants and weapons facilities are affecting our health and contributing to America's cancer epidemic (EGCESP-S-09-8).

Response: *Measurements of radioactive substances in the body would be misleading and unwarranted. Radioactive substances come from a variety of sources. Interpreting measurements of radioactive materials in people is difficult unless one knows what each individual was exposed to, when the exposure occurred, and by what routes they occurred (ingestion, inhalation, etc.). Also, mitigation must be accounted for, because people may have lived and acquired radionuclides elsewhere than near a nuclear power plant. Finally, substances in the human body are dynamic, not static. This includes radioactive and nonradioactive substances. The dynamic processes include intake of material; uptake to systemic circulation from the gastrointestinal tract, respiratory tract, or skin; translocation throughout the body system; retention over time; and elimination via excretion and radioactive decay.*

Nevertheless, the NRC requires the licensee to perform environmental monitoring for radionuclides in the vicinity of each nuclear reactor to ensure that regulatory limits set to protect workers and public health are maintained. The limits, including effluent release limits, are based on recommendations of standards-setting organizations. Radiation standards reflect extensive ongoing study by national and international organizations (e.g., the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, and the National Academy of Sciences) and are conservative to ensure that the public and workers at nuclear power plants are protected. The issue of radioactive effluents and their impact to human health are assessed in Sections 4.9 and 5.9 of this EIS.

Comment: NRC is acting and talking like it's already decided this plant will go through. For real discussion, experts need to present the grave dangers with equal time. Or even more time, since the health of everyone in downstate Illinois is at risk from nuclear plants (EGCESP-S-54-2).

Response: *The decision to issue an ESP has not been made at this time. This EIS has been prepared in accordance with the requirements of 10 CFR 52.18 and 10 CFR Part 51. The evaluation of impacts to human health is discussed in Sections 4.8, 4.9, 5.8, and 5.9 of this EIS.*

D.1.10 Comments Concerning the Uranium Fuel Cycle and Waste Management Issues

Comment: And I'm here because I'm very, very concerned about radioactive nuclear waste from Clinton Power Plant 1 and proposed Clinton Power Plant 2 (EGCESP-S-14-1).

Comment: The fact is that nuclear energy, whether it's unleashed through nuclear bombs or small deadly munitions or a nuclear power plant, all leads to the same end product, which is radioactive nuclear waste. We humans who have made the terrible mistake of creating this waste have absolutely no clue what to do with it now that it exists. No clue where to store it, how to transport it nor how to store it in ways that will keep it for the tens of thousands to millions of years that this radioactivity will remain extraordinary lethal. And who will keep it safe? Who will keep it safe? The radioactivity of the radioactive waste that already exist will need to be cared for far longer than human civilization has even existed. In a nuclear plant, every day routine operation radioactivity is released into our air, water and soil (EGCESP-S-14-3).

Comment: If you had a large medical center with a thousand laboratories using radioactive materials, you would have a combined inventory of about two curies of radiation, I understand from my sources, and in contrast operating a nuclear power reactor will have about 16 billion queries [curies] in its reactor core. This is the equivalent of a long lived radioactivity of at least 1,000 Hiroshima bombs, 1,000 Hiroshima bombs in the size of a reactor like Clinton. Just one pound of plutonium, which is the most toxic known element and remains deadly for 250,000 years. If it was evenly distributed and ingested will kill everybody on the planet, one pound. And yet a thousand megawatt power plant the size of Clinton 1 produces nearly 180 metric tons of radioactivity waste per year, high level radioactive waste. Is all of this waste plutonium? No, it's not. But do we need more high level radioactive waste of any kind? No (EGCESP-S-14-5).

Comment: What is happening to the spent fuel rods and other radioactive waste in Clinton Reactor 1, let alone for Clinton Reactor 2? How full is the storage? How safe is the storage? What's going to happen when the storage here is filled? What's going to happen about transporting it? How and when and where will it be transported? Where will it be kept? Who on earth would want this waste near them or transported through them? And what if there is no safe place? We do not know how to keep this safe for 250,000 years or millions of years (EGCESP-S-14-6).

Comment: There's a discussion about Yucca Mountain being a site. If it is ever approved, it would not open until 2010. And so waste wouldn't even start flowing until then. And in addition, Yucca Mountain doesn't even have enough capacity to hold all the waste that is being produced by plants that are currently operating, much less new plants (EGCESP-S-01-4).

Comment: Neither the industry nor the government knows exactly what to do with nuclear waste. A national waste repository in Yucca Mountain, NV is likely to be held up in court for many years - the state of Nevada does not want the site. Native people are being forced to take some of the waste, again(st) the wishes of the people who live there (EGCESP-S-09-24).

Comment: Nuclear energy is not safe for our environment or to our public health. It creates waste that we currently do not know how to dispose of. Yucca Mountain is definitely not a safe option, the science tells us that, and the transportation to such a location would endanger all the American people that live near the transportation routes. Not to mention the devastating effects that an accident could have on our food supply - as most of the routes to Yucca through the Great Plains are surrounded by farms. Even besides all this, if Yucca was approved, all the space in it is accounted for already. There would be no room for more waste from Clinton, IL that's for sure (EGCESP-S-48-2).

Comment: We have to be careful about the legacy we are leaving to our children's children's children's children. A legacy of lethal radiation relieved [left] to them to tend (EGCESP-S-14-10).

Comment: That is just like the waste that it produces and that also has to be disposed of and put under ground away from man for the next 45,000 years (EGCESP-S-24-5).

Comment: It's also not clean. We know that it's not clean because we have the nuclear waste to deal with (EGCESP-S-25-4).

Comment: This waste that we have that we're developing, we can't comprehend the damage it will do and the way it will have to be stored (EGCESP-S-28-2).

Comment: Nuclear power is dirty. It creates waste that will be horribly dangerous to every single future generation to come (EGCESP-S-47-3).

Comment: High level wastes, some of which would be stored at the Clinton site, are very lethal when exposed directly to human beings. While they may be contained for many years at the site without direct deaths to humans, they cannot be stored there or any where without exposure directly to humans. No place, even the proposed Yucca Mountain area proposed for long-term storage, can be maintained for the thousands of years that some of the nuclear wastes will be lethal to humans. Further, just proximity to a nuclear reactor and wastes may indirectly raise the death rates of persons living nearby. The nuclear wastes at the second (or first) nuclear power plant cannot be made safe. They pose an environmental danger to the population living near the Clinton plant (EGCESP-S-49-2).

Comment: 5. All impacts arising from the additional accumulation of high-level nuclear waste generated and indefinitely stored on-site at Clinton nuclear power station as the result of the operation of additional nuclear power reactors. This discussion is required, given that the Waste Confidence Rule applies only to waste generated by "existing facility licenses." 55 Fed. Reg. 38,474 (September 18, 1990) (EGCESP-S-51-5).

Response: *The safety and environmental effects of long-term storage of spent fuel onsite have been assessed by the NRC, and, as set forth in the Waste Confidence Rule (10 CFR 51.23), the Commission generically determined that such storage could be accomplished without significant environmental impact. In the Waste Confidence Rule, the Commission determined that spent fuel can be stored onsite for at least 30 years beyond the licensed operating life, which may include the term of a renewed license. At or before the end of that period, the fuel would be removed to a permanent repository. In its Statement of Consideration for the 1990 update of the Waste Confidence Rule (55 FR 38472), the Commission addressed the impacts of both license renewal and potential new reactors. Therefore, the current rule can be used in the staff's review of an early site permit application. In its most recent review of the Waste Confidence Rule on December 6, 1999 (64 FR 68005), the Commission reaffirmed the findings in the rule. In addition to the conclusion regarding safe onsite storage of spent fuel, the Commission states in the rule that there is reasonable assurance that at least one geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity for the spent fuel will be available within 30 years beyond the licensed life for operation of any reactor. The NRC staff assessed the environmental impacts of nuclear waste and the results of this analysis are presented in Chapter 6 of this EIS.*

Comment: The production of nuclear waste kills babies, women, men, children. This is not just another left-wing plight. This is a matter of sanity (EGCESP-S-09-12).

Comment: On transportation issues related to spent fuel; as stated at the March 20th, 2003 Pre-Application Early Site Permit Public Meeting, Clinton 1 is already at 60 percent capacity for storage of spent fuel. The management there is considering asking for permission to rerack this spent fuel to allow for more storage space at the site. Assumptions are that a national depository will open in the near future and that this spent fuel will be transported to this site for final storage.

In order to transport this waste, it could be moved by rail and tracks leased to Canadian National. Those tracks not only go through the heart of the City of Clinton, the cars will also be traveling through many more Illinois communities before exiting the state on the way to Yucca

Mountain. You heard the railroad go by tonight. Should an incident occur on this route, the immediate community could suffer an extreme radiological event with long term radiation and an inevitable result. No matter what jobs could be generated by building and operating a second nuclear reactor at the Clinton site, it is highly unlikely that the benefits afforded to the people in portions of DeWitt County could counter act such an event. Economic impacts on the citizens of Illinois; much is made of the green benefits of nuclear power. However, in good conscience, we must look at long term generational impacts and cause of nuclear waste on the citizens of Illinois and of this nation. Since all we know is that Exelon wants to have permission to build a second nuclear plant on this site, we can therefore conclude that there will be waste associated with the plant. For reasons stated above, ISA believes this is not in the best of interest of the citizens of Illinois to have to assume the risk of such generation of high level nuclear waste entails (EGCESP-S-27-5).

Response: *The NRC staff assessed the environmental impacts of the uranium fuel cycle, including the impacts of fuel manufacturing, transportation, and the onsite storage and eventual disposal of spent fuel. Results of this analysis are presented in Chapter 6 of this EIS.*

D.1.11 Comments Concerning Postulated Accidents

Comment: Each reactor has the potential to have a catastrophic accident severe enough to destroy for thousands of years all land within 250 miles of the reactor. Industry observers admit that a core meltdown accident has a 50 percent probability of occurring in any decade (EGCESP-S-09-16).

Comment: Each reactor has potential to have a catastrophic accident severe enough to destroy for thousands of years all life within 250 miles and with a fifty percent possibility occurring in any decade, in every decade. This possibility is too high for me (EGCESP-S-14-8).

Comment: A worst case accident resulting in a breach in the containment building at any nuclear reactor here in the United States would be devastating not only to the people of our country but also to the global community as a bloom of deadly radioactive fall out would spread worldwide, just as it did in the Chernobyl tragedy. Clinton, Illinois specifically is not a suitable site for numerous reasons. One of them is its close proximity to Chicago. It is not a smart decision to build a new reactor up wind to a major population center. If the containment building were breached in an accident with winds blowing from the southwest to the northeast, Chicago would be contaminated and destroyed in what would be the worst tragedy in the United States history (EGCESP-S-26-2).

Comment: It doubles the risk of something happening. And there is no guarantee in life, as it has been said. But if there is no guarantee in life and there's always a risk that a catastrophic accident could happen, and that's going to affect us, that's going to affect everybody who lives here (EGCESP-S-33-2).

Response: *The environmental impacts of postulated accidents are discussed, and the results of this analysis are presented in Section 5.10 of this EIS.*

Comment: 7. All impacts on public health and safety arising out of a severe accident, including the impacts of the accident itself, sheltering, evacuation, radiation exposure treatment and reoccupation or relocation of entire communities in the event of an accident at an expanded Clinton site (EGCESP-S-51-7).

Response: *The SER prepared for the early site permit application assesses issues related to emergency planning (see 10 CFR 52.18), including consultation with the Department of Homeland Security/ Federal Emergency Management Agency (DHS/FEMA). In addition, the staff will document in an SER whether the site characteristics are such that adequate security plans and measures can be developed (see 10 CFR 100.21). The environmental impacts of postulated accidents are assessed, and the results of this analysis are presented in Section 5.10 of this EIS.*

Comment: 8. All impacts arising from the simultaneous operation of the existing and aging Clinton power reactor in close proximity to any new proposed advanced reactor design, including the possibility of multiple, simultaneous accidents, whether related (e.g., by fire or natural disaster) or unrelated (EGCESP-S-51-8).

Response: *Existing requirements provide assurance that the probability of simultaneous accidents at multiple units would be substantially less (e.g., over an order of magnitude) than the probability of accidents involving a single unit. For example, 10 CFR Part 50, General Design Criterion 5, "Sharing of structures, systems, and components," requires that structures, systems, and components important to safety not be shared unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units. Also, a plant- and site-specific probabilistic risk assessment (PRA) will be required prior to operation of any future plant pursuant to 10 CFR 50.34(f)(1)(i). This PRA will determine whether the risk from the as-built units will be low and will account for any inter-unit dependencies. In contrast, the consequences associated with an accident involving multiple units (e.g., a multi-unit core-melt accident) could reasonably be expected to be only marginally greater than with a single-unit event. For example, given the same accident release characteristics for both units, the total releases from two reactor cores (and the associated accident consequences) would, as a first-order-of-magnitude approximation, be about twice that for a single unit. The substantially lower frequency of a multiple-unit accident would more than offset the potentially greater consequences of the multiple-unit accident. Thus, the risk* *associated with multiple, simultaneous accidents would be a negligible contributor to the overall risk from all units on the site. Accordingly, the staff does not plan to address multi-unit accidents as part of the ESP review.*

D.1.12 Comments Concerning Alternatives and Alternative Sites

Comment: Second issue I wanted to address is alternatives. We believe that the NRC is legally required to objectively evaluate alternative sources of energy, especially removable [renewable] energy sources and energy conservation (EGCESP-S-01-6).

Comment: And, in fact, the National Environmental Policy Act specifically requires a consideration of all alternatives, which includes alternative energy sources. Exelon's application relies on 20 year old data to basically dismiss clean energy alternatives as, you know, unreliable and not realistic. But, in fact, renewable energy sources and energy efficiency present a lower cost, safer and environmentally cleaner approach to meeting Illinois' energy needs than nuclear power would. For example, federal studies show that wind power can supply up to 20 percent of the U.S.'s energy needs and energy efficiency efforts can reduce energy demand by 33 percent by 2020. Of course, jobs and economic develop(ment) are at issue, obviously. It's very important to the community. But clean energy alternatives and energy efficiency provides significant job opportunities. For example, wind turbines are considered the cash crop of the 21st Century because they very easily fit in a farm where a farmer can get extra cash from the energy produced by wind turbines. In addition, the opportunities for economic development and energy efficiency technology are great. And we're currently falling behind other countries that invest in that. Therefore, we believe that the NRC should give fair consideration to alternative ways of meeting whatever power to be produced by this proposed second unit (EGCESP-S-01-8).

Comment: Conservation and economical alternative energy sources will one day make nuclear power obsolete. U.S. energy intensity is down 40% from doomsday government and industry projections announced in the 1980's (EGCESP-S-09-15).

Comment: And then I invite you to act with me in every way possible to decrease energy consumption, to develop renewable and safe clean energy and that will allow Clinton 1 and every other plant to be shut down forever (EGCESP-S-14-11).

Comment: This is also the same company that has repeatedly blocked in the last year attempts on the part of the Illinois Legislature to institute renewable energy portfolio standards, which would institute and guarantee that wind power, solar power would be explored, used, power that if you do the research you'll find can be cheaper than nuclear power (EGCESP-S-25-2).

Comment: We don't need the power from nuclear power. We can get it from wind and other renewable energy sources (EGCESP-S-25-7).

Comment: We encourage Exelon to look toward more renewable energy sources (EGCESP-S-27-8).

Comment: And I challenge the Chamber of Commerce, I challenge the DeWitt County Board, I challenge you to bring in industry into this county that is alternative energy, that is healthy industry that will not affect our future children (EGCESP-S-28-5).

Comment: The NRC also sets out in the guidelines for this meeting that it is interested in those facts that demonstrate their obviously superior alternative energy sources for this region. Based on reports and articles in the Environmental Law and Policy Center, the Nuclear Energy Institute's 20th anniversary conference wind, solar, biomass of geothermal energy approaches are far more cost effective than anything nuclear power has to offer. And these alternative energy approaches also would offer an incredible number of jobs for citizens in the region far more quickly than the proposed Clinton Reactor No. 2 can offer and should be seriously considered by those running this meeting that these alternative energy approaches do not produce the intensely hazardous radioactive waste products that nuclear reactors produce every day (EGCESP-S-34-13).

Comment: But large scale generation of electricity does not lend itself to solar generation, to windmills. They all are contributors. So I would suggest to you, from my perspective and having worked in energy policy for quite some time, it's not a question of which. It's a question of all.

I don't think we have the luxury with the population growth, with the demand growth that we see in the future to dismiss out of hand any source. We need everything we can get. They all have their risk, they all have their benefits (EGCESP-S-37-7).

Comment: Instead of a second nuclear reactor at this site which would release radioactive material into the environment, The Environmental Law and Policy Center has developed a plan called "Repowering the Midwest: the Clean Energy Development Plan for the Heartland." Please consider this plan instead of a second nuclear reactor at the Clinton site (EGCESP-S-39-2).

Comment: Without question there are reasonable alternatives even though pursuing them may require conservation, putting up with energy shortages at least in the short-run, and investing in the development of alternative sources of energy (EGCESP-S-40-3).

Comment: The Environmental Law and Policy Center has developed a plan called "Repowering the Midwest: The Clean Energy Development Plan for the Heartland." That plan reduces our use of nuclear power while creating more jobs and making/saving more money than building more nuclear reactors would. Ask the NRC to seriously consider that plan (EGCESP-S-41-7).

Comment: While consideration of whether there is a need for the power from construction and operation of a new Clinton 2 nuclear plant is barred by the NRC, id., the consideration of alternative means of meeting a need for that power is not foreclosed. In fact, the NRC is required to develop and explore, pursuant to Section 102(2)(E) of NEPA, "appropriate alternatives to recommended courses of action in any proposal, which involves unresolved conflicts concerning alternative uses of available resources" 10 CFR 51.45. Energy efficiency and renewable energy resources clearly qualify as "appropriate alternatives" to the siting of the proposed new Clinton 2 nuclear plant and must be rigorously explored and objectively evaluated as part of the EIS. Although Exelon included a discussion of renewable energy resources and energy efficiency in Section 9.2 of its Environmental Report, Exelon nonetheless improperly relied on outdated information to conclude that such alternatives are not feasible. Exelon's discussion relies heavily on the NRC's 1996 Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437, which, in turn, is based on data from the early 1990s regarding the viability of wind power, solar power, and energy efficiency. Technological improvements and market developments since the early 1990s, however, have greatly increased the efficiency and capacity of these alternatives, while at the same time reducing their costs and environmental impacts. The NRC's analysis of renewable energy resource and energy efficiency alternatives must reflect current knowledge and information regarding the economic and technological feasibility of these alternatives, as well as the comparative environmental impacts (EGCESP-S-42-2).

Comment: I urge you to consider the plan put forth by the Environmental Law and Policy Center, 'Repowering the Midwest: the Clean Energy Development Plan for the Heartland.' It outlines ways to reduce our use of nuclear power without sacrificing jobs (EGCESP-S-46-1).

Comment: We need to start using safe energy alternatives such as wind and solar power not dangerous nuclear power (EGCESP-S-48-3).

Comment: Instead put money, time, and investigation into constructing clean energy sources that can create a safe environment, permanent safe jobs, revenue for communities, and save government and tax payer money (EGCESP-S-50-5)

Comment: 1. Whether effects on the environment would be reduced if Exelon alternatively implemented more applications of energy efficiency technologies and energy conservation rather than the development of additional nuclear power capacity at the Clinton site. The Renewable Energy Policy Project has demonstrated that innovative and well-managed efficiency programs would reduce annual increases in electric growth by 61%, substantially reducing demand over a twenty-year period (EGCESP-S-51-12).

Comment: 2. Whether effects on the environment would be reduced if Exelon alternatively implemented use of passive solar, photovoltaic, wind turbines and hybrid renewable energy systems rather than the development of additional nuclear power capacity at the Clinton site (EGCESP-S-51-13).

Comment: 3. Whether effects on the environment would be reduced if Exelon alternatively implemented greater use of natural gas energy rather than the development of additional nuclear power capacity at the Clinton site (EGCESP-S-51-14).

Comment: 4. Whether effects on the environment would be reduced if Exelon alternatively implemented broader applications of the above mentioned resources as distributed power systems rather than increased reliance on an increasingly vulnerable electrical grid system connecting any additional new power capacity at the Clinton site (EGCESP-S-51-15).

Response: *The staff prepared this EIS in accordance with the requirements of 10 CFR 52.18 and 10 CFR 51. As discussed in proposed changes to Part 52 published in the Federal Register on July 3, 2003 (68 FR 40025), consideration of alternative energy sources need not be included in the applicant's ER. In the case of the Exelon application, Exelon did choose to include a consideration of alternative energy sources, and, therefore, the staff assessed energy conservation using current available data. Results of the staff's analysis are discussed in Chapters 8 and 9 of this EIS.*

Appendix E

Draft Environmental Impact Statement Comments and Responses

Appendix E

Draft Environmental Impact Statement Comments and Responses

This appendix is intentionally left blank. The final Environmental Impact Statement (EIS) will contain the comments on and responses to the draft EIS in this appendix.

Appendix F

Exelon Generation Company, LLC's (Exelon's) Key Early Site Permit Consultation Correspondence

Appendix F

Exelon Generation Company, LLC's (Exelon's) Key Early Site Permit Consultation Correspondence

Correspondence received during the evaluation process of the early site permit application for the Exelon site is identified in Table F-1. Copies of the correspondence are included at the end of this appendix.

Source	Recipient	Date of Letter
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Advisory Council on Historic Preservation (Don Klima)	December 18, 2003
Delaware Nation (Phyllis Wahahrockah)	United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	December 22, 2003
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Illinois Historic Preservation Agency (Maynard Crossland)	December 23, 2003
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Kickapoo of Oklahoma Business Committee (Honorable Kendall Scott)	December 30, 2003
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Kickapoo Traditional Tribe of Texas (Honrable Raul Garza, Jr.	December 30, 2003
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Kickapoo of Kansas Tribal Council (Honorable Carol Anske)	December 30, 2003
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Delaware Tribe of Western Oklahoma (Honorable Lawrence F. Snake)	December 30, 2003
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Peoria Tribe of Indians of Oklahoma (Honorable John P. Froman)	December 30, 2003

Source	Recipient	Date of Letter
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Eastern Delaware Tribe (Honorable Dee Ketchum)	December 30, 2003
Peoria Tribe of Indians of Oklahoma (Honorable John P. Froman	United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	January 13, 2004
Delaware Tribe of Indians of Oklahoma (Brice Obermeyer)	United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	January 13, 2004
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	National Oceanic and Atmosphere Administration Fisheries (Patricia Kurkul)	March 17, 2004
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Chicago Ecological Field Service Office, United States Fish and Wildlife Service (John Rogner)	March 17, 2004
United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	Rock Island Ecological Field Service Office, United States Fish and Wildlife Service (Richard Nelson)	March 17, 2004
Rock Island Ecological Field Service Office, United States Fish and Wildlife Service (Richard Nelson)	United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	April 6, 2004
Chicago Ecological Field Service Office, United States Fish and Wildlife Service (John Rogner)	United States Nuclear Regulatory Commission (Pao-Tsin Kuo)	April 12, 2004

1

December 18, 2003

Mr. Don Klima, Director
Office of Federal Agency Programs
Advisory Council on Historic Preservation
Old Post Office Building
1100 Pennsylvania Avenue, NW, Suite 809
Washington, DC 20004

SUBJECT: EARLY SITE PERMIT REVIEW FOR THE CLINTON SITE

Dear Mr. Klima:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an early site permit (ESP) submitted by Exelon Generation Company, LLC (Exelon) on September 25, 2003. An ESP allows an applicant to set aside a site for potential future construction of one or more new nuclear power plants, and provides the opportunity to resolve site safety and environmental issues before construction begins. An ESP does not allow actual construction of a nuclear plant, which must be requested through another application. The ESP site proposed by Exelon is on property co-located with the existing Clinton Power Station site near the town of Clinton in DeWitt County, Illinois. The application was submitted by Exelon pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52).

Exelon has also included a site redress plan in its application in accordance with 10 CFR 52.17(c) and 52.25. If a site redress plan is included in an ESP approved by the NRC, the applicant may carry out certain site preparation and limited construction activities. Exelon would still be required to obtain the appropriate local, State, and other Federal permits required for these activities prior to starting work.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) pursuant to 10 CFR Part 51, the NRC regulations that implement the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic and cultural resources. A draft EIS is scheduled for publication in December 2004, and will be provided to you for review and comment.

If you have any questions or require additional information, please contact the Environmental Project Manager for the Clinton ESP project, Mr. Thomas Kenyon at 301-415-1120 or TJK2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

Delaware Nation NAGPRA Office

P.O. Box 825, Anadarko, OK 73005
Phone: (405) 247-2448
Fax: (405) 247-9898

11/25/03
68FR46130
(7)
03 DEC 29 PM 1:44
RULES AND DIRECTIVES BRANCH

22 December 2003

ATTN: Chief, Rules and Directive Branch
Division of Administration Services
Office of Administration
Mailstop T-6 D59
U.S. Nuclear Regulatory Commission
Washington, DC 20555-001

Re: Proposed project- Early Site Permit Application at Clinton, Illinois Site

To Whom It May Concern:

Thank you for contacting the Delaware Nation regarding the above referenced project. The Delaware Nation is committed to protecting archaeological sites that are important to tribal heritage, culture, and religion. Furthermore, the tribe is particularly concerned with archaeological sites that may contain human burial remains and associated funerary objects.

Given the location of the proposed project, we request that you conduct a file search in conjunction with the State Office of Historic Preservation and the state's Archaeological Survey. These state agencies will advise you of the potential for archaeological resources, particularly sites of significant cultural interest or sites that contain human remains. Should either of these agencies determine that there are potentially significant archaeological sites in the area and that these sites are related to the tribe's heritage, the Delaware Nation requests that you contact our offices. Together with the SHPO and State Archaeologist, we will develop a plan to best protect these archaeological resources.

Should either of these agencies recommend an archaeological survey or test excavation of the proposed construction site, we ask that the Delaware Nation be informed of the results of the survey. The Delaware Nation also requests copies of any accompanying site forms or reports.

Also, any changes to the above referenced project should be resubmitted to the NAGPRA Director of the Delaware Nation for review.

Should this project inadvertently uncover an archaeological site and/or human remains, even after an archaeological survey, we request that you immediately contact the appropriate state agencies, as well as the Delaware Nation. Also, we ask that you halt all construction activities until the tribe and these state agencies are consulted.

We appreciate your cooperation in contacting the Delaware Nation. Should you have any questions, feel free to contact me.

Sincerely,

Phyllis Wahahrockah-Tasi M.H.R.
NAGPRA Director

E-RIDS=ADM-03
Add=T. Kenyon (TJK2)

Template=ADM-013

December 23, 2003

Mr. Maynard Crossland
Director
Illinois Historic Preservation Agency
Preservation Services Division
One Old State Capitol Plaza
Springfield, IL 62701

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE CLINTON ESP SITE

Dear Mr. Crossland:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The NRC staff is currently seeking information from consulting parties, and other individuals and organizations likely to have knowledge of, or concerns with, historic properties in the area, to identify issues relating to the proposed undertaking's potential effects on historic properties.

If built, the new unit(s) would be co-located with the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois. The application for an ESP was submitted by Exelon Generation Company, LLC (Exelon), on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032721596.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties, and will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants.

If approved, the ESP would not authorize the applicant to begin construction of the unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including alternative sites.

M. Crossland 2

Exelon has also included a site redress plan in its application in accordance with 10 CFR 52.17(c) and 52.25. If a site redress plan is incorporated in an ESP approved by the NRC, the applicant may carry out certain site preparation and limited construction activities. Exelon would still be required to obtain the appropriate local, State, and other Federal permits required for these activities prior to starting work.

In the context of the National Historic Preservation Act of 1966, as amended, the NRC staff has determined that the area of potential effect (APE) for this ESP review is the area at the power plant site and its immediate environs which may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of new transmission lines that may follow parallel with some of the existing transmission line systems now serving CPS. The new lines would run from the Clinton ESP site to an interconnect point at the Brokaw substation near Bloomington, Illinois, about 23 miles north of the site; and from the Clinton ESP site to the Oreana substation, about 8 miles south of the site. The power plant site is located in DeWitt county, Illinois, and the transmission line corridors traverse DeWitt and McLean counties.

In its application, Exelon refers to a comprehensive cultural resource and historic property investigation that was performed prior to the construction of CPS, approximately 30 years ago. Exelon further states that any issues that were raised were resolved through removal of these historic and cultural resources. No historic standing structures have been identified within the Exelon ESP power block footprint, cooling tower footprint, or within the immediate vicinity of CPS. Exelon states that the location of the ESP facility power block footprint appears to have been heavily disturbed by previous construction of CPS. If the power block or cooling tower footprint area was expanded or moved, there is a potential for impact to historic properties. The applicant has committed to perform further evaluation to determine if additional archaeological review is required if additional area within the ESP site will be required for development.

We invite you and your staff to participate in the review of the Clinton ESP application. We will also be contacting any Native American Tribes that may have a potential interest in the proposed undertaking, affording them the opportunity to participate in this process and identify issues of concern to them. These tribes are being identified by records research with the Bureau of Indian Affairs, State and local governments, tribal organizations, and through other historical documentation.

On December 18, 2003, the NRC will conduct a public environmental scoping meeting at the Revere Ware Room in the Vespasian Warner Public Library, 310 N. Quincy Street, Clinton, Illinois. You and your staff are invited to attend. Your office will receive a copy of the draft EIS along with a request for comments after it is issued. This draft EIS will include identification of historic properties, assessment of impacts, and our preliminary determination. The anticipated publication date for the draft EIS is December 2004.

M. Crossland 3

If you have any questions or require additional information, please contact the Environmental Project Manager for the Clinton ESP project, Mr. Thomas Kenyon at 301-415-1120 or TJK2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

December 30, 2003

The Honorable Kendall Scott, Chair
Kickapoo of Oklahoma Business Committee
Post Office Box 70
McCloud, OK 74851

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE CLINTON ESP SITE

Dear Chairman Scott:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by Exelon Generation Company, LLC (Exelon), on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois. Exelon has also included a site redress plan in its application in accordance with 10 CFR 52.17(c) and 52.25. If a site redress plan is incorporated in an ESP approved by the NRC, the applicant may carry out certain site preparation and limited construction activities. Exelon would still be required to obtain the appropriate local, State, and other Federal permits required for these activities before starting work.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Clinton ESP site is located on land that may be of interest to the Kickapoo of Oklahoma Business Committee. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Kickapoo of Oklahoma Business Committee to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Clinton ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c)(2), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to

The Honorable K. Scott -2-

identify their concerns, provide advice on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of new transmission lines that may follow parallel with some of the existing transmission line systems now serving CPS. The new lines would run from the Clinton ESP site to an interconnect point at the Brokaw substation near Bloomington, Illinois, about 23 miles north of the site; and from the Clinton ESP site to the Oreana substation, about 8 miles south of the site. The power plant site is located in DeWitt County, Illinois, and the transmission line corridors traverse DeWitt and McLean counties. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032721596.

In its application, Exelon refers to a comprehensive cultural resource and historic property investigation that was performed prior to the construction of CPS, approximately 30 years ago. Exelon further states that any issues that were raised were resolved through removal of these historic and cultural resources. No historic standing structures have been identified within the Exelon ESP power block footprint, cooling tower footprint, or within the immediate vicinity of CPS. Exelon states that the location of the ESP facility power block footprint appears to have been heavily disturbed by previous construction of CPS. If the power block or cooling tower footprint area was expanded or moved, there is a potential for impact to historic properties. The applicant has committed to perform further evaluation to determine if additional archaeological review is required if additional area within the ESP site will be required for development.

As discussed with Mr. Collier of your staff on December 12, 2003, the NRC conducted a public environmental scoping meeting on December 18, 2003 at the Revere Ware Room in the Vespasian Warner Public Library, 310 N. Quincy Street, Clinton, Illinois. Representatives of your tribe were invited to attend.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by January 9, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by Internet to ClintonEIS@nrc.gov.

The Honorable K. Scott -3-

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is December 2004. If you have any questions or require additional information, please contact the Environmental Project Manager for the Clinton ESP project, Mr. Thomas Kenyon, at 301-415-1120 or *ClintonEIS@nrc.gov*.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

December 30, 2003

The Honorable Raul Garza Jr., Chair
Kickapoo Traditional Tribe of Texas
HC 1, Post office Box 9700
Eagle Pass, TX 78853
Miami, OK 74355

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE CLINTON ESP SITE

Dear Chairman Garza:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by Exelon Generation Company, LLC (Exelon), on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois. Exelon has also included a site redress plan in its application in accordance with 10 CFR 52.17(c) and 52.25. If a site redress plan is incorporated in an ESP approved by the NRC, the applicant may carry out certain site preparation and limited construction activities. Exelon would still be required to obtain the appropriate local, State, and other Federal permits required for these activities before starting work.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Clinton ESP site is located on land that may be of interest to the Kickapoo Traditional Tribe of Texas. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Kickapoo Traditional Tribe of Texas to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Clinton ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c)(2), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to

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The Honorable R. Garza Jr. -2-

identify their concerns, provide advice on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of new transmission lines that may follow parallel with some of the existing transmission line systems now serving CPS. The new lines would run from the Clinton ESP site to an interconnect point at the Brokaw substation near Bloomington, Illinois, about 23 miles north of the site; and from the Clinton ESP site to the Oreana substation, about 8 miles south of the site. The power plant site is located in DeWitt County, Illinois, and the transmission line corridors traverse DeWitt and McLean counties. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032721596.

In its application, Exelon refers to a comprehensive cultural resource and historic property investigation that was performed prior to the construction of CPS, approximately 30 years ago. Exelon further states that any issues that were raised were resolved through removal of these historic and cultural resources. No historic standing structures have been identified within the Exelon ESP power block footprint, cooling tower footprint, or within the immediate vicinity of CPS. Exelon states that the location of the ESP facility power block footprint appears to have been heavily disturbed by previous construction of CPS. If the power block or cooling tower footprint area was expanded or moved, there is a potential for impact to historic properties. The applicant has committed to perform further evaluation to determine if additional archaeological review is required if additional area within the ESP site will be required for development.

As discussed with Ms. M. Salazar of your staff on December 5, 2003, the NRC conducted a public environmental scoping meeting on December 18, 2003 at the Revere Ware Room in the Vespasian Warner Public Library, 310 N. Quincy Street, Clinton, Illinois. Representatives of your tribe were invited to attend.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by January 9, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by Internet to *ClintonEIS@nrc.gov*.

The Honorable R. Garza Jr. -3-

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is December 2004. If you have any questions or require additional information, please contact the Environmental Project Manager for the Clinton ESP project, Mr. Thomas Kenyon, at 301-415-1120 or *ClintonEIS@nrc.gov*.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

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December 30, 2003

The Honorable Carol Anske, Chair
Kickapoo of Kansas Tribal Council
Route 1, Box 157
Horton, KS 66439

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE CLINTON ESP SITE

Dear Chairwoman Anske:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by Exelon Generation Company, LLC (Exelon), on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois. Exelon has also included a site redress plan in its application in accordance with 10 CFR 52.17(c) and 52.25. If a site redress plan is incorporated in an ESP approved by the NRC, the applicant may carry out certain site preparation and limited construction activities. Exelon would still be required to obtain the appropriate local, State, and other Federal permits required for these activities before starting work.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Clinton ESP site is located on land that may be of interest to the Kickapoo of Kansas Tribal Council. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Kickapoo of Kansas Tribal Council to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Clinton ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c)(2), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to

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The Honorable C. Anske -2-

identify their concerns, provide advice on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of new transmission lines that may follow parallel with some of the existing transmission line systems now serving CPS. The new lines would run from the Clinton ESP site to an interconnect point at the Brokaw substation near Bloomington, Illinois, about 23 miles north of the site; and from the Clinton ESP site to the Oreana substation, about 8 miles south of the site. The power plant site is located in DeWitt County, Illinois, and the transmission line corridors traverse DeWitt and McLean counties. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032721596.

In its application, Exelon refers to a comprehensive cultural resource and historic property investigation that was performed prior to the construction of CPS, approximately 30 years ago. Exelon further states that any issues that were raised were resolved through removal of these historic and cultural resources. No historic standing structures have been identified within the Exelon ESP power block footprint, cooling tower footprint, or within the immediate vicinity of CPS. Exelon states that the location of the ESP facility power block footprint appears to have been heavily disturbed by previous construction of CPS. If the power block or cooling tower footprint area was expanded or moved, there is a potential for impact to historic properties. The applicant has committed to perform further evaluation to determine if additional archaeological review is required if additional area within the ESP site will be required for development.

As communicated to Mr. Curtis Simon of your staff by voice mail on December 10, 2003, the NRC conducted a public environmental scoping meeting on December 18, 2003 at the Revere Ware Room in the Vespasian Warner Public Library, 310 N. Quincy Street, Clinton, Illinois. Representatives of your tribe were invited to attend.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by January 9, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by Internet to *ClintonEIS@nrc.gov*.

The Honorable C. Anske -3-

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is December 2004. If you have any questions or require additional information, please contact the Environmental Project Manager for the Clinton ESP project, Mr. Thomas Kenyon, at 301-415-1120 or *ClintonEIS@nrc.gov*.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

1

December 30, 2003

The Honorable Lawrence F. Snake, President
Delaware Tribe of Western Oklahoma
Post Office Box 825
Anadardo, OK 73005

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE CLINTON ESP SITE

Dear President Snake:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by Exelon Generation Company, LLC (Exelon), on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois. Exelon has also included a site redress plan in its application in accordance with 10 CFR 52.17(c) and 52.25. If a site redress plan is incorporated in an ESP approved by the NRC, the applicant may carry out certain site preparation and limited construction activities. Exelon would still be required to obtain the appropriate local, State, and other Federal permits required for these activities before starting work.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Clinton ESP site is located on land that may be of interest to the Delaware Tribe of Western Oklahoma. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Delaware Tribe of Western Oklahoma to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Clinton ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c)(2), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to identify their concerns, provide advice on the identification and evaluation of historic properties,

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The Honorable L. Snake -2-

including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of new transmission lines that may follow parallel with some of the existing transmission line systems now serving CPS. The new lines would run from the Clinton ESP site to an interconnect point at the Brokaw substation near Bloomington, Illinois, about 23 miles north of the site; and from the Clinton ESP site to the Oreana substation, about 8 miles south of the site. The power plant site is located in DeWitt County, Illinois, and the transmission line corridors traverse DeWitt and McLean counties. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032721596.

In its application, Exelon refers to a comprehensive cultural resource and historic property investigation that was performed prior to the construction of CPS, approximately 30 years ago. Exelon further states that any issues that were raised were resolved through removal of these historic and cultural resources. No historic standing structures have been identified within the Exelon ESP power block footprint, cooling tower footprint, or within the immediate vicinity of CPS. Exelon states that the location of the ESP facility power block footprint appears to have been heavily disturbed by previous construction of CPS. If the power block or cooling tower footprint area was expanded or moved, there is a potential for impact to historic properties. The applicant has committed to perform further evaluation to determine if additional archaeological review is required if additional area within the ESP site will be required for development.

As discussed with Ms. P. Wahahrockahtasi of your staff on December 5, 2003, the NRC conducted a public environmental scoping meeting on December 18, 2003 at the Revere Ware Room in the Vespasian Warner Public Library, 310 N. Quincy Street, Clinton, Illinois. Representatives of your tribe were invited to attend.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by January 9, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by Internet to *ClintonEIS@nrc.gov*.

The Honorable L. Snake -3-

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is December 2004. If you have any questions or require additional information, please contact the Environmental Project Manager for the Clinton ESP project, Mr. Thomas Kenyon, at 301-415-1120 or *ClintonEIS@nrc.gov.*

Sincerely,
/RA?
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

December 30, 2003

The Honorable John P. Froman, Chief
The Peoria Tribe of Indians of Oklahoma
118 S. Eight Tribes Trail
P.O. Box 1527
Miami, OK 74355

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE CLINTON ESP SITE

Dear Chief Froman:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by Exelon Generation Company, LLC (Exelon), on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois. Exelon has also included a site redress plan in its application in accordance with 10 CFR 52.17(c) and 52.25. If a site redress plan is incorporated in an ESP approved by the NRC, the applicant may carry out certain site preparation and limited construction activities. Exelon would still be required to obtain the appropriate local, State, and other Federal permits required for these activities before starting work.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Clinton ESP site is located on land that may be of interest to the Peoria Tribe of Indians of Oklahoma. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Peoria Tribe of Indians of Oklahoma to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Clinton ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c)(2), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to

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The Honorable J. Froman -2-

identify their concerns, provide advice on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of new transmission lines that may follow parallel with some of the existing transmission line systems now serving CPS. The new lines would run from the Clinton ESP site to an interconnect point at the Brokaw substation near Bloomington, Illinois, about 23 miles north of the site; and from the Clinton ESP site to the Oreana substation, about 8 miles south of the site. The power plant site is located in DeWitt County, Illinois, and the transmission line corridors traverse DeWitt and McLean counties. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032721596.

In its application, Exelon refers to a comprehensive cultural resource and historic property investigation that was performed prior to the construction of CPS, approximately 30 years ago. Exelon further states that any issues that were raised were resolved through removal of these historic and cultural resources. No historic standing structures have been identified within the Exelon ESP power block footprint, cooling tower footprint, or within the immediate vicinity of CPS. Exelon states that the location of the ESP facility power block footprint appears to have been heavily disturbed by previous construction of CPS. If the power block or cooling tower footprint area was expanded or moved, there is a potential for impact to historic properties. The applicant has committed to perform further evaluation to determine if additional archaeological review is required if additional area within the ESP site will be required for development.

As Mr. Kenyon discussed with you on December 5, 2003, the NRC conducted a public environmental scoping meeting on December 18, 2003 at the Revere Ware Room in the Vespasian Warner Public Library, 310 N. Quincy Street, Clinton, Illinois. Representatives of your tribe were invited to attend.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by January 9, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by Internet to *ClintonEIS@nrc.gov*.

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The Honorable J. Froman -3-

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is December 2004. If you have any questions or require additional information, please contact the Environmental Project Manager for the Clinton ESP project, Mr. Thomas Kenyon, at 301-415-1120 or *ClintonEIS@nrc.gov.*

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

December 30, 2003

The Honorable Dee Ketchum, Chief
Eastern Delaware Tribe
220 Northwest Virginia
Bartlesville, OK 74003

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE CLINTON ESP SITE

Dear Chief Ketchum:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by Exelon Generation Company, LLC (Exelon), on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois. Exelon has also included a site redress plan in its application in accordance with 10 CFR 52.17(c) and 52.25. If a site redress plan is incorporated in an ESP approved by the NRC, the applicant may carry out certain site preparation and limited construction activities. Exelon would still be required to obtain the appropriate local, State, and other Federal permits required for these activities before starting work.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Clinton ESP site is located on land that may be of interest to the Eastern Delaware Tribe. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Eastern Delaware Tribe to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Clinton ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c)(2), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to identify their concerns, provide advice on the identification and evaluation of historic properties,

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The Honorable D. Ketchum -2-

including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of new transmission lines that may follow parallel with some of the existing transmission line systems now serving CPS. The new lines would run from the Clinton ESP site to an interconnect point at the Brokaw substation near Bloomington, Illinois, about 23 miles north of the site; and from the Clinton ESP site to the Oreana substation, about 8 miles south of the site. The power plant site is located in DeWitt County, Illinois, and the transmission line corridors traverse DeWitt and McLean counties. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032721596.

In its application, Exelon refers to a comprehensive cultural resource and historic property investigation that was performed prior to the construction of CPS, approximately 30 years ago. Exelon further states that any issues that were raised were resolved through removal of these historic and cultural resources. No historic standing structures have been identified within the Exelon ESP power block footprint, cooling tower footprint, or within the immediate vicinity of CPS. Exelon states that the location of the ESP facility power block footprint appears to have been heavily disturbed by previous construction of CPS. If the power block or cooling tower footprint area was expanded or moved, there is a potential for impact to historic properties. The applicant has committed to perform further evaluation to determine if additional archaeological review is required if additional area within the ESP site will be required for development.

As discussed with Mr. Obermeyer of your staff on December 11, 2003, the NRC conducted a public environmental scoping meeting on December 18, 2003 at the Revere Ware Room in the Vespasian Warner Public Library, 310 N. Quincy Street, Clinton, Illinois. Representatives of your tribe were invited to attend.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by January 9, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by Internet to *ClintonEIS@nrc.gov*.

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The Honorable D. Ketchum -3-

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is December 2004. If you have any questions or require additional information, please contact the Environmental Project Manager for the Clinton ESP project, Mr. Thomas Kenyon, at 301-415-1120 or *ClintonEIS@nrc.gov.*

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

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11/25/03
68FR66130
(20)

DELAWARE TRIBE OF INDIANS

220 N.W. VIRGINIA • BARTLESVILLE, OKLAHOMA 74003
TELEPHONE: (918) 336-5272 • FAX: (918) 336-5513

January 13, 2004

RECEIVED
2004 FEB -3 AM 3:30
Rules and Directives Branch

Chief
Attn: Rules and Directives Branch
Division of Administrative Services
Mail Stop T-6 D59
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Re: Early Site Permit (ESP) Review For the Clinton ESP Site

Dear Chief,

Our review indicates that this project is located in an area that was not inhabited by the Delaware Tribe. As such, there is little potential for impacting unknown archaeological sites culturally affiliated with the Delaware Tribe and we have no particular objection to the proposal.

If you have any questions, feel free to contact this office by phone at (918) 336-5272.

Sincerely,

Brice Obermeyer
NAGPRA Director
Delaware Tribe of Indians

E-RIDS = ADM-03
Add = T. Kenyon (TJK2)

Template = ADM-013

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March 17, 2004

Ms. Patricia A. Kurkul, Regional Administrator
NOAA Fisheries
Northeast Regional Office
One Blackburn Drive
Gloucester, MA 01930-2298

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT FOR THE CLINTON ESP SITE

Dear Ms. Kurkul:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application submitted by Exelon Generation Company, LLC (Exelon) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application the NRC is preparing an environmental impact statement (EIS). The impact analyses in the EIS will include the potential impacts of the construction and operation of one or more new nuclear power plants at the preferred site or at one of six alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

The preferred location of the new unit(s), if built, would be the existing Clinton Power Station (CPS) site on Lake Clinton near the town of Clinton in DeWitt County, Illinois, approximately 6 miles east of the City of Clinton along the shore of Clinton Lake. Exelon also has a list of six alternate sites that will be evaluated in the EIS. The six alternate sites are existing generating stations owned and operated by Exelon: Braidwood Nuclear Station, in Will County, Illinois (on Braidwood Lake); Zion Nuclear Power Station, in Lake County, Illinois (on the western shore of Lake Michigan); Byron Generating Station, in Ogle County, Illinois (on the Rock River); Dresden Nuclear Power Station, in Grundy County, Illinois (on the south shoreline of the Illinois River at the confluence of the Des Plaines and Kankakee Rivers); LaSalle County Generating Station, in LaSalle County, Illinois (on LaSalle Lake); and Quad Cities Nuclear Power Station, in Rock Island County, Illinois (on the east bank of Pool 14 of the Mississippi River).

The application for an ESP was submitted by Exelon on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the new unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including the above alternative sites.

P. Kurkul 2

To support the EIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act of 1973, the NRC requests a list of endangered, threatened, candidate, and proposed species, and designated and proposed critical habitat under the jurisdiction of NOAA Fisheries, that may be in the vicinity of the CPS site and its transmission line corridors (McLean and DeWitt counties only), and the six alternate sites listed above. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

If you have any questions concerning the ESP application or other aspects of this project, please contact Mr. Thomas Kenyon, Senior Environmental Senior Project Manager, at (301) 415-1120 or by e-mail at TJK2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

March 17, 2004

Mr. John Rogner, Field Supervisor
U.S. Fish and Wildlife Service
1250 S. Grove Avenue, Suite 103
Barrington, IL 60010

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT FOR THE CLINTON ESP SITE

Dear Mr. Rogner:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application submitted by Exelon Generation Company, LLC (Exelon) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application the NRC is preparing an environmental impact statement (EIS). The impact analysis in the EIS includes the potential impacts of the construction and operation of one or more new nuclear power plants at the preferred or at one of six alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

The preferred location of the new unit(s), if built, would be the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois, approximately 6 miles east of the City of Clinton along the shore of Clinton Lake. Two of the six alternate sites that will be evaluated in the EIS are located within the area serviced by your office. The two alternate sites are existing generating stations owned and operated by Exelon; Braidwood Nuclear Station, in Will County, Illinois and Zion Nuclear Power Station, in Lake County, Illinois. Please note that the NRC will submit separate correspondence to the Rock Island Ecological Field Services office regarding the other four alternate sites; Byron Generating Station, in Ogle County, Illinois; Dresden Nuclear Power Station, in Grundy County, Illinois; LaSalle County Generating Station, in LaSalle County, Illinois; and Quad Cities Nuclear Power Station, in Rock Island County, Illinois.

The application for an ESP was submitted by Exelon on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the new unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including the above alternative sites.

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J. Rogner 2

To support the EIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act of 1973, the NRC requests a list of endangered, threatened, candidate, and proposed species, and designated and proposed critical habitat, that may be in the vicinity of the two alternate sites. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

If you have any questions concerning the ESP application or other aspects of this project, please contact Mr. Thomas Kenyon, Environmental Project Manager, at (301) 415-1120 or by e-mail at TJK2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

March 17, 2004

Mr. Richard Nelson, Field Supervisor
U.S. Fish and Wildlife Service
4469 48th Avenue Court
Rock Island, IL 61201

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT FOR THE CLINTON ESP SITE

Dear Mr. Nelson:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application submitted by Exelon Generation Company, LLC (Exelon) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application the NRC is preparing an environmental impact statement (EIS). The impact analysis in the EIS includes the potential impacts of the construction and operation of one or more new nuclear power plants at the preferred or at one of six alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

The preferred location of the new unit(s), if built, would be the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois, approximately 6 miles east of the City of Clinton along the shore of Clinton Lake. Four of the six alternate sites that will be evaluated in the EIS are located within the area serviced by your office. The four alternate sites are existing generating stations owned and operated by Exelon: Byron Generating Station, in Ogle County, Illinois; Dresden Nuclear Power Station, in Grundy County, Illinois; LaSalle County Generating Station, in LaSalle County, Illinois; and Quad Cities Nuclear Power Station, in Rock Island County, Illinois. Please note that the NRC will submit separate correspondence to the Chicago Ecological Field Services office regarding the other two alternate sites; Braidwood Nuclear Station, in Will County, Illinois and Zion Nuclear Power Station, in Lake County, Illinois.

The application for an ESP was submitted by Exelon on September 25, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the new unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including the above alternative sites.

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R. Nelson 2

To support the EIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act of 1973, the NRC requests a list of endangered, threatened, candidate, and proposed species, and designated and proposed critical habitat, that may be in the vicinity of the CPS site and its transmission line corridors (McLean and DeWitt counties only), and the four alternate sites. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

If you have any questions concerning the ESP application or other aspects of this project, please contact Mr. Thomas Kenyon, Environmental Project Manager, at (301) 415-1120 or by e-mail at TJK2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

cc: See next page

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Rock Island Field Office
4469 48th Avenue Court
Rock Island, Illinois 61201
Phone: (309) 793-5800 Fax: (309) 793-5804

IN REPLY REFER TO:
FWS/RIFO

52-007

April 6, 2004

Mr. Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Mr. Kuo:

This responds to your letter of March 17, 2004, requesting our comments on the application for an early site permit for the Clinton ESP Site submitted by Exelon Generation Company, LLC. The preferred location of the new unit(s), if built, would be the existing Clinton Power Station (CPS) site near the town of Clinton in DeWitt County, Illinois. In this letter we will provide information regarding the presence of threatened and/or endangered species for DeWitt County, as well as Ogle, Grundy, LaSalle and Rock Island Counties.

To facilitate compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, Federal agencies are required to obtain from the Fish and Wildlife Service information concerning any species, listed or proposed to be listed, which may be present in the area of a proposed action. Therefore, we are furnishing you the following list of species which may be present in the concerned area:

Classification	Common Name (Scientific Name)	Habitat
Protected	Bald eagle (*Haliaeetus leucocephalus*)	Breeding, wintering
Endangered	Indiana bat (*Myotis sodalis*)	Caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging)
Endangered	Karner blue butterfly (*Lycaeides Melissa samuelis*)	Pine barrens and oak savannas on sandy soils and containing wild lupines

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		(*Lupinus perennis*); the only known food plant of the larvae
Endangered	Higgins' eye pearly mussel (*Lampsilis higginsi*)	Mississippi River; Rock River to Steel Dam
Threatened	Prairie bush clover (*Lespedeza leptostachya*)	Dry to mesic prairies with gravelly soil
Threatened	Eastern prairie fringed orchid (*Platanthaera leucophaea*)	Mesic to wet prairies

The threatened bald eagle (*Haliaeetus leucocephalus*) is listed as breeding Ogle County. It is also listed as wintering along large rivers, lakes and reservoirs in DeWitt, Grundy, LaSalle, Ogle, and *Rock Island Counties in Illinois (* counties that contain night roosts).

During the winter, this species feeds on fish in the open water areas created by dam tailwaters, the warm water effluents of power plants and municipal and industrial discharges, or in power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. They perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species. The eagle may not be harassed, harmed, or disturbed when present nor may nest trees be cleared.

The endangered Indiana bat (*Myotis sodalis*) is known to occur in LaSalle County, Illinois. Potential habitat for this species occurs statewide, therefore, Indiana bats are considered to potentially occur in any area with forested habitat.

Indiana bats migrate seasonally between winter hibernacula and summer roosting habitats. Winter hibernacula include caves and abandoned mines. Females emerge from hibernation in late March or early April to migrate to summer roosts. Females form nursery colonies under the loose bark of trees (dead or alive) and/or cavities, where each female gives birth to a single young in June or early July. A maternity colony may include from one or more individuals. A single colony may utilize a number of roost trees during the summer, typically a primary roost tree and several alternates. Some males remain in the area near the winter hibernacula during the summer months, but others disperse throughout the range of the species and roost individually or in small numbers in the same types of trees as females. The species or size of tree does not appear to influence whether Indiana bats utilize a tree for roosting provided the appropriate bark structure is present. However, the use of a particular tree does appear to be influenced by weather conditions, such as temperature and precipitation.
During the summer, the Indiana bat frequents the corridors of small streams with riparian woods as well as mature upland forests. It forages for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation

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(old fields), along the borders of croplands, along wooded fencerows, over farm ponds and in pastures.

Suitable summer habitat in Illinois is considered to have the following characteristics within a ½ mile radius of a project site:

1) forest cover of 15% or greater;
2) permanent water;
3) one or more of the following tree species: shagbark and shellbark hickory that may be dead or alive, and dead bitternut hickory, American elm, slippery elm, eastern cottonwood, silver maple, white oak, red oak, post oak, and shingle oak with slabs or plates of loose bark;
4) potential roost trees with 10% or more peeling or loose bark

If the project site contains any habitat that fits the above description, it may be necessary to conduct a survey to determine whether the bat is present. If Indiana bats are known to be present, they must not be harmed, harassed or disturbed when present. Large-scale habitat alterations within known or potential Indiana bat habitat should not be permitted without a bat survey and/or consultation with this office as indicated below.

If the project site contains any habitat that fits the above description, it may be necessary to conduct a survey to determine whether the bat is present. If Indiana bats are known to be present, they must not be harmed, harassed or disturbed when present. Large-scale habitat alterations within known or potential Indiana bat habitat should not be conducted without a bat survey and consultation with this office. "Mist Netting Guidelines" can be obtained from our office.

Minor alterations of Indiana bat habitat (i.e., timber stand improvement or clearing of small stands) should be limited to non-maternity periods between the dates of September 16 and April 14.

The endangered Karner blue butterfly (*Lycaeides melissa samuelis*) is currently known to occur only in Lake County, Illinois. However, potential habitat may be found in Ogle County, based on the historic distribution of the wild lupine plant *Lupinus perennis*. This plant is the only known food source for the larval stage of this species.

The endangered Higgins' eye pearly mussel (*Lampsilis higginsi*) is listed for the Mississippi River north of Lock and Dam 20 which includes Rock Island County, Illinois. This species prefers sand/gravel substrates with a swift current and is most often found in the main channel border or an open, flowing side channel.

While there is no designated critical habitat, the Higgins' eye Recovery Team has designated habitats essential to the recovery of the species. These areas include Cordova, Rock Island

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County, Illinois (river mile 503-505.4L); and Sylvan Slough, Rock Island, Illinois (river mile 485.4-486L).

The State of Illinois has also designated certain mussel refuge areas that contain this species. Their regulations would affect the commercial harvest of mussels on these refuges. If project is located near a known Higgins' eye mussel bed, it may be necessary to conduct a survey to determine the presence of the species.

The prairie bush clover (*Lespedeza leptostachya*) is listed as threatened in Ogle County, Illinois. It occupies dry to mesic prairies with gravelly soil. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever prairie remnants are encountered.

The eastern prairie fringed orchid (*Platanthera leucophaea*) is listed as threatened for Grundy County, Illinois. It may potentially occur in Ogle County, Illinois. It occupies wet grassland habitats. There is no critical habitat designated for this species. Federal regulations prohibit any commercial activity involving this species or the destruction, malicious damage or removal of this species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. This species should be searched for whenever wet prairie remnants are encountered.

These comments provide technical assistance only and do not fulfill the requirements under Section 7 of the Endangered Species Act of 1973, as amended, unless you have been designated, in writing, to the Regional Director of the U.S. Fish and Wildlife Service, Region 3, by the appropriate Federal agency, as a non-Federal representative for the purposes of conducting informal consultation on the subject Federal action, pursuant to 50 CFR 402.08. This letter provides comments under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). If you have questions, please contact Heidi Woeber of my staff at (309)793-5800, ext. 209.

Sincerely,

Richard C. Nelson
Supervisor

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chicago Ecological Services Field Office
1250 South Grove Avenue, Suite 103
Barrington, Illinois 60010
Phone: (847) 381-2253 Fax: (847) 381-2285

52-007

IN REPLY REFER TO:
FWS/AES-CIFO/4-1200

April 12, 2004

Mr. / Ms. Pao-Tsin Kuo
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Sir or Madame:

This responds to your letter dated March 17, 2004 requesting information on endangered and threatened species on or near two proposed alternate sites for one or more nuclear power plants by Exelon Generation Company, LLC. Both alternate sites are existing generating stations owned and operated by Exelon; Braidwood Nuclear Station in Will County, Illinois and Zion Nuclear Power Station in Lake County, Illinois.

The Zion Nuclear Power Station in Lake County, Illinois appears to lie directly adjacent to Illinois Beach State Park where we have three federal species of concern and one species with critical habitat designation.

The federally threatened eastern prairie white fringed orchid (*Plantanthera leucophaea*) is located at Illinois Beach State Park. Possible habitat of the Eastern prairie white fringed orchid includes but is not restricted to mesic prairie, sedge meadows, marsh edges and bogs. Soils of these habitats include glacial soils, lake plain deposits, muck, and peat. We request that a search for these types of habitat be conducted. If any of these aforementioned habitat remnants are found within any of the project areas, we request that searches for this species be conducted between June 28 and July 11, as this is when the orchid typically flowers and is most identifiable. If any eastern prairie white fringed orchids are found, this office should be notified immediately.

The federally endangered Karner blue butterfly (*Lycaeides Melissa samuelis*) is also believed to occur at Illinois Beach State Park. This butterfly was historically associated with native barrens and savanna ecosystems, but it is now associated with remnant barrens and savannas, highway and powerline right-of-ways, gaps within forest stands, young forest stands, forest roads and trails, airports, and military camps. These areas all have soils that are suitable for lupine growth, an open canopy, and management that causes soil disturbance or suppression of perennial shrub and herbaceous vegetation (such as by mowing, brush-hogging, logging, chemical control, or prescribed fire). These habitats can be very diverse vegetationally, and support herbaceous species that co-occur with lupine in the native remnant barrens and savanna habitats. Almost all

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of these contemporary habitats can be described as having a broken or scattered tree canopy that varies within habitats from 0 to between 50 and 80 percent canopy cover. The habitats have lupine, the sole larval food source, nectar plants for feeding adults, critical microhabitats, and attendant ants. Illinois Beach State Park provides each of these criteria.

The federally threatened Pitcher's thistle *(Cirsium pitcheri)* also occurs at Illinois Beach State Park. Pitcher's thistle is part of a dynamic dune ecosystem. It is found most frequently in the near-shore plant communities. Potential *Cirsium pitcheri* habitat includes beach, foredune, interdunal trough, and secondary dune areas. Pitcher's thistle colonizes patches of open, windblown areas of the landscape, and gradually declines locally as the density of vegetation and ground litter increases through plant succession. It is dependent on continually colonizing the mosaic of open habitats within the Great Lakes dunes. The species is patchily distributed with varying population sizes in all open zones of the dunes vegetation. Plant populations decline in stabilized, late successional secondary dune sites and in areas heavily used by people. We strongly caution you to avoid impacts to any of these ecosystems.

In addition, portions of Illinois Beach State Park are designated as critical habitat for the Great Lakes breeding population of the piping plover (*Charadrius melodus*). Piping plovers are listed as endangered under the Endangered Species Act of 1973, as amended. Critical habitat is a specific geographic area that is essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. Please ensure that your proposed project actions will not destroy or adversely modify critical habitat. Exact boundaries of proposed construction showing no adverse effect to beach areas should be considered.

At this time there are no known federal occurrences of listed species in or near the Braidwood Nuclear Station, in Will County, Illinois.

This letter only addresses federally listed species; the Illinois Department of Natural Resources should be contacted for information on State-listed species. Any impacts to wetlands or waters of the United States may require a permit from the U.S. Army Corps of Engineers. This letter does not preclude separate evaluation and comment by the U.S. Fish and Wildlife Service on wetland impacts proposed for section 404, Clean Water Act authorization.

If you have any questions, please contact Ms. Cathy Pollack at 847/381-2253 ext. 239, or Ms. Karla Kramer at 847/381-2253 ext. 230.

Sincerely,

John D. Rogner

John D. Rogner
Field Supervisor

Appendix G

Environmental Impacts of Transportation

Appendix G

Environmental Impacts of Transportation

This appendix discusses the potential environmental effects of transportation of reactor fuel and radioactive waste to and from potential early site permit (ESP) sites. Section G.1 briefly discusses the effects of transportation of unirradiated fuel to ESP sites, and Section G.2 discusses the effects of transportation of spent fuel from ESP sites to a spent fuel disposal facility. Section G.3 discusses the environmental effects of radioactive waste shipments.

G.1 Unirradiated Fuel Shipping

This section addresses the number and characteristics of shipments of unirradiated fuel to ESP sites relative to the conditions in 10 CFR 51.52. Comparisons are also made against Table S-4 in 10 CFR 51.52(c) and WASH-1238 (AEC 1972), which provided the data that supports Table S-4. Section G.1.1 presents the basic unirradiated fuel shipping requirements for each advanced reactor design. These data were extracted from INEEL (2003). Section G.1.2 presents the comparisons to 10 CFR 51.52 conditions.

G.1.1 Advanced Reactor Unirradiated Fuel Shipping Data

In WASH-1238 (AEC 1972), a reference boiling water reactor (BWR) and pressurized water reactor (PWR) were used to formulate the basic numbers of unirradiated fuel shipments required for initial core loading and refueling. Both reference reactor types had a net electrical output of 1100 MW(e). The reference BWR assumed an initial core loading of 150 metric tons of uranium (MTU), and the reference PWR assumed 100 MTU. Both reactor types resulted in 18 truck shipments of unirradiated fuel per reactor. Annual reload quantities were assumed to be 30 MTU/yr for both reactor types, which resulted in an additional six truck shipments per year per reactor. In total, about 252 truck shipments of unirradiated fuel are required over a 40-year reactor life, including the initial core and 39 years of reloads, for both reactor types.

The initial fuel loading and annual reload quantities for the Advanced Boiling Water Reactor (ABWR), a 1500-MW(e) reactor, and the Economic Simplified Boiling Water Reactor (ESBWR) are approximately the same: 156.96 MTU per reactor initial core loading and 32.76 MTU/yr per reactor reload quantities (INEEL 2003). This equates to about 872 unirradiated fuel assemblies in the initial core and 213 assemblies per year for refueling. Truck shipment capacities were stated in INEEL (2003) to be 28 to 30 unirradiated fuel assemblies per truck shipment. Assuming 30 fuel assemblies per truck shipment results in about 30 shipments of unirradiated fuel to load the initial core and 6.1 truck shipments per year for refueling. If 28 fuel assemblies per truck shipment are used, the initial core load requires about 32 shipments of unirradiated fuel and annual refueling requires about 6.5 truck shipments per year.

The surrogate AP1000 is a 1150-MW(e) advanced PWR power plant. The initial core load was estimated to be 84.5 MTU per reactor and annual reload requirements were estimated at 24.4 MTU/yr per reactor. The data in INEEL (2003) also indicated that the average uranium mass in an unirradiated surrogate AP1000 fuel assembly was 0.583 MTU and that 12 fuel assemblies per truck shipment would be transported. This resulted in about 14 truck shipments to supply the initial core and about 3.8 truck shipments per year to support refueling. For a site with 2 reactors, these estimates would be doubled.

The ACR-700 is an advanced design Canada Deuterium Uranium (CANDU) reactor assumed to generate 731 MW(e). It was stated in INEEL (2003) that the initial core load for the ACR-700 included 61.3 MTU per reactor and the annual refueling requirements are 33.1 MTU/yr per reactor. Each fuel assembly contains 18 kg of uranium (INEEL 2003). This corresponds to 3406 fuel assemblies in the initial core loading and 1839 fuel assemblies per year for refueling. A range of truck shipment capacities was given in INEEL (2003) to be 180 to 240 fuel assemblies per truck shipment. This equates to 15 to 19 truck shipments to supply the initial core load and from 7.7 to 10.2 annual refueling shipments. For a site with two reactors, these estimates would be doubled.

The International Reactor Innovative and Secure (IRIS) design is a 335-MW(e) advanced PWR. It requires an initial core load of 48.67 MTU or 89 fuel assemblies per unit (546.9 kg of uranium per fuel assembly) (INEEL 2003). For refueling, the IRIS reactor was assumed to require an additional 6.26 MTU/yr of unirradiated fuel per reactor or about 40 unirradiated fuel assemblies every 3.5 years. INEEL (2003) indicates that a "typical" site may contain three reactors. Assuming each truck shipment carries eight fuel assemblies, the initial core load requires 34 truck shipments per three-reactor site and annual refueling requires an additional 4.3 truck shipments per year per three-reactor site.

The Gas Turbine – Modular Helium Reactor (GT-MHR) is a gas-cooled reactor that uses a substantially different fuel design than current and advanced LWRs. The reactor's thermal power level is rated at 600 MW(t) per reactor and electric generation capacity is rated at 285 MW(e) per reactor. A standard GT-MHR site is assumed to comprise four reactors. INEEL (2003) states that the initial core load for a single reactor is about 1020 fuel assemblies. Annual average reload requirements are 510 fuel assemblies per reactor. INEEL (2003) also indicates that each truck shipment can carry 80 fuel assemblies, so for all four reactors it will require about 51 truck shipments to transport the initial core load and about 20 truck shipments per year for the annual reload requirements.

The Pebble Bed Modular Reactor (PBMR) is a gas-cooled reactor that is rated at 400 MW(t) (165 MW[e]) per reactor. A typical PBMR site is assumed to consist of eight reactors. The PBMR uses a substantially different fuel design than a typical LWR. INEEL (2003) states that each reactor requires 260,000 fuel spheres per reactor for its initial core load; 120,000 fuel spheres per reactor are required for annual average reloads. A total of 48,000 fuel spheres is assumed to be transported in a typical truck shipment. As a result, it will take about 44 shipments of fuel spheres to transport the initial core load for all eight reactors and about 20 shipments per year to transport the annual reload quantity for all eight reactors.

To make comparisons to Table S-4, the environmental impacts are normalized to a reference reactor-year. The reference reactor is an 1100 MW(e) reactor that has an 80 percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electrical output for the advanced reactor sites to the electrical output of the reference reactor.

G.1.2 Analysis of the Environmental Impacts of Unirradiated Fuel Shipments

As required by 10 CFR 51.52, applicants are required to submit a statement that the reactor and the transportation of fuel and waste to and from the reactor meet all the conditions specified in 10 CFR 51.42(a) or 10 CFR 51.52(b). The conditions specified in 10 CFR 51.52(a) that apply to unirradiated fuel include the following:

(1) The reactor core has a thermal loading less than 3800 MW.

(2) The reactor fuel is in the form of sintered UO_2 pellets not exceeding 4 percent uranium-235 by weight and the pellets are encapsulated in zircaloy rods.

(3) Unirradiated fuel is shipped to the reactor by truck.

(4) The environmental impacts of transportation of fuel and waste are as set forth in Summary Table S-4 in 10 CFR 51.52(c).

Unirradiated fuel shipment information for the advanced reactors is discussed below for each of these criteria.

G.1.2.1 Reactor Core Thermal Loading

The thermal output ratings of the seven advanced reactor types, as given in INEEL (2003), are as follows:

- ABWR – 4300 MW(t) (single reactor)
- ESBWR – 4000 MW(t) (single reactor)
- Surrogate AP1000 – 3400 MW(t) (single reactor)
- ACR-700 – 1982 MW(t) per reactor x two reactors per site = 3964 MW(t) per site
- IRIS – 1000 MW(t) per reactor x three reactors per site = 3000 MW(t) per site
- GT-MHR – 600 MW(t) per reactor x four reactors per site = 2400 MW(t) per site
- PBMR – 400 MW(t) per reactor x eight reactors per site = 3200 MW(t) per site.

As shown above, single-unit ABWR and ESBWR plants exceed the 3800-MW(t) condition in 10 CFR 51.52(a)(1). In addition, the twin-reactor ACR-700 site exceeds the core thermal power condition.

G.1.2.2 Reactor Fuel Form

All of the advanced LWRs (i.e., the ABWR, ESBWR, surrogate AP1000, IRIS, and ACR-700) use sintered UO_2 fuel pellets encapsulated in zircaloy rods. The average enrichment for the ACR-700 fuel is about 2 percent, well within the 10 CFR 51.52(a)(2) condition. The average enrichments for the other advanced LWR fuels exceed the 4 percent uranium-235 by weight condition in 10 CFR 51.52(a)(2).

The gas-cooled reactors (i.e., the GT-MHR and PBMR) have a substantially different fuel form than described in 10 CFR 51.52(a)(2). The fuel forms for these reactors are coated uranium oxycarbide fuel kernels (GT-MHR) or coated uranium dioxide fuel kernels (PBMR). The fuel kernels are coated with layers of pyrolitic carbon and silicone carbide. Thus, these fuel forms are not the same as the conditions specified in 10 CFR 51.52(a)(2). Furthermore, the equilibrium enrichments for these fuels are 12.9 percent (PBMR) and 19.8 percent (GT-MHR). Therefore, the advanced gas-cooled reactor fuel forms are not the same as the conditions specified in 10 CFR 51.52(a)(2).

G.1.2.3 Shipping Mode

All the reactor types, as stated in INEEL (2003), use trucks to ship unirradiated fuel to the various sites (INEEL 2003).

G.1.2.4 WASH-1238 and Table S-4 of 10 CFR 51.52(c)

The Table S-4 condition that applies to shipment of unirradiated fuel limits the number of shipments of fuel and waste to and from a commercial nuclear power plant to less than one per day. Table G-1 summarizes the number of truck shipments of unirradiated fuel required for

Table G-1. Numbers of Truck Shipments of Unirradiated Fuel for Each Advanced Reactor Type

	Number of Shipments per Site			Site Electric		Normalized,
Reactor Type	**Initial Core[a]**	**Annual Reload**	**Total[b]**	**Generation, MW(e)[c]**	**Capacity Factor[c]**	**Shipments per 1100 MW(e)[d,e]**
Reference LWR (WASH-1238)	18	6	252	1100	0.8	252
ABWR/ESBWR[d,e]	30	6.1	267	1500[f]	0.95	165
Surrogate AP1000	14	3.8	161	1150[f]	0.95	130
ACR-700	30	15.4	628	1462[g]	0.9	420
IRIS	34	4.3	201	1005[h]	0.96	184
GT-MHR	51	20	831	1140[i]	0.88	729
PBMR	44	20	824	1320[j]	0.95	579

NOTE: The reference LWR shipment values have all been normalized to 880 MW(e) net electrical generation.
(a) Shipments of the initial core have been rounded up to the next highest whole number.
(b) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(c) Unit capacities and capacity factors were taken from INEEL (2003).
(d) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100 MW[e] reactor at 80 percent or net electrical output of 880 MW[e]).
(e) Ranges of capacities are given in INEEL (2003) for these reactor unirradiated fuel shipments. The unirradiated fuel shipment data for these reactors were derived using the upper limit of the ranges.
(f) The ABWR/ESBWR site includes one reactor at 1500 MW(e) and the surrogate AP1000 site includes one reactor at 1150 MW(e).
(g) The ACR-700 site includes two reactors at 731 MW(e) per reactor.
(h) The IRIS site includes three reactors at 335 MW(e) per reactor.
(i) The GT-MHR site includes four reactors at 285 MW(e) per reactor.
(j) The PBMR site includes eight reactors at 165 MW(e) per reactor.

each reactor type. The table also normalizes the numbers of shipments to the net electrical generation output for the reference reactor in WASH-1238 (AEC 1972), or 880 MW(e) (1100-MW[e] plant operating at 80-percent annual capacity factor).

As shown, the ACR-700, PBMR, and GT-MHR advanced reactor types exceed the number of truck shipments estimated for the reference LWR in WASH-1238 (AEC 1972). The largest number of shipments, in excess of 700 shipments over 40 years, is for the GT-MHR. However, this equates to far less than one truck shipment per day. Consequently, the numbers of shipments for all the advanced reactor types are within the conditions specified in Table S-4 of 10 CFR 51.52. Table S-4 includes a condition that the truck shipments not exceed 33,000 kg (73,000 lb) as governed by Federal or State gross vehicle weight restrictions. All of the advanced reactors were indicated in INEEL (2003) to be capable of meeting this restriction for unirradiated fuel shipments.

Finally, Table S-4 includes conditions related to radiological doses to transport workers and members of the public along transport routes. These doses are a function of the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel time and stop time), and number of shipments to which the individuals are exposed. The radiological dose impacts of the transportation of unirradiated fuel were calculated using the RADTRAN 5 computer code (Neuhauser et al. 2003). The RADTRAN 5 calculations were performed to develop estimates of the worker and public doses associated with annual unirradiated fuel shipments to the ESP sites.

One of the key assumptions in WASH-1238 (AEC 1972) for the reference LWR unirradiated fuel shipments is that the radiation dose rate at 1 m (3 ft) from the transport vehicle is about 0.001 mSv/hr (0.1 mrem/hr). This assumption was also used in the analysis of advanced reactor unirradiated fuel shipments. This assumption is reasonable for all the advanced reactor fuel types because the fuel materials will be low-dose-rate uranium radionuclides and will be packaged similarly (i.e., inside a metal container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table G-1 by 40 years of operation. Other key input parameters used in the radiation dose analysis for unirradiated fuel are shown in Table G-2.

The RADTRAN 5 results for this "generic" unirradiated fuel shipment are as follows:

- Worker dose: 1.71×10^{-5} person-Sv/shipment (1.71×10^{-3} person-rem/shipment)

- General public dose (onlookers - persons at stops and sharing the highway): 6.65×10^{-5} person/Sv shipment (6.65×10^{-3} person-rem/shipment)

Table G-2. RADTRAN 5 Input Parameters for Unirradiated Fuel Shipments

Parameter	RADTRAN 5 Input Value	Source
Shipping distance, km	3200	AEC (1972)[a]
Travel fraction – rural	0.90	NRC (1977)
Travel fraction – suburban	0.05	
Travel fraction – urban	0.05	
Population density – rural, persons/km²	10	DOE (2002a)
Population density – suburban, persons/km²	349	
Population density – urban, persons/km²	2260	
Vehicle speed – rural, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a)
Vehicle speed – suburban, km/hr	88.49	
Vehicle speed – urban, km/hr	88.49	
Traffic count – rural, vehicles/hr	530	DOE (2002a)
Traffic count – suburban, vehicles/hr	760	
Traffic count – urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mSv/hr	0.001	AEC (1972)
Packaging length, m	7.3	Approximate length of two LWR fuel element packages placed on end
Number of truck crew	2	AEC (1972), NRC (1977), and DOE (2002a)
Stop time, hr/trip	4.5	Based on 0.0014-hour stop time per km (Hostick et al. 1992)
Population density at stops, persons/km²	64,300	Based on 20 people in annular ring extending from 1 to 10 m (3.3 to 33 ft) from the vehicle

(a) AEC (1972) provides a range of shipping distances between 40 km (25 mi) and 4800 km (3000 mi) for unirradiated fuel shipments. A 3200-km (2000-mi) "average" shipping distance was assumed here.

- General public dose (along route - persons living near a highway): 1.61×10^{-6} person-Sv/ shipment (1.61×10^{-4} person-rem/shipment).

These values were combined with the average annual shipments of unirradiated fuel for each advanced reactor type (see Table G-1) normalized to the WASH-1238 (AEC 1972) reference LWR electric output (880 MW(e)) to calculate annual doses to the public and workers. The results are compared to Table S-4 conditions. The results are shown in Table G-3. As shown, the calculated radiation doses for shipping unirradiated fuel to advanced reactor sites are within the Table S-4 conditions.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposures to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose,

Table G-3. Radiological Impacts of Transporting Unirradiated Fuel to ESP Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual dose, person-Sv/yr[a] per 1100 MW(e)		
		Workers	Public – Onlookers	Public – Along Route
Reference LWR (WASH-1238 [AEC 1972])	6.1	1.1×10^{-4}	4.2×10^{-4}	1.0×10^{-5}
ABWR/ESBWR	4.1	7.1×10^{-5}	2.7×10^{-4}	6.6×10^{-6}
Surrogate AP1000	3.3	5.6×10^{-5}	2.2×10^{-4}	5.2×10^{-6}
ACR-700	10.5	1.8×10^{-4}	7.0×10^{-4}	1.7×10^{-5}
IRIS	4.6	7.9×10^{-5}	3.1×10^{-4}	7.4×10^{-6}
GT-MHR	18.2	3.1×10^{-4}	1.2×10^{-3}	2.9×10^{-5}
PBMR	14.5	2.5×10^{-4}	9.6×10^{-4}	2.3×10^{-5}
10 CFR 51.52, Table S-4 Condition	<1 per day	4×10^{-2}	3×10^{-2}	3×10^{-2}

(a) Multiply person-Sv/yr times 100 to obtain dose in person-rem/yr.

no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). All the public doses presented in Table G-3 are less than 0.001 person-Sv/yr (0.1 person-rem/yr); therefore, the total detriment estimates associated with these doses would all be less than 1×15^{-4} fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are very small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

G.1.3 Transportation Accidents

Accidents involving unirradiated fuel shipments are also addressed in Table S-4. Accident risks are the product of accident frequency times consequence. Accident frequencies are likely to be lower than they were when WASH-1238 (AEC 1972) was published because traffic accident, injury, and fatality rates have fallen over the past 30 years. Consequences of accidents that are severe enough to result in a release of unirradiated fuel particles are not significantly different for advanced LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, the impacts of accidents during transport of unirradiated fuel to advanced LWR sites would be smaller than the WASH-1238 results that formed the basis for Table S-4.

With respect to the advanced gas-cooled reactors, accident rates (accidents per unit distance) and associated accident frequencies (accidents per year) would follow the same trends as for LWRs, i.e., overall reduction relative to the accident rates used in WASH-1238 (AEC 1972). The consequences of accidents involving gas-cooled reactor unirradiated fuel, however, are more uncertain. A literature search was conducted to identify publicly available documents that describe the effects of accidents (i.e., exposure of unirradiated gas-cooled reactor fuel to structural and thermal transients). No definitive references were found. Consequently, it was assumed here that the gas-cooled reactor unirradiated fuel shipments would have the same abilities as LWR unirradiated fuel to maintain functional integrity following a traffic accident. This assumption is judged to be conservative because gas-cooled reactor fuel operates at significantly higher temperatures and thus maintains integrity under more severe thermal conditions than LWR fuel. Detailed information about the behavior of the gas-cooled reactor fuel under impact conditions was not available. However, packaging systems for unirradiated gas-cooled reactor fuel will be required to meet the same requirements as unirradiated LWR fuel packages. Properly designed and manufactured packaging systems are the most effective means of preventing damage and dispersal of the contained materials under accident conditions. Consequently, packaging systems for unirradiated gas-cooled reactor fuels would provide release (i.e., consequence) prevention and mitigation equivalent to those designed for unirradiated LWR fuels. In addition, the fuel forms for the gas-cooled reactors are similar to those for LWRs (i.e., uranium oxide for the PBMR and uranium oxycarbide for the GT-MHR versus uranium oxide for LWRs); thus, the failure resistance provided by unirradiated gas-cooled reactor fuels is not expected to be significantly lower than that for LWRs. Based on the assumption that unirradiated gas-cooled and LWR fuels and associated packaging systems provide equivalent resistance to thermal and impact conditions, it was concluded that the impacts of accidents involving unirradiated gas-cooled reactor fuel are not expected to be significantly different than those for unirradiated LWR fuel.

G.2 Spent Fuel Shipping

This section discusses the impact of transporting irradiated or spent advanced reactor fuel from candidate sites to a spent fuel disposal facility located at Yucca Mountain, Nevada. The section is divided into two parts. The first part considers incident-free transportation, and the second part considers transportation accidents.

The analysis is based on shipment of spent fuel by legal-weight trucks in casks with characteristics similar to casks currently available (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Each shipment is assumed to consist of a single shipping cask loaded onto a modified trailer. These assumptions are consistent with assumptions made in the evaluation of the environmental impacts of transportation of spent fuel presented in Addendum I to NUREG-1437 (NRC 1999). As discussed in Addendum I, these assumptions are conservative because the alternative assumptions involve rail transportation or heavy-haul trucks, which would reduce the number of spent-fuel shipments.

Environmental impacts of the transportation of spent fuel were calculated using the RADTRAN 5 computer code (Neuhauser et al. 2003). Routing and population data for input to RADTRAN 5 for shipment by truck were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2000). The population data in the TRAGIS code is based on the 2000 Census.

G.2.1 Incident-Free Transportation of Spent Fuel

"Incident-free" transportation refers to transportation activities in which the shipments of radioactive material reach their destination without releasing any radioactive cargo to the environment. The vast majority of radioactive shipments are expected to reach their destination without experiencing an accident or incident or releasing any cargo. The "incident-free" impacts from these normal, routine shipments arise from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Although Federal regulations in 10 CFR Part 71 and 49 CFR Part 173 impose constraints on radioactive material shipments, some radiation penetrates the shipping container and exposes nearby persons to low levels of radiation.

Incident-free legal-weight truck transportation of spent fuel has been evaluated by considering shipments from six representative reactor sites to a repository at Yucca Mountain, Nevada, for disposal. This assumption is conservative because it tends to maximize the shipping distance from the East Coast and Midwest, where most of the reactors are assumed to be located. Therefore, shipment to one or more other potential sites would reduce the impacts.

Environmental impacts from these shipments will occur to persons residing along the transportation corridors between the potential advanced reactor sites and the repository; to persons in vehicles passing the spent-fuel shipment; to persons at vehicle stops for refueling, rest, and vehicle inspections; and to transportation crew members. The impacts to these exposed population groups were quantified using the RADTRAN 5 computer code (Neuhauser et al. 2003).

This analysis addresses the impacts of spent nuclear fuel transport to a high-level waste repository from a generic perspective because Congress has directed the U.S. Department of Energy to study only Yucca Mountain for the proposed repository. The analysis assumes that all spent nuclear fuel would be shipped to that repository.

The characteristics of specific shipping routes (e.g., population densities, shipping distances) influence the normal radiological exposures. To address the differences that arise from the specific reactor site from which the spent fuel shipment originates, each advanced reactor design was assumed to be located at all of the primary and alternative ESP sites. These sites are:

Primary Sites

- North Anna
- Clinton
- Grand Gulf

Alternative Sites[(a)]

- Savannah River Site (SRS)
- Portsmouth Gaseous Diffusion Plant (PGDP)
- Fitzpatrick
- Pilgrim
- Zion
- Quad Cities
- Braidwood
- Surry Power Station

Input to RADTRAN 5 includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code (Johnson and Michelhaugh 2000) for the origin-destination combinations of interest for legal-weight trucks. The resulting route characteristics information is shown in Table G-4. Note that for truck shipments, all the spent fuel is assumed to be shipped to the Yucca Mountain site over designated controlled-quantity highway routes. The routes used here are the same as those used in the Yucca Mountain Environmental Impact Statement (DOE 2002b).

Shipping casks have not been designed for advanced reactor spent fuel. Although some of the advanced reactor fuel designs are similar to current LWR fuel, no attempt has been made to optimize the cargo capacities of shipping casks for advanced LWR fuels. For the non-LWR fuel types (i.e., the GT-MHR and PBMR), there is little information on even a conceptual basis that would provide a defensible technical basis for shipping-cask capacities. The shipping-cask

(a) Impacts were not calculated for the River Bend site because the analysis is bounded by the impacts calculated for Grand Gulf. Impacts were not calculated for the Dresden and LaSalle sites because they are bounded by the Braidwood analysis.

Table G-4. Transportation Route Information for Shipments from ESP Sites to the Yucca Mountain Spent Fuel Disposal Facility

ESP Site	One-way Shipping Distance, km				Population Density, persons/km^2			Stop Time per Trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
Primary Site								
North Anna	4409.5	3498	812.4	99.1	11.3	319	2310.6	5
Clinton	3076.3	2626.3	398.3	51.7	9.4	306.1	2372.2	3.5
Grand Gulf[(a)]	3718.3	3030.4	581.3	106.6	9.2	339.4	2429.4	4
Alternative Site								
Savannah River Site (SRS)	4263	3260	881	122	11	331.5	2311.2	5
Portsmouth Gaseous Diffusion Plant (PGDP)	3902.2	3166.9	647.2	88.1	10.7	316.4	2339.7	4.5
Fitzpatrick	4212.2	3228.6	875.4	108.2	11.4	312.4	2348.7	5
Pilgrim	4682.3	3469.3	1091.7	121.3	11.8	312.3	2377.2	5.5
Zion	3138.9	2629.6	441.3	68	9.5	323.8	2360.3	3.5
Quad Cities	2853.1	2451	352.6	49.5	9.1	310.2	2391.3	3
Braidwood[(b)]	3034.5	2604.4	378.7	51.4	9.4	308.9	2377.2	3.5
Surry Power Station	4555.4	3590.7	863.9	100.8	11.4	317.6	2301.6	5

(a) The River Bend alternative site can be assumed to be bounded by the Grand Gulf values because of the proximity of the sites.
(b) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

capacity data in the *Early Site Permit Environmental Report Sections and Supporting Information* (INEEL 2003) is summarized as follows:

- ABWR – The ABWR fuel is not significantly different from existing LWR fuel designs; thus, the number of ABWR assemblies that can be transported in a legal-weight truck shipment (i.e., 25-ton shipping cask) is not expected to be different from current cargo capacities.

- ESBWR – The ESBWR fuel is similar to the ABWR fuel.

- Surrogate AP1000 – The surrogate AP1000 fuel assemblies are similar to current-generation PWR fuel. No information was provided in INEEL (2003) on shipping cask capacities for surrogate AP1000 spent nuclear fuel.

- ACR-700 – The ACR-700 fuel is somewhat different from the current and advanced LWR fuel designs. The applicant estimated that an ACR-700 rail cask would hold about 10 MTU of spent fuel, similar to the current cask designs. This value is nearly identical to the cargo capacities of current rail cask designs; thus, it was assumed that the truck cask capacity for ACR-700 and current-generation LWRs would also be about the same (i.e., 1.8 MTU/shipment).

- IRIS – The IRIS fuel is similar to current-generation PWR fuel. No information was provided in INEEL (2003) on shipping-cask capacities for IRIS spent nuclear fuel.

- GT-MHR – The GT-MHR fuel is a spherical coated-particle fuel with a uranium oxycarbide fuel kernel loaded into graphite fuel assemblies. This fuel concept is significantly different from current and advanced LWR fuels (sintered UO_2 pellets loaded into zircaloy tubes). According to INEEL (2003), six spent fuel assemblies containing 0.023 MTU of spent fuel is assumed to be transported in a legal weight truck cask.

- PBMR – The PBMR fuel is also a spherical coated-particle fuel with uranium oxide fuel kernels. In INEEL (2003), it is estimated that 0.495 MTU of spent PBMR fuel can be transported in a single legal-weight truck shipment.

The aforementioned shipping cask capacities are approximations based on current shipping cask designs. Actual shipping cask capacities in the future may be significantly different. Applicants must account for this in applications at the construction permit or combined operating license stage.

Incident-free radiation doses are a function of many variables. The most important of these variables are presented in Table G-5. Most of these variables, which are extracted from the literature, are considered to be "standard" values used in many RADTRAN 5 applications, including environmental impact statements, regulatory analyses, and others.

For purposes of this analysis, the transportation crew for spent fuel shipments delivered by truck consisted of two drivers. Escorts were considered, but they were not included because their distance from the shipping cask would reduce the dose rates to levels well below the dose rates experienced by the drivers. Stop times were assumed to accrue at the rate of 30 minutes per 4-hour driving time. TRAGIS outputs were used to determine the number of stops for each origin-destination.

Doses to the public at truck stops have been significant contributors to the doses calculated in previous RADTRAN 5 analyses. For this analysis, stop doses are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure G-1. The inner ring represents persons who may be at the truck stop at the same time

Table G-5. RADTRAN 5 Incident-Free Exposure Parameters

Parameter	RADTRAN 5 Input Value	Source
Vehicle speed – rural, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a). Because most travel is on interstate highways, the same vehicle speed is assumed in rural, suburban, and urban areas. No speed reductions were assumed for travel at rush hour.
Vehicle speed – suburban, km/hr	88.49	
Vehicle speed – urban, km/hr	88.49	
Traffic count – rural, vehicles/hr	530	DOE (2002a)
Traffic count – suburban, vehicles/hr	760	
Traffic count – urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mSv/hr	0.14	Approximate dose rate at 1 m (3 ft) that is equivalent to maximum dose rate allowed by Federal regulations (i.e., 0.1 mSv/hr at 2 m (~7 ft) from the side of a transport vehicle) (DOE 2002b)
Packaging dimensions, m	Length – 5.2 Diameter – 1.0	DOE (2002b)
Number of truck crew	2	AEC (1972), NRC (1977), and DOE (2002a)
Stop time, hr/trip	Route-specific	See Table G-4.
Population density at stops, persons/km^2	30,000	Sprung et al. (2000)
Min/max radii of annular area around vehicle at stops, m	1 to 10	Sprung et al. (2000)
Shielding factor applied to annular area surrounding vehicle at stops	1 (no shielding)	Sprung et al. (2000)
Population density surrounding truck stops, persons/km^2	340	Sprung et al. (2000)
Min/max radius of annular area surrounding truck stop, m	10 to 800	Sprung et al. (2000)
Shielding factor applied to annular area surrounding truck stop	0.2	Sprung et al. (2000)

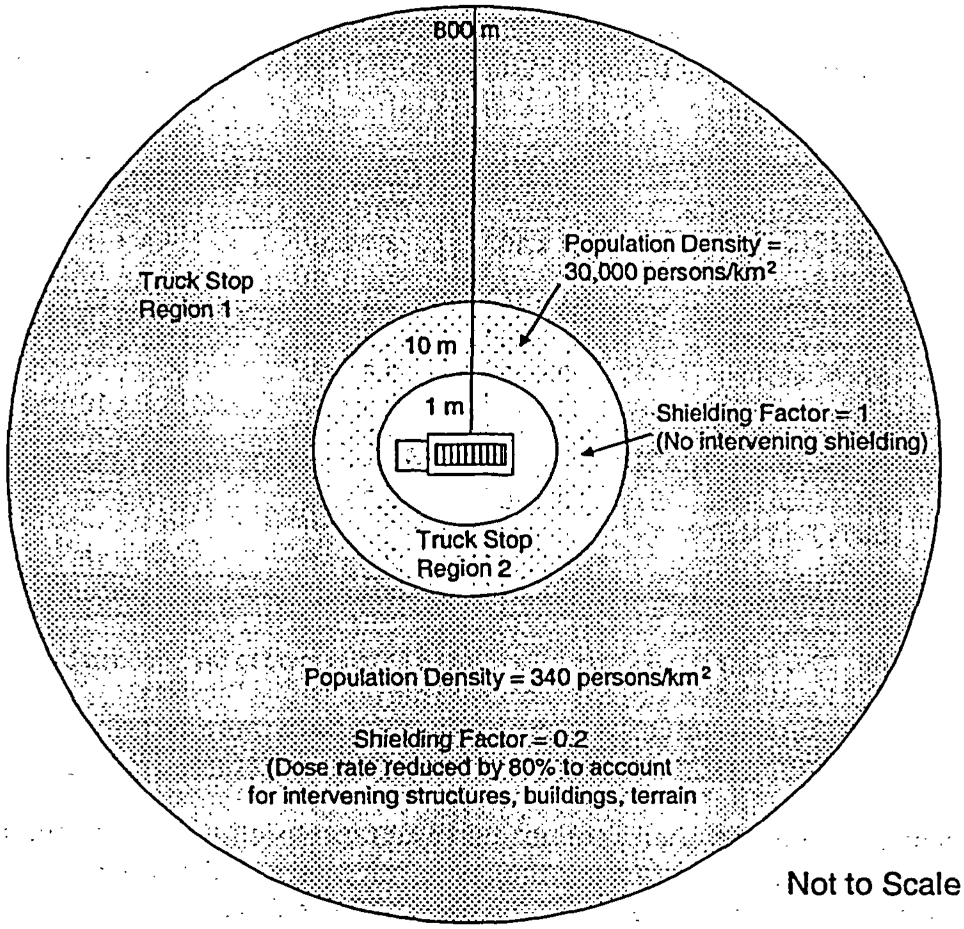

Figure G-1. Illustration of Truck Stop Model (Sprung et al. 2000)

as a spent fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and extends from 10 to 800 m from the vehicle. This scheme is the same as that used in Sprung et al. (2000).

Population densities and shielding factors were also taken from Sprung et al. (2000) and were based on the observations of Griego et al. (1996).

The results of these routine (incident-free) exposure calculations are shown in Table G-6 for spent fuel shipments from all eleven primary and alternative sites to the potential Yucca Mountain repository. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at truck stops and persons and on highways exposed to the spent fuel shipments), and along the route (persons living near the highway).

Table G-6. Routine (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from Potential ESP Sites to the Yucca Mountain Disposal Facility

	Population Dose, person-Sv/shipment[a]		
Reactor Site	**Crew**	**Onlookers**	**Along Route**
Braidwood[b]	7.1×10^{-4}	2.4×10^{-3}	4.4×10^{-5}
Clinton	7.2×10^{-4}	2.5×10^{-3}	4.5×10^{-5}
Fitzpatrick	9.8×10^{-4}	3.5×10^{-3}	9.5×10^{-5}
Grand Gulf[c]	8.7×10^{-4}	2.8×10^{-3}	7.0×10^{-5}
North Anna	1.0×10^{-3}	3.5×10^{-3}	9.2×10^{-5}
Pilgrim	1.1×10^{-3}	3.9×10^{-3}	1.2×10^{-4}
Portsmouth	9.1×10^{-4}	3.2×10^{-3}	7.3×10^{-5}
Quad Cities	6.7×10^{-4}	2.1×10^{-3}	4.1×10^{-5}
Savannah River	9.9×10^{-4}	3.5×10^{-3}	1.0×10^{-4}
Surry Power Station	1.1×10^{-3}	3.5×10^{-3}	9.7×10^{-5}
Zion	7.3×10^{-4}	2.5×10^{-3}	5.2×10^{-5}

(a) Multiply person-Sv/shipment times 100 to obtain doses in person-rem/shipment.
(b) The River Bend alternative site can be assumed to be bounded by the Grand Gulf values because of the proximity of the sites.
(c) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

This discussion addresses whether or not the environmental effects of incident-free advanced reactor spent fuel shipments are within the guidelines established in Table S-4. The bounding cumulative doses to the exposed population given in Table S-4 are:

- Transport workers 0.04 person-Sv (4 person-rem) per reference reactor year
- General public (onlookers) 0.03 person-Sv (3 person-rem) per reference reactor year
- General public (along route) 0.03 person-Sv (3 person-rem) per reference reactor year.

Calculation of the cumulative doses entailed converting the per-shipment risks given in Table G-6 to estimates of environmental effects per reference reactor year of operation. The per-shipment results, which are independent of reactor type (i.e., the doses are dependent on the assumed external radiation dose rate emitted from the cask, which is fixed at the regulatory maximum limit for all of the advanced reactor types), are given in terms of the population dose per shipment of spent fuel. To develop estimates of the annual environmental impacts, the following assumptions were made:

- The basis for the annual number of shipments of spent fuel from the reference LWR in WASH-1238 (AEC 1972) will be used. In WASH-1238, it was assumed that 60 shipments per year would be made, each shipment carrying 0.5 MTU of spent fuel.

This equates to shipping 30 MTU of spent fuel per year. This is equivalent to the annual refueling requirements for the reference LWR. It was assumed that the other reactor types would also ship spent fuel at a rate equal to their annual refueling requirements.

- Shipping cask capacities that were used to calculate annual spent fuel shipments for the advanced LWRs were assumed to be the same as for the reference LWR, i.e., approximately 0.5 MTU per truck shipment.

- The annual numbers of spent fuel shipments from the advanced gas-cooled reactors were taken directly from INEEL (2003). These estimates were 38 shipments per year from the GT-MHR site and 16 shipments per year from the PBMR site.

Table G-7 provides the estimated annual population doses from routine (incident-free) transportation of spent fuel from ESP sites to the Yucca Mountain disposal facility. The results in Tables G-7 to G-9 have been normalized to the WASH-1238 (AEC 1972) net electrical generation (i.e., 880 MW[e]). Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). All the population doses presented in Table G-7 are less than one person-Sv/yr (100 person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 0.1 fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are very small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

As shown in Table G-7, some of the estimated population doses are higher than the Table S–4 conditions. Two key reasons for the higher population doses relative to Table S–4 are the higher number of spent fuel shipments estimated for some of the reactor technologies and the longer shipping distances used in this assessment than were used in WASH-1238 (AEC 1972).

Table G-7. Routine (Incident-Free) Population Doses from Spent Fuel Transportation, Normalized to Reference LWR Net Electrical Generation

Reactor Type	Reference LWR (WASH-1238)			ABWR/ESBWR			Surrogate AP1000			ACR-700		
No. Shipments per year	60			41			40			90		
	Environmental Effects, person-Sv per reference reactor year[a]											
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Braidwood[b]	4.2×10^{-2}	1.5×10^{-1}	2.6×10^{-3}	2.9×10^{-2}	1.0×10^{-1}	1.8×10^{-3}	2.8×10^{-2}	9.7×10^{-2}	1.7×10^{-3}	6.3×10^{-2}	2.2×10^{-1}	3.9×10^{-3}
Clinton	4.3×10^{-2}	1.5×10^{-1}	2.7×10^{-3}	2.9×10^{-2}	1.0×10^{-1}	1.8×10^{-3}	2.8×10^{-2}	9.7×10^{-2}	1.8×10^{-3}	6.4×10^{-2}	2.2×10^{-1}	4.1×10^{-3}
Fitzpatrick	5.9×10^{-2}	2.1×10^{-1}	5.7×10^{-3}	4.0×10^{-2}	1.4×10^{-1}	3.9×10^{-3}	3.9×10^{-2}	1.4×10^{-1}	3.8×10^{-3}	8.8×10^{-2}	3.1×10^{-1}	8.5×10^{-3}
Grand Gulf[c]	5.2×10^{-2}	1.7×10^{-1}	4.2×10^{-3}	3.5×10^{-2}	1.2×10^{-1}	2.8×10^{-3}	3.4×10^{-2}	1.1×10^{-1}	2.7×10^{-3}	7.8×10^{-2}	2.5×10^{-1}	6.2×10^{-3}
North Anna	6.2×10^{-2}	2.1×10^{-1}	5.5×10^{-3}	4.2×10^{-2}	1.4×10^{-1}	3.7×10^{-3}	4.1×10^{-2}	1.4×10^{-1}	3.6×10^{-3}	9.2×10^{-2}	3.2×10^{-1}	8.2×10^{-3}
Pilgrim	6.5×10^{-2}	2.3×10^{-1}	7.0×10^{-3}	4.4×10^{-2}	1.6×10^{-1}	4.8×10^{-3}	4.3×10^{-2}	1.5×10^{-1}	4.6×10^{-3}	9.8×10^{-2}	3.5×10^{-1}	1.0×10^{-3}
Portsmouth	5.5×10^{-2}	1.9×10^{-1}	4.4×10^{-3}	3.7×10^{-2}	1.3×10^{-1}	3.0×10^{-3}	3.6×10^{-2}	1.2×10^{-1}	2.9×10^{-3}	8.1×10^{-2}	2.8×10^{-1}	6.6×10^{-3}
Quad Cities	4.0×10^{-2}	1.3×10^{-1}	2.4×10^{-3}	2.7×10^{-2}	8.6×10^{-1}	1.7×10^{-3}	2.6×10^{-2}	8.4×10^{-2}	1.6×10^{-3}	6.0×10^{-2}	1.9×10^{-1}	3.6×10^{-3}
Savannah River	6.0×10^{-2}	2.1×10^{-1}	6.0×10^{-3}	4.0×10^{-2}	1.4×10^{-1}	4.1×10^{-3}	3.9×10^{-2}	1.4×10^{-1}	4.0×10^{-3}	8.9×10^{-2}	3.2×10^{-1}	9.0×10^{-3}
Surry Power Station	6.4×10^{-2}	2.1×10^{-1}	5.8×10^{-3}	4.3×10^{-2}	1.4×10^{-1}	3.9×10^{-3}	4.2×10^{-2}	1.4×10^{-1}	3.8×10^{-3}	9.5×10^{-2}	3.2×10^{-1}	8.7×10^{-3}
Zion	4.4×10^{-2}	1.5×10^{-1}	3.1×10^{-3}	3.0×10^{-2}	1.0×10^{-1}	2.1×10^{-3}	2.9×10^{-2}	9.7×10^{-2}	2.0×10^{-3}	6.5×10^{-2}	2.2×10^{-1}	4.6×10^{-3}

Table G-7. (contd)

Reactor Type	IRIS			GT-MHR			PBMR		
No. Shipments per year	35			34			12		
	Environmental Effects, person-rem per reference reactor year[a]								
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Braidwood	2.5×10^{-2}	8.5×10^{-2}	1.5×10^{-3}	2.4×10^{-2}	8.2×10^{-2}	1.5×10^{-3}	7.9×10^{-3}	2.7×10^{-2}	4.9×10^{-4}
Clinton	2.5×10^{-2}	8.5×10^{-2}	1.6×10^{-3}	2.4×10^{-2}	8.2×10^{-2}	1.5×10^{-3}	8.0×10^{-3}	2.8×10^{-2}	5.1×10^{-4}
Fitzpatrick	3.4×10^{-2}	1.2×10^{-1}	3.3×10^{-3}	3.3×10^{-2}	1.2×10^{-1}	3.2×10^{-3}	1.1×10^{-2}	3.9×10^{-2}	1.1×10^{-3}
Grand Gulf	3.0×10^{-2}	9.8×10^{-2}	2.4×10^{-3}	2.9×10^{-2}	9.4×10^{-2}	2.3×10^{-3}	9.7×10^{-3}	3.2×10^{-2}	7.8×10^{-4}
North Anna	3.6×10^{-2}	1.2×10^{-1}	3.2×10^{-3}	3.4×10^{-2}	1.2×10^{-1}	3.1×10^{-3}	1.2×10^{-2}	4.0×10^{-2}	1.0×10^{-3}
Pilgrim	3.8×10^{-2}	1.3×10^{-1}	4.0×10^{-3}	3.6×10^{-2}	1.3×10^{-1}	3.9×10^{-3}	1.2×10^{-2}	4.3×10^{-2}	1.3×10^{-3}
Portsmouth	3.1×10^{-2}	1.1×10^{-1}	2.5×10^{-3}	3.0×10^{-2}	1.1×10^{-1}	2.4×10^{-3}	1.0×10^{-2}	3.6×10^{-2}	8.2×10^{-4}
Quad Cities	2.3×10^{-2}	7.4×10^{-2}	1.4×10^{-3}	2.2×10^{-2}	7.1×10^{-2}	1.4×10^{-3}	7.5×10^{-3}	2.4×10^{-2}	4.6×10^{-4}
Savannah River	3.4×10^{-2}	1.2×10^{-1}	3.5×10^{-3}	3.3×10^{-2}	1.2×10^{-1}	3.3×10^{-3}	1.1×10^{-2}	3.9×10^{-2}	1.1×10^{-3}
Surry Power Station	3.7×10^{-2}	1.2×10^{-1}	3.3×10^{-3}	3.5×10^{-2}	1.2×10^{-1}	3.2×10^{-3}	1.2×10^{-2}	4.0×10^{-2}	1.1×10^{-3}
Zion	2.5×10^{-2}	8.5×10^{-2}	1.8×10^{-3}	2.4×10^{-2}	8.2×10^{-2}	1.7×10^{-3}	8.2×10^{-3}	2.8×10^{-2}	5.8×10^{-4}

(a) Multiply person-Sv/yr times 100 to obtain doses in person-rem/yr.
(b) The River Bend alternative site can be assumed to be bounded by the Grand Gulf values because of the proximity of the sites.
(c) *Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.*

Table G-8. Comparison of Incident-Free Doses from NUREG-0170 (NRC 1977) Spent Fuel Shipments and Spent Fuel Shipment from Quad-Cities to a Potential Geologic Repository at Yucca Mountain in this Analysis

Incident-Free Exposure Parameter	NUREG-0170 (NRC 1977)	This Study (Quad Cities to Yucca Mountain)[a]
One-way shipping distance, km	2530	2853
Travel fraction		
Urban	0.05	0.02
Suburban	0.05	0.12
Rural	0.9	0.86
Population density along highway, persons per km^2		
Urban	3861	2391.3
Suburban	719	310.2
Rural	6	9.1
Speed, km/hr		
Urban	24	88
Suburban	40	88
Rural	88	88
Traffic count, vehicles/hr		
Urban	2800	2400
Suburban	780	760
Rural	470	530
Shipment dose Rate, mSv/hr at 2m	0.1	0.1
Crew dose rate, mSv/hr	0.02	Calculated (7.4 m from package)
Stop time, hr per trip		
Urban	2	3 hours per trip (30 minutes per 4 hours driving time)
Suburban	5	
Rural	1	
Population density at stops (per km^2)		
Urban	3861	Distribution: 1 to 10 m - 30,000; 10 to 800 m - 340 (see Figure G-1)
Suburban	719	
Rural	6	
Person-Sv/shipment		
Crew	1.2×10^{-3}	4.8×10^{-4}
Off-link	1.5×10^{-4}	3.1×10^{-4}
On-link	7.4×10^{-5}	1.7×10^{-4}

Table G-8. (contd)

Incident-Free Exposure Parameter	NUREG-0170 (NRC 1977)	This Study (Quad Cities to Yucca Mountain)[a]
Stops	1.9×10^{-4}	1.7×10^{-4}[b]
Total	1.6×10^{-3}	8.5×10^{-4}
Handlers + Storage	2.1×10^{-3}	Not calculated
Grand Total	3.7×10^{-3}	8.5×10^{-4}

(a) Tables G-5 and G-6 provide the bases for these input parameters.
(b) Stop doses have been adjusted as described in the text to reflect more realistic assumptions than were used in the bounding analysis (Table G-7).

WASH-1238 (AEC 1972) used a "typical" distance for a spent fuel shipment of 1600 km (1000 mi), whereas the shipping distances used in this assessment ranged from about 3000 km (1800 mi) to 4700 km (2900 mi). The higher numbers of shipments are based on spent fuel shipping-casks designed to transport short-cooled fuel (150 days out of the reactor). It was assumed in this analysis that the shipping-cask capacities are 0.5 MTU/shipment, roughly equivalent to one PWR or two BWR spent fuel assemblies per shipment. Newer designs are based on longer-cooled spent fuel (5 years out of reactor) and have larger capacities than those used in this assessment. DOE (2002b) spent fuel shipping-cask capacities were approximately1.8 MTU/shipment, or up to four PWR or nine BWR fuel assemblies per shipment. Use of the newer shipping-cask designs will reduce the number of spent fuel shipments and the associated environmental impacts. If the population doses are adjusted for the shipping distance (a factor of 2 to 3) and shipping cask capacity (a factor of 4), the routine population doses from spent fuel shipments from all reactor types and all sites fall within the Table S-4 conditions.

Most of the stops made for actual spent fuel shipments are short duration stops (i.e., 10 minutes) for brief visual inspections of the cargo (e.g., checking the cask tie-downs). These stops typically occur in areas devoid of people, such as an overpass or freeway ramp in an unpopulated area. Therefore, doses to residents surrounding these types of stops are negligible. In DOE (2002b), close-proximity exposures (i.e., from 1 to 15.8 m from the cask) were not assumed to occur at the short-duration inspection stops. In this analysis, for the purpose of developing bounding estimates of environmental effects, close-proximity (1 to 10 m from cask) exposures at all truck stops were included in the RADTRAN 5 calculations. Because the numbers of stops in this analysis are effectively doubled relative to DOE (2002b), truck stop doses are also doubled. The doses to residents would also be lower; however, because doses to residents are two to three orders of magnitude (i.e., a factor of 100 to 1000) less than the calculated close-proximity doses, this reduction does not affect the total stop dose.

Table G-9. Radionuclide Inventories Used in the Transportation Accident Risk Calculations for Each Advanced Reactor Type

Radionuclide	ABWR and ESBWR Inventory, Bq/MTU[a]	Surrogate AP1000 Inventory, Bq/MTU	GT-MHR Inventory, Bq/MTU	PBMR Inventory, Bq/MTU
Am-241	4.96×10^{13}	2.69×10^{13}	8.18×10^{13}	7.55×10^{13}
Am-242m	1.24×10^{12}	4.85×10^{11}	5.03×10^{11}	8.51×10^{11}
Am-243	1.20×10^{12}	1.24×10^{12}	5.14×10^{11}	4.77×10^{12}
Ce-144	4.22×10^{14}	3.28×10^{14}	2.15×10^{15}	1.19×10^{15}
Cm-242	2.04×10^{12}	1.05×10^{12}	1.51×10^{12}	2.78×10^{12}
Cm-243	1.37×10^{12}	1.14×10^{12}	2.02×10^{11}	1.96×10^{12}
Cm-244	1.80×10^{14}	2.87×10^{14}	2.83×10^{13}	5.48×10^{14}
Cm-245	2.43×10^{10}	4.48×10^{10}	1.65×10^{8}	5.29×10^{10}
Co-60	1.01×10^{14}	(b)	(b)	(b)
Cs-134	1.78×10^{15}	1.78×10^{15}	2.21×10^{15}	4.03×10^{15}
Cs-137	4.59×10^{15}	3.44×10^{15}	1.08×10^{16}	1.41×10^{16}
Eu-154	3.81×10^{14}	3.38×10^{14}	3.23×10^{14}	3.74×10^{14}
Eu-155	1.93×10^{14}	1.71×10^{14}	8.77×10^{13}	1.08×10^{14}
Pm-147	1.25×10^{15}	6.51×10^{14}	6.92×10^{15}	5.07×10^{15}
Pu-238	2.27×10^{14}	2.25×10^{14}	1.17×10^{14}	4.55×10^{14}
Pu-239	1.43×10^{13}	9.44×10^{12}	2.25×10^{13}	1.11×10^{13}
Pu-240	2.28×10^{13}	2.01×10^{13}	3.96×10^{13}	3.32×10^{13}
Pu-241	4.51×10^{15}	2.58×10^{15}	8.33×10^{15}	7.18×10^{15}
Pu-242	8.29×10^{10}	6.73×10^{10}	1.56×10^{11}	4.51×10^{11}
Ru-106	6.07×10^{14}	5.74×10^{14}	1.48×10^{15}	1.68×10^{15}
Sb-125	1.99×10^{14}	1.42×10^{14}	2.21×10^{14}	2.51×10^{14}
Sr-90	3.27×10^{15}	2.29×10^{15}	8.95×10^{15}	1.08×10^{16}
Y-90	3.27×10^{15}	2.29×10^{15}	8.95×10^{15}	1.08×10^{16}

(a) To convert Bq/MTU to Ci/MTU, divide the value by 3.7×10^{10}.
(b) Co-60 is an activation product. Only the ABWR/ESBWR submittal in INEEL (2003) provided inventory data for activation products.

The number of exposed persons at stops is higher in this analysis by about a factor of 1.5 relative to DOE (2002b) assumptions (6.9 persons in DOE 2002b versus 10 persons assumed in this analysis). Thus, the bounding doses calculated in this analysis are also a factor of 1.5 (10 divided by 6.9) greater than those given in DOE (2002b). Furthermore, empirical data provided in Griego et al. (1996) indicate that a 30-minute stop is toward the high end of the stop time distribution. Average stop times for food and refueling observed by Griego et al. (1996) are on the order of 18 minutes. This amounts to another factor of 1.5 increase in stop doses calculated here relative to DOE (2002b).

Based on these observations, the staff concluded that the stop model used in this study overestimates public doses at stops by approximately a factor of four (factor of 2 for close-proximity exposure time at stops, a factor of 1.5 for average stop time at food and refueling stops, and a factor of 1.5 for the number of people in proximity to the shipping cask). Coupled with the factor of 2 reduction in shipping cask dose rates that result from fuel aging, the doses to onlookers at stops could be reduced to about one-eighth of the doses shown in Table G-7 [1/(2 x 1.5 x 1.5 x 2) ≈ 0.12] to reflect more realistic truck shipping conditions. Based on the previous discussion, use of more realistic dose rates, shipping cask capacities, and truck stop model assumptions in the RADTRAN 5 calculations could substantially reduce the environmental effects presented in Table G-7.

Table G-8 provides a comparison between the radiological incident-free doses calculated in NUREG-0170 (NRC 1977) and those calculated here. The table also summarizes the key incident-free input parameters that were used in NUREG-0170 and this study. Comparisons are also made between the doses for spent fuel shipments in NUREG-0170 and doses calculated for a shipment from the Quad Cities to a potential geologic repository at Yucca Mountain because the shipping distances are comparable (2530 km in NUREG-0170 versus 2853 km for Quad Cities to Yucca Mountain). As shown in the table, many parameters have changed over the years and the technical bases for them have improved. For example, the work of Griego et al. (1996) has improved the basis for assumptions about stop times and persons exposed at truck stops, and the TRAGIS computer code has improved the basis for shipping distances and population distributions along highway routes.

The incident-free impacts at truck stops shown in the table have been adjusted, as discussed above, to reflect more realistic conditions than assumed in the bounding analysis. Adjustments were not made to the onlookers, along route, and crew doses shown in Table G-7. As shown, the adjusted doses in Table G-8 for spent fuel shipments from the Quad Cities to potential geologic repository at the potential Yucca Mountain site are about a factor of 2 lower than the per-shipment doses from NUREG-0170 when the doses to and doses associated with in-transit storage from NUREG-0170 are excluded. Storage doses were excluded from this analysis because spent fuel shipments proceed directly from the reactor site to Yucca Mountain with no intermediate storage involved. Handler doses were excluded from this analysis because doses to workers who load the spent fuel cask at reactors and unload them at the potential repository are treated as facility doses, not transportation doses, in recent National Environmental Policy Act of 1969 (NEPA) documents.

G.2.2 Transportation Accident Impacts

RADTRAN 5 assesses accident risk by multiplying the probabilities times consequences of accidents to produce a risk value. RADTRAN 5 considers a spectrum of potential transportation accidents, ranging from those with high frequencies and low consequences (for example, fender-benders) to those with low frequencies and high consequences (accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were taken directly from the *Early Site Permit Environmental Report Sections and Supporting Data* (INEEL 2003). The report included hundreds of radionuclides for each advanced reactor type. A screening analysis was conducted to select the dominant contributors to accident risks to simplify the RADTRAN 5 calculations. The screening identifies the radionuclides that will contribute more than 99.999 percent of the dose from inhalation. A sum-of-fractions approach was used for this screening. First, the inventory of each radionuclide was multiplied by its respective inhalation dose conversion factor, taken from Federal Guidance Report 13 (EPA 2002). These values were then summed. Then, each inventory-conversion factor product was divided by the sum of the products to obtain the fraction of the total inhalation dose for each radionuclide. The resulting fractions were then sorted from largest to smallest, their cumulative contributions were calculated, and those that contributed to 99.999 percent of the inhalation-dose potential were selected. Several gases, including hydrogen-3, krypton-85, and iodine-129, were added to the list because they are more easily released than the solid and semi-volatile species contained in the fuel. The inventories of radionuclides used in this study are shown in Table G-9. The table shows that the dominant radionuclides are approximately the same regardless of fuel type. The table does not show radionuclide inventory data for the ACR-700 and IRIS advanced reactors, as those were not given in INEEL (2003). Nor were they provided in WASH-1238 (AEC 1972) for the reference LWR. Consequently, accident risks were not quantified for these reactor types.

Robust shipping casks are used to transport spent fuel because of the heavy radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, which means they must withstand a series of severe hypothetical accident conditions with essentially no loss of containment or shielding capability. The tests include a 9-m (30-ft) free drop onto an unyielding surface, a drop onto a puncture probe, an exposure to an engulfing 800°C fire for 30 minutes, and an underwater immersion. According to Sprung et al. (2000), the probability of encountering accident conditions more severe than these tests that could lead to shipping cask failure are less than 0.01 percent of all accidents (that is, more than 99.99 percent of all accidents would not result in a release of radioactive material from the shipping cask). It was assumed that shipping casks for advanced reactor spent fuels will provide equivalent mechanical and thermal protection of the spent fuel cargo.

The RADTRAN 5 accident risk calculations were performed using unit radionuclide inventories (Bq/MTU) for the spent fuel shipments from the various reactor types. The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (MTU/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from each potential ESP site. As was done for routine exposures, it was assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities: 32.76 MTU/yr for the ABWR and ESBWR; 24.4 MTU/yr for a single-reactor surrogate AP1000 site; 6.8 MTU/yr for the four-reactor GT MHR site; and 8.3 MTU/yr for the eight-reactor PBMR site. These data were taken from INEEL (2003) and have not been normalized to the reference LWR net electrical generation.

Route-specific accident rates (accidents per km) were derived for the RADTRAN 5 accident risk analysis. The approach used to develop accident rates for spent fuel shipments is as follows. The TRAGIS data provide estimates of the distance traveled in each state along a route and the type of highway (interstate, state highway, or other). Saricks and Tompkins (1999) provide accident rates for each state that are a function of highway type. The approach taken to estimate route-specific accident rates was to multiply the state-level accident or fatality rates by the distances traveled in each state on the corresponding highway type and then sum over all the states on each route. For example, for interstate highways, the interstate distances and interstate accident rates were used. For non-interstate highway travel, either the "Primary" or "Other" accident rates given by Saricks and Tompkins (1999) were used. This allowed computation of route-specific accident rates.

Transportation accident risk analysis in RADTRAN 5 is performed using an accident severity and package release model. The user can define up to 30 severity categories, with each category increasing in magnitude. Severity categories are related to fire, puncture, crush, and immersion environments created in vehicular accidents. For this analysis, the 19 severity categories defined in NUREG/CR-6672 (Sprung et al. 2000) were adopted.

Each severity category has an assigned conditional probability (or the probability, given an accident occurs, that it will be of the specified severity). The accident scenarios are further defined by allowing the user to input release fractions and aerosol and respirable fractions for each severity category. These fractions are a function of the physical-chemical properties of the materials being transported as well as the mechanical and thermal accident conditions that define the severity categories. The severity and release fractions used here are presented in Table G-10.

The severity categories and release fractions in Sprung et al. (2000) were designed specifically to address accidents involving current generation LWR fuel and the current generation of spent fuel shipping casks. While some of the advanced reactor fuel designs are similar to the current generation (e.g., the ABWR, ESBWR, Surrogate AP1000, ACR-700, and IRIS), others are significantly different, including the GT-MHR and PBMR. Extrapolating the current generation

Table G-10. Severity and Release Fractions Used to Model Spent Fuel Transportation Accidents (Sprung et al. 2000)

Severity Category	Severity Fraction[(a)]	Release Fractions[(b)]				
		Gas	Cesium	Ruthenium	Particulates	Corrosion Products
1	1.53×10^{-8}	0.8	2.4×10^{-8}	6.0×10^{-7}	6.0×10^{-7}	2.0×10^{-3}
2	5.88×10^{-5}	0.14	4.1×10^{-9}	1.0×10^{-7}	1.0×10^{-7}	1.4×10^{-3}
3	1.81×10^{-6}	0.18	5.4×10^{-9}	1.3×10^{-7}	1.3×10^{-7}	1.8×10^{-3}
4	7.49×10^{-8}	0.84	3.6×10^{-5}	3.8×10^{-6}	3.8×10^{-6}	3.2×10^{-3}
5	4.65×10^{-7}	0.43	1.3×10^{-8}	3.2×10^{-7}	3.2×10^{-7}	1.8×10^{-3}
6	3.31×10^{-9}	0.49	1.5×10^{-8}	3.7×10^{-7}	3.7×10^{-7}	2.1×10^{-3}
7	0	0.85	2.7×10^{-5}	2.1×10^{-6}	2.1×10^{-6}	3.1×10^{-3}
8	1.13×10^{-8}	0.82	2.4×10^{-8}	6.1×10^{-7}	6.1×10^{-7}	2.0×10^{-2}
9	8.03×10^{-11}	0.89	2.7×10^{-8}	6.7×10^{-7}	6.7×10^{-7}	2.2×10^{-3}
10	0	0.91	5.9×10^{-6}	6.8×10^{-7}	6.8×10^{-7}	2.5×10^{-3}
11	1.44×10^{-10}	0.82	2.4×10^{-8}	6.1×10^{-7}	6.1×10^{-7}	2.0×10^{-3}
12	1.02×10^{-12}	0.89	2.7×10^{-8}	6.7×10^{-7}	6.7×10^{-7}	2.2×10^{-3}
13	0	0.91	5.9×10^{-6}	6.8×10^{-7}	6.8×10^{-7}	2.5×10^{-3}
14	7.49×10^{-11}	0.84	9.6×10^{-5}	8.4×10^{-5}	1.8×10^{-5}	6.4×10^{-3}
15	0	0.85	5.5×10^{-5}	5.0×10^{-5}	9.0×10^{-6}	5.9×10^{-3}
16	0	0.91	5.9×10^{-6}	6.4×10^{-6}	6.8×10^{-7}	3.3×10^{-3}
17	0	0.91	5.9×10^{-6}	6.4×10^{-6}	6.8×10^{-7}	3.3×10^{-3}
18	5.86×10^{-6}	0.84	1.7×10^{-5}	6.7×10^{-8}	6.7×10^{-8}	2.5×10^{-3}
19	0.99993	0	0	0	0	0

(a) Severity fractions are the conditional probabilities, given the occurrence of an accident, that the mechanical and thermal conditions experienced by a spent fuel shipping cask are within the conditions defined by the Severity Category. See Sprung et al. (2000) for detailed information about the derivation of these data.

(b) RADTRAN 5 also models the fraction of the released material that is of small enough particle size to be dispersible in prevailing wind conditions and the fraction that is respirable. For this analysis, these parameters were set to 1.0 (i.e., 100 percent dispersible and 100 percent respirable).

of LWR fuel and shipping casks to advanced LWR fuels and shipping casks is relatively straightforward because the fuel form, cladding, and physical and mechanical properties are similar. Furthermore, substantial experimental data exist to develop technically defensible release fractions for various radionuclide groups (e.g., gases, semi-volatiles such as cesium and ruthenium, and particulates). However, because detailed experimental studies of releases from GT-MHR and PBMR fuels have not been conducted, there are significant uncertainties about potential release quantities from these fuels. For this assessment, release fractions for current generation LWR fuels were used to approximate the impacts from the advanced reactor spent fuel shipments. This essentially assumes that the behavior of the fuel materials and containment systems (i.e., cladding, fuel coatings) is similar to that of current LWR fuel under applied mechanical and thermal conditions. Due to the lack of experimental data on gas-cooled reactor fuels, it is currently not known if this approach is bounding. However, gas-cooled reactors operate at much higher temperatures than LWRs; thus, high-temperature conditions anticipated in transportation accident fires are expected to have less effect on radionuclide releases than they would for LWR fuels. Smaller release fractions are consequently anticipated for advanced gas-cooled reactor fuels than for LWR fuels subjected to thermal transients.

For accidents that result in a release of radioactive material, RADTRAN 5 assumes the material is dispersed into the environment according to standard Gaussian diffusion models. The code allows the user to choose two different methods for modeling the atmospheric transport of radionuclides after a potential accident. The user can input either Pasquill atmospheric-stability category data or averaged time-integrated concentrations. In this analysis, the default standard cloud option (using time-integrated concentrations) was used.

RADTRAN 5 calculates the population dose from the released radioactive material for five possible exposure pathways:

- external dose from exposure to the passing cloud of radioactive material

- external dose from radionuclides deposited on the ground by the passing plume – The analysis included the radiation exposures from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.

- internal dose from inhalation of airborne radioactive contaminants

- internal dose from radioactive materials that were deposited on the ground and the resuspended – The analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

- internal dose from ingestion of contaminated food – Because the analysis assumed interdiction of foodstuffs and evacuation after an accident, no internal dose due to ingestion of contaminated foods was calculated.

A sixth pathway, external doses arising from increased radiation fields surrounding a shipping cask with damaged shielding, was considered but not included in the analysis. It is possible that shielding materials incorporated into the cask structures could become damaged as a result of an accident. For example, casks with lead shielding could undergo a slumping phenomenon in which impact or fire causes gaps to form in the lead. Radiation would penetrate through the gaps in the shielding at higher intensities, leading to higher radiation dose rates. These are commonly referred to as loss of shielding events. They were not included in this assessment because their contribution to spent fuel transportation risks is much smaller than the dispersal accident risks.

Standard radionuclide uptake and dosimetry models are incorporated into RADTRAN 5. The computer code combines the accident consequences and frequencies of each severity category, sums up the severity categories, and then integrates across all the shipments. Accident-risk impacts are provided in the form of a collective population dose (person-rem over the entire shipping campaign).

The shipping distances and population distribution information for the routes used for the evaluation of the impacts of incident-free transportation (see Table G-4) were also used to calculate transportation impacts. Representative shipping casks described above were assumed.

Table G-11 presents unit (per MTU) accident risks associated with transportation of spent fuel from each potential ESP site to the Yucca Mountain high-level waste repository.

Projected annual accident risks, normalized to the WASH-1238 (AEC 1972) reference LWR net electrical generation (i.e., 880 MW[e]) are presented in Table G-11. As expected, accident risks are highest for the longest shipments. Also, consistent with past spent fuel transportation risk assessments, the routine impacts are several orders of magnitude greater than accident impacts.

Considering the uncertainties in the data and computational methods, the overall transportation accident risks associated with ABWR, ESBWR, Surrogate AP1000, GT-MHR, and PBMR spent fuel shipments are judged to be small. Although likely to also be small, accident risks associated with IRIS and ACR-700 spent fuel shipments could not be analyzed due to lack of radionuclide source-term data. Additional analyses are necessary to quantify the impacts of IRIS and ACR-700 spent fuel shipments.

Table G-12 presents the environmental consequences of transportation accidents when shipping spent fuel from the proposed ESP sites and alternative sites to a spent fuel repository assumed to be at Yucca Mountain, Nevada. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions. The table presents estimates of population dose (person-Sv/reference reactor year) for several of the advanced reactor designs. These values are normalized to the WASH-1238 reference reactor (880-MW(e) net electrical generation, 1100-MW(e) reactor operating at 80 percent capacity).

Table G-11. Unit Spent Fuel Transportation Accident Risks for Advanced Reactors

	Advanced Reactor Type			
Site	ABWR/ ESBWR	Surrogate AP1000	GT-MHR	PBMR
Population Dose, person-Sv/MTU[a]				
Braidwood[b]	1.1×10^{-7}	1.0×10^{-8}	1.5×10^{-8}	2.5×10^{-8}
Clinton	5.1×10^{-7}	1.0×10^{-8}	1.5×10^{-8}	2.6×10^{-8}
Fitzpatrick	1.9×10^{-7}	1.7×10^{-8}	2.5×10^{-8}	4.3×10^{-8}
Grand Gulf[c]	2.1×10^{-7}	1.9×10^{-8}	2.8×10^{-8}	4.7×10^{-8}
North Anna	2.3×10^{-7}	2.1×10^{-8}	3.2×10^{-8}	5.4×10^{-8}
Pilgrim	4.0×10^{-7}	3.7×10^{-8}	5.8×10^{-8}	9.3×10^{-8}
Portsmouth	2.6×10^{-7}	2.1×10^{-8}	3.1×10^{-8}	5.2×10^{-8}
Quad Cities	1.0×10^{-7}	9.4×10^{-9}	1.4×10^{-8}	1.4×10^{-8}
Savannah River	2.6×10^{-7}	2.4×10^{-8}	3.6×10^{-8}	6.1×10^{-8}
Surry Power Station	2.4×10^{-7}	2.2×10^{-8}	3.3×10^{-8}	5.6×10^{-8}
Zion	1.5×10^{-7}	1.4×10^{-8}	2.1×10^{-8}	3.5×10^{-8}

(a) To convert to person-rem, multiply person-Sv by 100.
(b) The River Bend alternative site can be assumed to bounded by the Grand Gulf values because of the proximity of the sites.
(c) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). All the population doses presented in Table G-12 are less than 1.0×10^{-5} person-Sv (1.0×10^{-3} person-rem) per reference reactor year (100 person-rem/yr); therefore, the total detriment estimates associated

Table G-12. Annual Spent Fuel Transportation Accident Impacts for Advanced Reactors, Normalized to Reference LWR Net Electrical Generation

	Advanced Reactor Type			
MTU/reference	ABWR/ESBWR	Surrogate AP1000	GT-MHR	PBMR
reactor year	20.3	19.7	6.0	5.8
Population Dose, person-Sv/per reference reactor year[a]				
Braidwood[b]	2.2×10^{-6}	2.0×10^{-7}	8.9×10^{-8}	1.5×10^{-7}
Clinton	1.0×10^{-5}	2.0×10^{-7}	9.0×10^{-8}	1.5×10^{-7}
Fitzpatrick	3.8×10^{-6}	3.3×10^{-7}	1.5×10^{-7}	2.5×10^{-7}
Grand Gulf[c]	4.2×10^{-6}	3.7×10^{-7}	1.7×10^{-7}	2.7×10^{-7}
North Anna	4.7×10^{-6}	4.2×10^{-7}	1.9×10^{-7}	3.1×10^{-7}
Pilgrim	8.1×10^{-6}	7.2×10^{-7}	3.5×10^{-7}	5.4×10^{-7}
Portsmouth	5.2×10^{-6}	4.0×10^{-7}	1.8×10^{-7}	3.0×10^{-7}
Quad Cities	2.1×10^{-6}	1.8×10^{-7}	8.4×10^{-8}	8.2×10^{-8}
Savannah River	5.3×10^{-6}	4.7×10^{-7}	2.1×10^{-7}	3.5×10^{-7}
Surry Power Station	4.8×10^{-6}	4.3×10^{-7}	2.0×10^{-7}	3.2×10^{-7}
Zion	3.0×10^{-6}	2.7×10^{-7}	1.2×10^{-7}	2.0×10^{-7}

(a) Multiply person-Sv/reference reactor year times 100 to obtain doses in person-rem/reference reactor year.
(b) The River Bend alternative site can be assumed to be bounded by the Grand Gulf values because of the proximity of the sites.
(c) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

with these population doses would all be less than 1.0×10^{-6} fatal cancers, nonfatal cancers, and severe hereditary effects per reference reactor year. These risks are quite small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

G.3 Shipment of Radioactive Waste

This section discusses the environmental effects of transporting radioactive waste from advanced reactor sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- Radioactive waste (except spent fuel) is packaged and in a solid form.
- Radioactive waste (except spent fuel) is shipped from the reactor by truck or rail.

INEEL (2003) indicates that all of the advanced reactors will transport their radioactive waste by truck. Furthermore, INEEL (2003) indicates that all of the advanced reactors plan to solidify and package their radioactive waste. In addition, all of the advanced reactors will be subject to NRC (10 CFR Part 71) and Department of Transportation regulations for the shipment of radioactive material (49 CFR Parts 173 and 178).

Table S-4 also specifies the following conditions that apply to shipments of radioactive waste:

- weight – less than 33,000 kg (73,000 lb) per truck or 100 tons per cask per railcar
- traffic density – less than one truck shipment per day or three railcars per month.

The advanced reactors would be capable of shipping their radioactive wastes in compliance with Federal or State weight restrictions. With respect to the traffic density, all of the advanced reactor vendors provided radioactive waste generation estimates. Table G-13 provides these estimates, in addition to the radioactive waste generation estimates for the reference LWR in WASH-1238 (AEC 1972).

As shown in the table, only the PBMR generates a larger volume of radioactive waste than the reference LWR in WASH-1238. However, the GT-MHR and PBMR information in INEEL (2003) assumed these advanced reactors would ship wastes using two different packaging systems: one that hauls 28.3 m^3/shipment (1000 ft^3 per shipment) and one that hauls 5.7 m^3/shipment (200 ft^3/per shipment). Under those conditions, the number of shipments of radioactive waste per year, normalized to 1100 MW(e) electric generation capacity, would be about six shipments/year per 1100 MW(e) (880 net MW(e)) for the GT-MHR and seven shipments/year per 1100 MW(e) for the PBMR. These estimates are well below the reference LWR (42 shipments/yr per 1100 MW(e)). In any event, all the estimates are well below the one truck shipment per day condition given in 10 CFR 51.52, Table S-4. Doubling the shipment estimates to account for empty return shipments is still well below the one shipment per day condition.

Table G-13. Summary of Radioactive Waste Shipments for Advanced Reactors

Reactor Type	DOE (2003) Waste Generation Information	Annual Waste Volume, m^3/yr per Site	Electrical Output, MW(e) per Site	Normalized Rate, m^3/1100 MW(e) Reactor (880 MW(e) Net)[a]	Shipments/ 1100 MW(e) (880 MW(e) Net) Electrical Output[b]
Reference LWR (WASH-1238)	100 m^3/yr per reactor	108	1100	108	46
ABWR	100 m^3/yr per reactor	100	1500[f]	62	27
ESBWR	100 m^3/yr per reactor	100	1500[c]	62	27
Surrogate AP1000	55 m^3/yr per reactor	56	1150[c]	45	20
ACR-700	47.5 m^3/yr per reactor	95	1462[d]	64	28
IRIS	25 m^3/yr per reactor	74	1005[e]	67	29
GT-MHR	98 m^3/yr (4-reactor site)	98	1140[f]	86	37[h]
PBMR	100 drums/yr per reactor	168	1320[g]	118	51[h]

Conversions: 1 m^3 = 35.31 ft^3. *Drum volume = 210 liters (0.21 m^3).*

(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are given in Table 6-3 for each reactor type. All are normalized to 880 MW(e) net electrical output (1100-MW[e] plant with an 80 percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m^3 per shipment (108 m^3/yr divided by 46 shipments/yr).

(c) The ABWR and ESBWR sites include one reactor at 1500 MW(e) and the surrogate AP1000 site includes one reactor at 1150 MW(e).

(d) The ACR-700 site includes two reactors at 731 MW(e) per reactor.

(e) The IRIS site includes three reactors at 335 MW(e) per reactor.

(f) The GT-MHR site includes four reactors at 285 MW(e) per reactor.

(g) The PBMR site includes eight reactors at 165 MW(e) per reactor.

(h) The applicant states in INEEL (2003) that 90 percent of the waste could be shipped on trucks carrying 28 m^3 (1000 ft^3) of waste and the remaining 10 percent in shipments carrying 5.7 m^3 (200 ft^3) of radioactive waste. This would result in six to seven shipments per year after normalization to the reference LWR electrical output.

G.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 71. Code of Federal Regulations Title 10, *Energy*, "Packaging and Transportation of Radioactive Material."

49 CFR Part 173. Code of Federal Regulations. Title 49, *Transportation*, Part 173, "Shippers - General Requirements for Shipments and Packagings." 49 CFR Part 178. Code of Federal Regulations. Title 49, *Transportation*, Part 178, "Specifications for Packagings."

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Appendix H

Supporting Documentation on Radiological Dose Assessment

Appendix H

Supporting Documentation on Radiological Dose Assessment

The staff performed an independent radiological dose assessment on the radiological impacts of normal operation for a new nuclear unit at the Exelon Generation Company, LLC (Exelon) early site permit (ESP) site. Results of this assessment are presented in this appendix and are compared to Exelon's results found in Section 5.9 ("Radiological Impacts of Normal Operation.") The appendix is divided into three sections: (1) dose estimates to the public from liquid effluents, (2) dose estimates to the public from gaseous effluents, and (3) dose estimates to the biota from both the liquid and gaseous effluents.

For comparative purposes with Exelon's estimates, all doses and radioactivity levels are reported in millirem (mrem) and curies (Ci), respectively.

H.1 Dose Estimates to the Public from Liquid Effluents

The staff used the LADTAP II code (Strenge et al. 1986) and input parameters supplied by Exelon in its Environmental Report (ER) (Exelon 2003) to estimate doses to the maximally exposed individual from the liquid effluent pathway. Population doses were not calculated for radioactive liquid effluents.

H.1.1 Scope

Doses to the maximally exposed individual were calculated for the following:

- *Total Body* – Dose was the total for all pathways (i.e., fish consumption, shoreline usage, swimming exposure, boating) with the highest value for either the adult, teen, child, or infant compared to the 0.03 mSv/yr (3 mrem/yr) per reactor design objective in Title 10 of the Code of Federal Regulations (CFR), Part 50, Appendix I.

- *Organ* – Dose was the total for each organ for all pathways (i.e., fish consumption, shoreline usage, swimming exposure, boating) with the highest value for either the adult, teen, child, or infant compared to the 0.1 mSv/yr (10 mrem/yr) per reactor design objective in 10 CFR Part 50, Appendix I.

The input parameters used by Exelon were reviewed for appropriateness. If appropriate they were used as inputs into LADTAP II for the U.S. Nuclear Regulatory Commission (NRC) staff's independent calculation. Default values from Regulatory Guide 1.109 (NRC 1977) were used when input parameters were not available or Exelon's parameters were determined not to be appropriate.

Population doses were not calculated because (1) there are no municipal or industrial water intakes within 80 km (50 mi) downstream of the ESP site, and (2) no commercial fishing is allowed on Salt Creek. The only possible aquatic pathway would be sport fishing on Clinton Lake; however, detailed dilution and statistics on the number of fish caught by sport fishermen were not available (Exelon 2003).

H.1.2 Resources Used

The staff used a personal computer (PC) version of the LADTAP II code entitled "NRCDOSE," obtained through the Oak Ridge Radiation Safety Information Computational Center (RSICC) to calculate doses to the public from liquid effluents. Version 2.3.5 of NRCDOSE was used. The PC version of the code was written by Chesapeake Nuclear Company.

H.1.3 Input Parameters

Table H-1 provides a listing of the major parameters used in calculating dose to the public from liquid effluent releases during normal operation. The values used by the applicant and the staff for each parameter are listed along with the appropriateness of the value.

Table H-1. Parameters Used in Calculating Dose to the Public from Liquid Effluent Releases

Parameter	Exelon Value		Staff Value		Comments (Appropriateness of Value)
Source term (Ci/yr)[a]	Table 3.5-1 of Exelon (2003) (modified as discussed in "Comments" column)		Table 3.5-1 of Exelon (2003)		The source term used in the Exelon calculation differs from Table 3.5-1 for the radionuclides where ACR-700 releases were bounding to include C-14, Cr-51, Fe-59, Co-60, Zr-95, Nb-95, and Sb-124. These releases were higher in the Exelon source term. After calculations were initially performed by Exelon, the ACR-700 liquid effluent
	H-3	3.1×10^{3}	H-3	3.1×10^{3}	
	Na-24	3.26×10^{-3}	Na-24	3.26×10^{-3}	
	Cr-51	9.73×10^{-3}	Cr-51	7.7×10^{-3}	
	Mn-54	2.6×10^{-3}	Mn-54	2.6×10^{-3}	
	Mn-56	3.81×10^{-3}	Mn-56	3.81×10^{-3}	
	Fe-55	5.81×10^{-3}	Fe-55	5.81×10^{-3}	
	Fe-59	5.08×10^{-4}	Fe-59	4.0×10^{-4}	
	Co-57	7.19×10^{-5}	Co-57	7.19×10^{-5}	
	Co-58	6.72×10^{-3}	Co-58	6.72×10^{-3}	

Table H-1. (contd)

Parameter	Exelon Value	Staff Value	Comments (appropriateness of value)
Source term (Ci/yr)[a] (contd)	Co-60 1.35×10^{-2}	Co-60 9.11×10^{-3}	releases were revised; however, because initial calculations were bounding, Exelon chose not to recalculate doses. Therefore, Exelon doses may be slightly higher than the staff's.
	Zn-65 8.2×10^{-4}	Zn-65 8.2×10^{-4}	
	Rb-88 5.4×10^{-4}	Rb-88 5.4×10^{-4}	
	Sr-89 2.0×10^{-4}	Sr-89 2.0×10^{-4}	
	Sr-90 3.51×10^{-5}	Sr-90 3.51×10^{-5}	
	Nb-95 1.95×10^{-2}	Nb-95 1.91×10^{-3}	
	Zr-95 9.19×10^{-3}	Zr-95 1.04×10^{-3}	
	Mo-99 1.14×10^{-3}	Mo-99 1.14×10^{-3}	
	Tc-99m 1.1×10^{-3}	Tc-99m 1.1×10^{-3}	
	Ru-103 9.86×10^{-3}	Ru-103 9.86×10^{-3}	Both the Exelon and NRC staff used the LADTAP II code to calculate doses. The code accepts only 35 radionuclides; therefore, the 35 radionuclides listed here represent those that contribute significantly to dose.
	Ru-106 1.47×10^{-1}	Ru-106 1.47×10^{-1}	
	Ag-110m 2.1×10^{-3}	Ag-110m 2.1×10^{-3}	
	Sb-124 1.78×10^{-3}	Sb-124 6.79×10^{-4}	
	I-131 2.83×10^{-2}	I-131 2.83×10^{-2}	
	I-132 3.28×10^{-3}	I-132 3.28×10^{-3}	
	I-133 1.34×10^{-2}	I-133 1.34×10^{-2}	
	I-134 1.7×10^{-3}	I-134 1.7×10^{-3}	
	I-135 9.94×10^{-3}	I-135 9.94×10^{-3}	
	Cs-134 1.99×10^{-2}	Cs-134 1.99×10^{-2}	
	Cs-136 1.26×10^{-3}	Cs-136 1.26×10^{-3}	
	Cs-137 2.66×10^{-2}	Cs-137 2.66×10^{-2}	
	Cs-138 1.9×10^{-4}	Cs-138 1.9×10^{-4}	
	Ba-140 1.1×10^{-2}	Ba-140 1.1×10^{-2}	
	La-140 1.49×10^{-2}	La-140 1.49×10^{-2}	
	Ce-141 1.8×10^{-4}	Ce-141 1.8×10^{-4}	
	Ce-144 6.32×10^{-4}	Ce-144 6.32×10^{-4}	
Discharge flow rate m^3/s (ft^3/s)	0.152 (5.35)	0.152 (5.35)	Site-specific value from Exelon (2003) - Table 5.4-1
Source term multiplier	1	1	Site-specific value from Exelon (2003)
Site type	Fresh water	Fresh water	Site-specific value from Exelon (2003)
Reconcentration model	Partially mixed	Partially mixed	Site-specific value from Exelon (2003)
Effluent discharge rate from impoundment system to receiving water body m^3/s (ft^3/s)	5.61 (198)	5.61 (198)	Site-specific value from Exelon (2003)

Table H-1. (contd)

Parameter	Exelon Value	Staff Value	Comments (appropriateness of value)
Impoundment total volume m^3 (ft^3)	9.1×10^7 (3.2×10^9)	9.1×10^7 (3.2×10^9)	Site-specific value from Exelon (2003) - Table 5.4-1
Shore width factor	0.3	0.3	Site-specific value from Exelon (2003) - appropriate per guidance in NRC (1977)
Dilution factors for aquatic food and boating, shoreline and swimming, and drinking water	1	1	Site-specific value from Exelon (2003) - conservative value
Transit time (hr)	0	0	Site-specific value from Exelon (2003) - conservative value
Consumption and usage factors for adults, teens, children, and infants	Values from Table 5.4-2 of Exelon (2003)	Values from Table 5.4-2 of Exelon (2003)	Default values from Regulatory Guide 1.109 (NRC 1977)

(a) To convert Ci/yr to Bq/yr, multiply the value by 3.7×10^{10}.

H.1.4 Comparison of Results

Table H-2 compares the applicant's results with those performed by the staff. Doses calculated were similar.

The LADTAPI code will accept only 35 radionuclides. The staff used the 35 primary radionuclides listed in Table H-1 in their calculations. Another computer run was made with the remaining radionuclides listed in Table 3.5-1 of Exelon (2003). The results are shown in Table H-3 and confirmed that the remaining radionuclides contribute insignificantly (less than 1 percent) to the dose.

Table H-2. Comparison of Doses to the Public from Liquid Effluent Releases

Type of Dose	Exelon's ER (Exelon 2003)[a]	Staff's Calculation[a]	Percent Difference
Total Body (mrem/yr)	0.95 (adult)	0.95 (adult)	0
Organ Dose (mrem/yr)	1.33 (teen liver)	1.32 (teen liver)	-0.8

(a) To convert mrem/yr to mSv/yr divide by 100.

Table H-3. Impact on Dose from Remaining Radionuclides in Liquid Effluent Source Term

Type of Dose	Dose from Remaining Radionuclides[a]	Dose from Primary Radionuclides[a]	Percent Contribution to Dose from Remaining Radionuclides
Total Body (mrem/yr)	1.46×10^{-4} (adult)	0.95 (adult)	0.015
Organ Dose (mrem/yr)	1.69×10^{-4} (teen liver)	1.32 (teen liver)	0.013

(a) To convert mrem/yr to an Sv/yr, divide by 100.

H.2 Dose Estimates to the Public from Gaseous Effluents

The staff used the GASPAR II code (Strenge et al. 1987) and input parameters supplied by Exelon in its ER (Exelon 2003) to estimate doses to the maximally exposed individual and to the population within an 80-km (50-mile) radius of the ESP site from the gaseous effluent pathway.

H.2.1 Scope

The staff calculated gamma air dose, beta air dose, total body dose, and skin dose from noble gases at the exclusion area boundary located 1.2 km (0.64 mi) north-northeast of the ESP site. Dose to the maximally exposed individual was also calculated for the following locations:

- Nearest residence (plume and inhalation)
- Nearest garden (vegetable)
- Nearest meat cow (meat)
- Nearest milk cow
- Nearest milk goat.

The input parameters used by the applicant were found in Exelon (2003) or the applicant's supporting calculation sheets. These parameters were reviewed for appropriateness. If appropriate, they were used as inputs into GASPAR II for the staff's independent calculation. Default values from Regulatory Guide 1.109 (NRC 1977) were used when input parameters were not available or if an applicant's parameter was determined not to be appropriate.

Population doses were calculated for the following pathways (plume, ground, inhalation, vegetable ingestion, cow milk ingestion, and meat ingestion) using the GASPAR II code.

H.2.2 Resources Used

The staff used a PC version of GASPAR II code entitled "NRCDOSE" obtained through the Oak Ridge RSICC to calculate doses to the public from gaseous effluents. Version 2.3.5 of NRCDOSE was used. The PC version of the code was written by Chesapeake Nuclear Company.

H.2.3 Input Parameters

Table H-4 provides a list of the major parameters used in calculating dose to the public from gaseous effluent releases during normal operation. The values used by the applicant and the staff for each parameter are listed along with the appropriateness of the value.

Table H-4. Parameters Used in Calculating Dose to Public from Gaseous Effluent Releases

Parameter	Exelon Value		Staff Value		Comments (Appropriateness of Value)
Source term for calculating noble gas dose at exclusion area boundary (Ci/yr)[a]	Table 3.5-3 of Exelon (2003)		Table 3.5-3 of Exelon (2003)		These are bounding plant parameter envelope (PPE) values and are appropriate.
	Ar-41	4.0×10^2	Ar-41	4.0×10^2	
	Kr-85	8.2×10^3	Kr-85	8.2×10^3	
	Kr-85m	7.2×10^1	Kr-85m	7.2×10^1	
	Kr-87	3.0×10^1	Kr-87	3.0×10^1	
	Kr-88	9.2×10^1	Kr-88	9.2×10^1	
	Kr-89	2.41×10^2	Kr-89	2.41×10^2	
	Xe-131m	3.6×10^3	Xe-131m	3.6×10^3	
	Xe-133	9.2×10^3	Xe-133	9.2×10^3	
	Xe-133m	1.74×10^2	Xe-133m	1.74×10^2	
	Xe-135	6.6×10^2	Xe-135	6.6×10^2	
	Xe-135m	4.05×10^2	Xe-135m	4.05×10^2	
	Xe-137	5.14×10^2	Xe-137	5.14×10^2	
	Xe-138	4.32×10^2	Xe-138	4.32×10^2	
Source term for calculating dose to the maximally exposed individual (Ci/yr)[a]	Ar-41	4.0×10^2	Ar-41	4.0×10^2	These are bounding PPE values and are appropriate.
	Kr-85	8.2×10^3	Kr-85	8.2×10^3	
	Kr-85m	7.2×10^1	Kr-85m	7.2×10^1	
	Kr-87	3.0×10^1	Kr-87	3.0×10^1	
	Kr-88	9.2×10^1	Kr-88	9.2×10^1	The GASPAR II code
	Kr-89	2.41×10^2	Kr-89	2.41×10^2	accepts only 33

Table H-4. *(contd)*

Parameter	Exelon Value	Staff Value	Comments (Appropriateness of Value)
	Xe-131m 3.6×10^{3}	Xe-131m 3.6×10^{3}	radio nuclides; therefore, the radionuclides listed here represent those that significantly contribute to the dose from gaseous effluents.
	Xe-133 9.2×10^{3}	Xe-133 9.2×10^{3}	
	Xe-135 6.6×10^{2}	Xe-135 6.6×10^{2}	
	Xe-135m 4.05×10^{2}	Xe-135m 4.05×10^{2}	
	Xe-137 5.14×10^{2}	Xe-137 5.14×10^{2}	
	Xe-138 4.32×10^{2}	Xe-138 4.32×10^{2}	
	I-131 2.59×10^{-1}	I-131 2.59×10^{-1}	
	I-132 2.19×10^{0}	I-132 2.19×10^{0}	
	I-133 1.7×10^{0}	I-133 1.7×10^{0}	
	I-134 3.78×10^{0}	I-134 3.78×10^{0}	
	I-135 2.41×10^{0}	I-135 2.41×10^{0}	
	H-3 3.53×10^{3}	H-3 3.53×10^{3}	
	C-14 1.46×10^{1}	C-14 1.46×10^{1}	
	Mn-54 5.41×10^{-3}	Mn-54 5.41×10^{-3}	
	Fe-55 6.49×10^{-3}	Fe-55 6.49×10^{-3}	
	Co-58 4.6×10^{-2}	Co-58 4.6×10^{-2}	
	Co-60 1.74×10^{-2}	Co-60 1.74×10^{-2}	
	Fe-59 8.11×10^{-4}	Fe-59 8.11×10^{-4}	
	Zn-65 1.1×10^{-2}	Zn-65 1.1×10^{-2}	
	Sr-89 6.0×10^{-3}	Sr-89 6.0×10^{-3}	
	Sr-90 2.4×10^{-3}	Sr-90 2.4×10^{-3}	
	Zr-95 2.0×10^{-3}	Zr-95 2.0×10^{-3}	
	Nb-95 3.8×10^{-3}	Nb-95 3.8×10^{-3}	
	Ru-103 3.51×10^{-3}	Ru-103 3.51×10^{-3}	
	Sb-124 1.81×10^{-4}	Sb-124 1.81×10^{-4}	
	Cs-134 6.22×10^{-3}	Cs-134 6.22×10^{-3}	
	Cs-137 9.46×10^{-3}	Cs-137 9.46×10^{-3}	
Population distribution	Used data from Exelon's supporting documentation (equivalent to data found in Tables 2.5-1 and 2.5-3 of Exelon [2003])	Used data from Exelon's supporting documentation (equivalent to data found in Tables 2.5-1 and 2.5-3 of Exelon [2003])	Site-specific data - appropriate for use
Atmospheric dispersion factors (sec/m^3)	Used data from Exelon's supporting documentation (equivalent to Tables 2.7-53, 2.7-55, and 2.7-56 of Exelon [2003])	Used data from Exelon's supporting documentation (equivalent to Tables 2.7-53, 2.7-55, and 2.7-56 of Exelon [2003])	Site-specific data - appropriate for use

Table H-4. (contd)

Parameter	Exelon Value	Staff Value	Comments (Appropriateness of Value)
Ground deposition factors (m^{-2})	Used data from Exelon's supporting documentation (equivalent to Table 2.7-54 of Exelon [2003])	Used data from Exelon's supporting documentation (equivalent to Table 2.7-54 of Exelon [2003])	Site-specific data - appropriate for use
Milk production rate within 80 km (50 mi) (L/yr)	Used data from Exelon's supporting documentation	Used data from Exelon's supporting documentation	Site-specific data - appropriate for use
Meat production rate within 80 km (50 mi) (kg/yr)	Used data from Exelon's supporting documentation	Used data from Exelon's supporting documentation	Site-specific data - appropriate for use
Vegetable/fruit production rate within 80 km (50 mi) (kg/yr)	Used data from Exelon's supporting documentation	Used data from Exelon's supporting documentation	Site-specific data - appropriate for use
Pathway receptor locations (direction, distance, and atmospheric dispersion factors)- nearest site boundary, vegetable garden, residence, meat animal	Used data from Exelon's supporting documentation (equivalent to Table 2.7-53 of Exelon [2003])	Used data from Exelon's supporting documentation (equivalent to Table 2.7-53 of Exelon [2003])	Site-specific data - appropriate for use
Consumption factors for leafy vegetables, meat, milk, and vegetable/fruit	Table 5.4-4 of Exelon (2003)	Table 5.4-4 of Exelon (2003)	Site-specific data - appropriate for use
Fraction of year leafy vegetables are grown	0.33	0.33	Site-specific data - appropriate for use
Fraction of year that milk cows are on pasture	0.58	0.58	Site-specific data - appropriate for use
Fraction of milk-cow intake that is from pasture while on pasture	1.0	1.0	Default value of GASPAR II code

Table H-4. (contd)

Parameter	Exelon Value	Staff Value	Comments (Appropriateness of Value)
Average absolute humidity over the growing season	8.0 g/m^3	8.0 g/m^3	Default value of GASPAR II code
Average temperature over the growing season	0	0	Default value of GASPAR II code
Fraction of year goats are on pasture	0.67	0.67	Site-specific data - appropriate for use
Fraction of year beef-cattle are on pasture	0.58	0.58	Site-specific data - appropriate for use
Fraction of beef-cattle intake that is from pasture while on pasture	1.0	1.0	Default value of GASPAR II code

(a) To convert Ci/yr to Bq/yr, multiply the value by 3.7 x 10^{10}.

H.2.4 Comparison of Doses to the Public from Gaseous Effluent Releases

Table H-5 compares Exelon's results for doses from noble gases at the exclusion area boundary with the results calculated by the staff. Doses calculated were similar.

Table H-5. Comparison of Doses to the Public from Noble Gas Releases

Type of Dose	Exelon's ER (Exelon 2003)	Staff's Calculation	Percent Difference
Gamma air dose at exclusion area boundary – noble gases only (mrad/yr)[(a)]	1.35	1.35	0
Beta air dose at exclusion area boundary – noble gases only (mrad/yr)[(a)]	2.89	2.91	0.7
Total body dose at exclusion area boundary – noble gases only (mrem/yr)[(a)]	0.875	0.877	0.2
Skin dose at exclusion area boundary – noble gases only (mrem/yr)[(a)]	2.94	2.95	0.3

(a) To convert from mrad/yr or mrem/yr to mGy/yr or mSv/yr, divide by 100.

Table H-6 compares doses to the maximally exposed individual calculated by Exelon and the staff. Doses to the maximally exposed individual were calculated at the nearest residence, nearest garden, nearest meat cow, and nearest milk cow. Doses calculated were similar.

Table H-6. Comparison of Doses to the Maximally Exposed Individual from Gaseous Effluent Releases

Location	Pathway	Total Body Dose (mrem/yr)[a, b]	Skin Dose (mrem/yr)[a, b]	Thyroid Dose (mrem/yr)[a, b]
Nearest residence, 1.2 km (0.73 mi) SW	Plume	0.39 (0.39)	1.4 (1.4)	--
Nearest residence, 1.2 km (0.73 mi) SW	Inhalation			
	Adult	0.12 (0.12)	--	0.48 (0.48)
	Teen	0.12 (0.12)	--	0.60 (0.60)
	Child	0.11 (0.11)	--	0.70 (0.70)
	Infant	0.063 (0.063)	--	0.60 (0.60)
Nearest garden, 1.5 km (0.93 mi) N	Vegetable			
	Adult	0.27 (0.27)	--	2.6 (2.6)
	Teen	0.36 (0.36)	--	3.6 (3.6)
	Child	0.68 (0.68)	--	7.0 (7.0)
Nearest meat animal, 1.5 km (0.93 mi) N	Meat			
	Adult	0.061 (0.061)	--	--
	Teen	0.045 (0.045)	--	--
	Child	0.073 (0.073)	--	--
Nearest milk cow,[c] 8.1 km (5.0 mi) N	Cow Milk			0.15 (0.15)
	Adult	0.0097 (0.0097)	--	0.24 (0.24)
	Teen	0.014 (0.0.14)	--	0.47 (0.47)
	Child	0.027 (0.027)	--	1.1 (1.1)
	Infant	0.050 (0.050)	--	
Nearest milk goat,[d] 7.1 km (4.4 mi) SE	Goat Milk			
	Adult	0.015 (0.015)	--	0.17 (0.17)
	Teen	0.02 (0.02)	--	0.27 (0.27)
	Child	0.034 (0.034)	--	0.54 (0.54)
	Infant	0.059 (0.059)	--	1.3 (1.3)

(a) Values in parentheses represent the values that the staff calculated. The Exelon values (those not in parentheses were taken from Table 5.4-6 of Exelon (2003).
(b) To convert from mrem/yr to mSv/yr, divide by 100.
(c) This distance and direction from the ESP site represent the location of the nearest cow producing milk for human consumption.
(d) This distance and direction from the ESP site represent the location of the nearest milk goat. In Table 2.7-53 of the ER (Exelon 2003), the largest atmospheric dispersion factor for the nearest milk goat is listed at a distance of 8 km (6 mi) north of the ESP site. This atmospheric dispersion factor is 15 percent greater than the atmospheric dispersion factor used in Exelon's calculation; however, it would not result in a significant increase in the dose to the maximally exposed individual.

H.2.5 Comparison of Results - Population Doses

Table H-7 compares the Exelon's population dose estimates taken from Table 5.4-11 of Exelon (2003) with the staff's estimate. Doses calculated were similar.

Table H-7. Comparison of Population Doses from Gaseous Effluent Releases

Pathway	Applicant's Estimate	Staff's Estimate	Percent Difference
	TOTAL BODY (person-rem/yr)[(a)]		
Plume	0.403	0.403	0%
Ground	0.145	0.145	0%
Inhalation	0.480	0.48	0%
Vegetable ingestion	0.108	0.108	0%
Cow-milk ingestion	0.392	0.391	0.3%
Meat ingestion	0.298	0.298	0%
Total	1.830	1.82	-0.6%
	THYROID (WORST CASE ORGAN) (person-rem/yr)[(a)]		
Plume	0.403	0.403	0%
Ground	0.145	0.145	0%
Inhalation	1.530	1.52	-0.7%
Vegetable ingestion	0.109	0.109	0%
Cow-milk ingestion	3.350	3.16	-5.7%
Meat ingestion	0.42	0.415	-1.2%
Total	5.95	5.75	-3.4%

(a) To convert from person-rem/yr to person-Sv/yr, divide by 100.

H.3 Dose Estimates to the Biota from Liquid and Gaseous Effluents

To estimate doses to the biota from the liquid and gaseous effluent pathways, the staff used the LADTAP II code (Strenge et al. 1986) and the GASPAR II code (Strenge et al. 1987) and input parameters supplied by Exelon as part of its ER (Exelon 2003).

H.3.1 Scope

Doses to both terrestrial and aquatic biota were calculated using the LADTAP II code. Aquatic biota include fish, invertebrates, and algae. Terrestrial biota include muskrat, raccoon, heron, and duck. The LAPTAP II code calculates an internal dose component and an external dose component and sums them for a total body dose. The input parameters used by Exelon were reviewed for appropriateness. If appropriate, they were used as inputs into LADTAP II code for the staff's independent calculation. Default values from Regulatory Guide 1.109 (NRC 1977) were used when input parameters were not available or Exelon's parameters were determined not to be appropriate.

The LADTAP II code calculates only biota dose from the liquid effluent pathway. Terrestrial biota could also be exposed via the gaseous effluent pathway. These values would be the same as those for the maximally exposed individual calculated using the GASPAR II code. Exelon (2003) used the maximally exposed individual doses at the exclusion area boundary (1.2 km [0.64 mi] from the plant) to estimate these doses. The maximally exposed individual calculation for the biota assumed a ground deposition factor twice that used in the maximally exposed individual calculation for a member of the public. Gaseous doses are not significant compared to the liquid pathway.

H.3.2 Resources Used

To calculate doses to the public, (Version 2.3.5) the staff used a computer code entitled "NRCDOSE" a PC version of the LADTAP II code, and the GASPAR II code obtained through the Oak Ridge RSICC. The PC version of NRCDOSE was written by Chesapeake Nuclear Company.

H.3.3 Input Parameters

Most of the LADTAP II input parameters are specified in Section H.1.3 to include the source term, discharge flow rate, reconcentration model, effluent discharge rate from the impoundment system to the receiving water body, impoundment total volume, and shore width factor. Parameters unique to the biota dose calculation were taken from Table 5.4-15 (terrestrial biota parameters), Table 5.4-16 (shoreline and swimming exposures), and Table 5.4-17 of the ER (Exelon 2003). These parameters were default values used in the LADTAP II code (Strenge et al. 1986) and are appropriate values to use in calculating biota dose.

H.3.4 Comparison of Results

Table H-8 compares Exelon's biota dose estimates from liquid effluents taken from Table 5.4-18 of Exelon (2003) with the staff's estimate. Dose estimates were similar.

Table H-9 compares Exelon's biota dose estimates for gaseous effluents taken from Table 5.4-18 of Exelon (2003) with the staff's estimate. Dose estimates were similar except for the staff's dose estimate to the heron, which were approximately twice that of the applicant. The difference is likely due to the applicant's considering the heron to be present at the impact site only 50 percent of the time, which is a reasonable assumption.

Table H-8. Comparison of Dose Estimates to Biota from Liquid Effluents

Biota	Type of Dose	Exelon's ER (mrad/yr)[(a)]	Staff's Calculation (mrad/yr)[(a)]	Percent Difference
Fish	Internal	2.43	2.42	-0.4
	External	3.82	3.81	-0.3
Invertebrates	Internal	6.11	6.75	10.5
	External	7.63	7.61	-0.3
Algae	Internal	27.8	30.9	11
	External	0.00718	0.00701	-2.4
Muskrat	Internal	13.4	15.1	12.7
	External	2.55	2.54	-0.4
Raccoon	Internal	4.57	5.16	12.9
	External	1.91	1.9	-0.5
Heron	Internal	66.3	75.1	13.3
	External	2.55	2.54	-0.4
Duck	Internal	12.0	13.5	12.5
	External	3.82	3.81	-0.3

(a) To convert from mrad/yr to mGy/yr, divide by 100.

Table H-9. Comparison of Dose Estimates to Biota from Gaseous Effluents

Biota	Type of Dose	Exelon's ER (mrad/yr)[(a)]	Staff's Calculation (mrad/yr)[(a)]	Percent Difference
Fish	Internal	--	--	--
	External	--	--	--
Invertebrates	Internal	--	--	--
	External	--	--	--
Algae	Internal	--	--	--
	External	--	--	--
Muskrat	Internal	0.166	0.166	0
	External	1.06	1.44[(c)]	36
Raccoon	Internal	0.166	0.166	0
	External	1.44	1.44[(c)]	0
Heron	Internal	0.083	0.166	100[(b)]
	External	0.627	1.44[(c)]	130[(b)]
Duck	Internal	0.166	0.166	0
	External	1.16	1.44[(c)]	36

(a) To convert from mrad/yr to mGy/yr divide by 100.
(b) Difference is likely due to the applicant considering the heron to be present at the impact site only 50 percent of the time. This is a reasonable assumption.
(c) This dose is equal to the sum of the total body dose from the plume and twice the ground deposition dose at the exclusion area boundary (1.2 km [0.64 mi] from the plant): 0.875 mrad+ 2 (0.284 mrad) = 1.44 mrad.

H.4 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

Exelon Generation Company, LLC (Exelon). 2003. *Exelon Generation Company, LLC, Early Site Permit: Environmental Report.* Exelon Nuclear, Kennett Square, Pennsylvania.

Strenge, D.L., R.A .Peloquin, and G. Whelan. 1986. *LADTAP II – Technical Reference and User Guide.* NUREG/CR-4013, Pacific Northwest Laboratory, Richland, Washington.

Strenge, D.L., T.J. Bander, and J.K. Soldat. 1987. *GASPAR II – Technical Reference and User Guide.* NUREG/CR-4653, Pacific Northwest Laboratory, Richland, Washington.

U.S. Nuclear Regulatory Commission (NRC). 1977. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I.* Regulatory Guide 1.109, NRC, Washington, D.C.

Appendix I

Authorizations and Consultations

Appendix I

Authorizations and Consultations

This appendix contains a list of the environmental-related authorizations, permits, and certifications potentially required by Federal, Sate, regional, local, and affected Native American tribal agencies related to the construction and operation of the potential new nuclear unit at the Exelon ESP site, reproduced from Table 1.2-1 of the Environmental Report.

Table I-1. Federal, State, and Local Authorizations

Agency	Authority	Requirement	License/ Permit No.	Expiration Date	Authorization Granted
U.S. Nuclear Regulatory Commission (USNRC)	10 CFR 40	Source Material License	—[a]	—[a]	Possession of source material
USNRC	Atomic Energy Act of 1954 (AEA), 10 CFR 51	ER	—[a]	—[a]	Site approval for a nuclear power station separate from an application for a standard design certification or combined operating license (COL)
USNRC	10 CFR 52	COL	—[a]	—[a]	Construction and Operation Safety Review for a nuclear power station
USNRC	10 CFR 70	Special Nuclear Materials License	—[a]	—[a]	Possession of fuel
USNRC	10 CFR 30	By-product License	—[a]	—[a]	Possession of special nuclear materials
U.S. Fish and Wildlife Services (USFWS)	Threatened and Endangered Species Act	Letter of Compliance	—[a]	—[a]	Compliance with Threatened and Endangered Species Act
Federal Aviation Administration (FAA)	49 USC 1501	Construction Notice	—[a]	—[a]	Construction of structures affecting air navigation

Table I-1. (contd)

Agency	Authority	Requirement	License/ Permit No.	Expiration Date	Authorization Granted
U.S. Environmental Protection Agency (USEPA)	Clean Water Act (CWA)	Storm Water Pollution Prevention Plan (SWP3)	—[a]	—[a]	Discharge of storm water associated with construction activities
US Army Corps of Engineers (USACOE)	CWA	Section 404 Permit	—[a]	—[a]	Disturbance of the crossing of a navigable stream
USACOE	Section 404 Conditional Permit	Walleye Spawning Areas Permit	—[a]	—[a]	Disturbances of walleye spawning areas
USACOE	33 CFR 209	Dredge and Fill Discharge Permit	—[a]	—[a]	Construction/modification of the discharge to Salt Creek
State Historic Preservation Office (SHPO)	36 CFR 800	Cultural Resources Review	—[a]	—[a]	Confirmation that site and transmission line right-of-way are not considered historic preservation areas
Illinois Commerce Commission	Illinois Public Utilities Act	Certification of Public Convenience and Necessity	—[a]	—[a]	Construction and operation of plant
Illinois Department of Transportation (IDOT)	Illinois Rev. Stat. 1971	Construction Permit	—[a]	—[a]	Construct lift crane
(IDOT)	Illinois Rev. Stat. 1971	Construction Permit	—[a]	—[a]	Construct dome lighting mast
IDOT	Illinois Commerce Act 1911	Construction Permit	—[a]	—[a]	Construction/modification of discharge structures on Salt Creek

Table I-1. (contd)

	Agency	Authority	Requirement	License/ Permit No.	Expiration Date	Authorization Granted
1	IDOT	Illinois Commerce Act 1911	Construction Permit[b]	–[a]	–[a]	Construction of transmission lines crossing waterways
2	IDOT	Illinois Commerce Act 1911	Construction Permit[b]	–[a]	–[a]	Construction of transmission lines crossing state highways
3 4 5 6	Illinois Environmental Protection Agency (IEPA)	Resource Conservation and Recovery Act (RCRA)	Development (DE), Operating (OP), and Supplemental Permits	–[a]	–[a]	Storage and transportation of hazardous materials
7	IEPA	17 IL Adm. Code Part 120	Surface Water Withdrawal Permit	–[a]	–[a]	Withdrawal of water from a public surface water source
8	IEPA	CWA	IEPA Section 401 Water Quality Certification	–[a]	–[a]	Certification that activities will comply with water quality standards of the State
9	IEPA	General permit for discharges associated with construction activities	Notice of Intent (NOI) for Construction	–[a]	–[a]	Discharge of storm water from site during construction
10	IEPA	General permit for discharges associated with construction activities	Notice of Termination (NOT) for Construction	–[a]	–[a]	Termination of coverage under the general permit for storm water discharge associated with construction site activities
11	IEPA	CWA	NPDES Permit	–[a]	–[a]	Discharges to surface water

Table I-1. (contd)

	Agency	Authority	Requirement	License/ Permit No.	Expiration Date	Authorization Granted
1	IEPA	CAA	Minor Source Construction Permit	–[a]	–[a]	Construction and operation of facilities generating air emissions
2	IEPA	Title V	Title V Operating Permit	–[a]	–[a]	Operation of facility generating air emissions
3	IEPA	General Storm Water Permit	Notice of Termination (NOT) for Industrial Activities	–[a]	–[a]	Termination of coverage under the general permit for storm water discharge associated with operations activities
4	IEPA	Environmental Protection Act (415 ILCS 5)	Sanitary Waste Water Hauling Permit	–[a]	–[a]	Transportation of sanitary waste water
5	IEPA	Environmental Protection Act (415 ILCS 5)	Sludge Disposal Operating Permit	–[a]	–[a]	Disposal of sludge
6	IEPA	Environmental Protection Act (415 ILCS 5)	Non-Hazardous Domestic Waste Water or Sludge Transporting Permit	–[a]	–[a]	Transportation of non-hazardous waste water or sludge
7	IEPA	IL Adm. Code, Part 170	Emergency Petroleum Storage Tank Permit	–[a]	–[a]	Implementation of storage tanks containing petroleum products

Table I-1. (contd)

Agency	Authority	Requirement	License/ Permit No.	Expiration Date	Authorization Granted
IEPA	Environmental Protection Act (415 ILCS 5)	Open Burning Permit	—[a]	—[a]	Open burning of petroleum products for backup generators
IEPA	Environmental Protection Act (415 ILCS 5)	Supplemental Waste Stream Permit	—[a]	—[a]	Disposal of waste from additional waste streams
IEPA	N/A	Refrigerant Recovery/Re-cycling Equipment Certifications	—[a]	—[a]	Recovery and recycling of refrigerants
IEPA	Environmental Protection Act (415 ILCS 5)	Construction Permit	—[a]	—[a]	Construction of waste treatment facilities
IEPA	Environmental Protection Act (415 ILCS 5)	Construction Permit	—[a]	—[a]	Construction of temporary sewage treatment unit for construction phase only
IEPA	Environmental Protection Act (415 ILCS 5)	Operating Permit	—[a]	—[a]	Operation of temporary sewage treatment unit for construction phase only
IEPA	Environmental Protection Act (415 ILCS 5)	Operating Permit	—[a]	—[a]	Treatment of waste water discharge
DeWitt County Zoning Board of Appeals	Illinois Zoning Act	Approvals	—[a]	—[a]	Construction of the plant

Table I-1. (contd)

Agency	Authority	Requirement	License/ Permit No.	Expiration Date	Authorization Granted
Circuit Court of DeWitt County	Eminent Domain Act	Petition for Condemnation	–[(a)]	–[(a)]	Exercise right of eminent domain

(a) Data not available. Applicable permits may not be applied for until the COL phase. Applications for permits will be made before the beginning of construction, as required. Some permits may be combined with existing CPS permits.
(b) To be obtained by the Regional Transmission Operator.
Notes: All permits will be applied for before the beginning of construction. Some permits may not be obtained since the area may be combined with some existing CPS permits.

Appendix J

Plant Parameter Envelope Values

Appendix J

Plant Parameter Envelope Values

This appendix contains the Exelon Plant Parameter Envelope reproduced from Section 1.4, "Plant Parameter Envelope" of the *Site Safety Analysis Report*.

Table J-1. Plant Parameter Envelope (PPE) Values

PPE	Section	PPE Value	Site Characteristic Value	Usage
1.	Structure			
1.1	Building Characteristics			
1.1.1	Height	234 ft above grade	Not Applicable	ER
1.1.2	Foundation Embedment	140 ft below grade	Not Applicable	ER
1.2	Precipitation (for Roof Design)			
1.2.1	Maximum Rainfall Rate	(a)	13.5 in./hr (4.3 in./5 min)	SSAR
1.2.2	Snow Load	(a)	35 lb/ft^2	SSAR
1.3	Safe Shutdown Earthquake (SSE)	(a)		
1.3.1	Design Response Spectra	(a)	Site Specific Determination: Figure 2.5-12	SSAR
1.3.2	Peak Ground Acceleration	(a)	0.26 g	SSAR
1.3.3	Time History	(a)	NUREG/CR-6728	SSAR
1.3.4	Capable Tectonic Structures or Sources	(a)	No active faults: < 25 mi	SSAR
			Possible faults: > 25 mi < 200 mi	
1.4	Site Water Level (Allowable)	(a)		
1.4.1	Maximum Flood (or Tsunami)	(a)	26.1 ft below grade	SSAR
1.4.2	Maximum Ground Water	(a)	5 ft below grade	SSAR
1.5	Soil Properties Design Bases	(a)		
1.5.1	Liquefaction	(a)	None at site below 60 ft below ground surface (bgs)	SSAR
			Soils above 60 ft bgs to be replaced or improved	
1.5.2	Minimum Bearing Capacity (Static)	(a)	50,000 lbs/ft^2	SSAR
1.5.3	Minimum Shear Wave Velocity	(a)	0-51 ft = 820 fps	SSAR
			50-285 ft = 1090 fps	
			285-310 ft = 2580 fps	
1.6	Tornado (Design Bases)	(a)		
1.6.1	Maximum Pressure Drop	(a)	2.0 psi	SSAR
1.6.2	Maximum Rotational Speed	(a)	240 mph	SSAR
1.6.3	Maximum Translational Speed	(a)	60 mph	SSAR
1.6.4	Maximum Wind Speed	(a)	300 mph	SSAR

Table J-1. (contd)

PPE	Section	PPE Value	Site Characteristic Value	Usage
1.6.6	Radius of Maximum Rotational Speed	(a)	150 ft	SSAR
1.6.7	Rate of Pressure Drop	(a)	1.2 psi/sec	SSAR
1.7	Wind			
1.7.1	Basic Wind Speed	(a)	75 mph	SSAR
1.7.2	Importance Factors	1.11 (Safety Related)	Not Applicable	SSAR
2.	Normal Plant Heat Sink			
2.3	Condenser			
2.3.2	Condenser/Heat Exchanger Duty	15.08 E+09 Btu/hr	Not Applicable	SSAR ER
2.4	Mechanical Draft Cooling Towers			
2.4.1	Acreage	50 ac	Not Applicable	ER
2.4.3	Blowdown Constituents and Concentrations	See Table 1.4-2	Not Applicable	SSAR ER
2.4.4	Blowdown Flow Rate	12,000 gpm (49,000 gpm max.)	Not Applicable	SSAR ER
2.4.5	Blowdown Temperature	100°F	Not Applicable	SSAR ER
2.4.7	Evaporation Rate	31,500 gpm (b)	Not Applicable	SSAR
2.4.8	Height	60 ft	Not Applicable	ER
2.4.9	Makeup Flow Rate	42,000 gpm	Not Applicable	ER
2.4.10	Noise	55 dBa @ 1000 ft	Not Applicable	ER
2.4.12	Cooling Water Flow Rate	1,200,000 gpm	Not Applicable	SSAR
2.4.13	Heat Rejection Rate (Blowdown)	12,000 gpm (49,000 gpm max.) @ 100°F	Not Applicable	ER
2.4.14	Maximum Consumption of Raw Water	60,000 gpm	Not Applicable	ER
2.5	Natural Draft Cooling Towers			
2.5.1	Acreage	34.5 ac total (with 3 x 2.75 ac per reactor basin, 8.25 ac total for basins)	Not Applicable	ER
2.5.3	Blowdown Constituents and Concentrations	See Table 1.4-2	Not Applicable	ER
2.5.4	Blowdown Flow Rate	12,000 gpm (49,000 gpm max.)	Not Applicable	SSAR ER

Table J-1. (contd)

PPE	Section	PPE Value	Site Characteristic Value	Usage
2.5.5	Blowdown Temperature	100°F	Not Applicable	SSAR ER
2.5.7	Evaporation Rate	31,500 gpm (b)	Not Applicable	SSAR
2.5.8	Height	550 ft	Not Applicable	ER
2.5.9	Makeup Flow Rate	42,000 gpm	Not Applicable	ER
2.5.10	Noise	55 dBa @ 1000 ft	Not Applicable	ER
2.5.12	Cooling Water Flow Rate	1200,000 gpm	Not Applicable	SSAR
2.5.13	Heat Rejection Rate (Blowdown)	12,000 gpm normal	Not Applicable	ER
2.5.14	Maximum Consumption of Raw Water	60,000 gpm	Not Applicable	ER
3.	Ultimate Heat Sink			
3.2	CCW Heat Exchanger			
3.2.1	Maximum Inlet Temp. to CCW Heat Exchanger	95°F	Not Applicable	SSAR
3.2.2	CCW Heat Exchanger Duty	225 E+06 Btu/hr 411.4E+06 Btu/hr (Shutdown)	Not Applicable	ER
3.3	Mechanical Draft Cooling Towers			
3.3.1	Acreage	0.5 ac	Not Applicable	ER
3.3.3	Blowdown Constituents and Concentrations	See Table 1.4-2	Not Applicable	ER
3.3.4	Blowdown Flow Rate	144 gpm expected (700 gpm max.)	Not Applicable	SSAR ER
3.3.5	Blowdown Temperature	95°F	Not Applicable	SSAR ER
3.3.7	Evaporation Rate	411 gpm (700 gpm max.)	Not Applicable	SSAR ER
3.3.8	Height	60 ft	Not Applicable	ER
3.3.9	Makeup Flow Rate	555 gpm (1400 gpm max)	Not Applicable	ER ER
3.3.10	Noise	55 dBa @ 1000 ft	Not Applicable	ER
3.3.12	Cooling Water Flow Rate	26,125 gpm normal (52,250 gpm shutdown)	Not Applicable	SSAR ER
3.3.13	Heat Rejection Rate (blowdown)	144 gpm expected (700 max. gpm) @ 95°F	Not Applicable	ER

Table J-1. (contd)

PPE	Section	PPE Value	Site Characteristic Value	Usage
5.	Potable Water/Sanitary Waste System			
5.1	Discharge to Site Water Bodies			
5.1.1	Flow Rate	60 gpm expected (198 max gpm)	Not Applicable	SSAR ER
5.2	Raw Water Requirements			
5.2.1	Maximum Use	198 gpm	Not Applicable	ER
5.2.2	Monthly Average Use	90 gpm	Not Applicable	SSAR ER
6.	Demineralized Water System			
6.1	Discharge to Site Water Bodies			
6.1.1	Flow Rate	110 gpm expected	Not Applicable	ER
6.2	Raw Water Requirements			
6.2.1	Maximum Use	720 gpm	Not Applicable	ER
6.2.2	Monthly Average Use	550 gpm	Not Applicable	SSAR ER
7.	Fire Protection System			
7.1	Raw Water Requirements			
7.1.1	Maximum Use	2500 gpm	Not Applicable	ER
7.1.2	Monthly Average Use	10 gpm	Not Applicable	SSAR ER
8.	Miscellaneous Drain			
8.1	Discharge to Site Water Bodies			
8.1.1	Flow Rate	75 gpm total (150 gpm max)	Not Applicable	ER
9.	Unit Vent/Airborne Effluent Release Point			
9.1	Atmospheric Dispersion (X/Q) (Accident)			
9.1.1	0-2 hr @ EAB (sec/m^3)	(a)	1.85E-04 (5%) 3.56E-05 (50%)	SSAR ER
9.1.2	0-8 hr @ LPZ (sec/m^3)[c]	(a)	2.49E-05 (50%) 3.40E-06 (50%)	SSAR ER
9.1.3	8-24 hr @ LPZ (sec/m^3)	(a)	1.68E-05 (5%) 2.85E-06 (50%)	SSAR ER

Table J-1. (contd)

PPE	Section	PPE Value	Site Characteristic Value	Usage
9.1.4	1-4 day @ LPZ (sec/m^3)	(a)	7.18E-06 (5%)	SSAR
			1.85E-06 (50%)	ER
9.1.5	4-30 day @ LPZ (sec/m^3)	(a)	2.11E-06 (5%)	SSAR
			1.00E-06 (50%)	ER
9.2	Atmospheric Dispersion (X/Q)(Annual Average)	(a)	2.04E-06 sec/m^3 @ EAB[d]	SSAR
				ER
9.3	Dose Consequences	(a)		
9.3.1	Normal	(a)	Refer to SSAR 3.1.1 and 3.1.1.2 and ER 5.4	SSAR
				ER
9.3.2	Post-Accident	(a)	Refer to SSAR 3.3 and ER 7.1	SSAR
				ER
9.4	Release Point	(a)		
9.4.2	Elevation (Normal)	(a)	Ground Level	SSAR
9.4.3	Elevation (Post-Accident)	(a)	Ground Level	SSAR
9.4.4	Minimum Distance to Site Boundary	(a)	1025 m (3362 ft)	SSAR
9.5	Source Term			
9.5.1	Gaseous (Normal)	See Table 1.4-3 for isotopic breakdown.	Not Applicable	SSAR
				ER
9.5.2	Gaseous (Post-Accident)	Based on limiting DBAs[e]. (Refer to SSAR 3.3)	Not Applicable	SSAR
9.5.3	Tritium (Normal)	See Table 1.4-3	Not Applicable	SSAR
				ER
10.	Liquid Radwaste System			
10.1	Dose Consequences			
10.1.1	Normal	(a)	SSAR 3.1.2.2	SSAR
10.2	Release Point			
10.2.1	Flow Rate	Average daily discharge for 292 days per year with dilution flow of 2400 gpm	Not Applicable	SSAR
				ER

Table J-1. (contd)

PPE	Section	PPE Value	Site Characteristic Value	Usage
10.3	Source Term			
10.3.1	Liquid	See Table 1.4-4 for isotopic listing.	Not Applicable	SSAR
				ER
10.3.2	Tritium	See Table 1.4-4	Not Applicable	SSAR
				ER
11.	Solid Radwaste System			
11.2	Solid Radwaste			
11.2.1	Activity	See Table 1.4-5	Not Applicable	SSAR
				ER
11.2.2	Principal Radionuclides	See Table 1.4-5	Not Applicable	SSAR
				ER
11.2.3	Volume	15,087 ft^3/yr avg.	Not Applicable	SSAR
				ER
13.	Auxiliary Boiler System			
13.1	Exhaust Elevation	110 ft above grade	Not Applicable	ER
13.2	Flue Gas Effluents	See Table 1.4-6	Not Applicable	ER
15.	Onsite/Offsite Electrical Power System			
15.1	Acreage			
15.1.1	Switchyard	15 ac	Not Applicable	ER
16.	Standby Power System			
16.1	Diesel			
16.1.2	Diesel Exhaust Elevation	30 ft above grade	Not Applicable	ER
16.1.3	Diesel Flue Gas Effluents	See Table 1.4-7	Not Applicable	ER
16.2	Gas-Turbine			
16.2.2	Gas-Turbine Exhaust Elevation	60 ft	Not Applicable	ER
16.2.3	Gas-Turbine Flue Gas Effluents	See Table 1.4-8	Not Applicable	ER
16.2.5	Gas-Turbine Fuel Type	Distillate	Not Applicable	ER
17.	Plant Characteristics			
17.3	Megawatts Thermal	6800 MW(t)	Not Applicable	SSAR
17.4	Plant Design Life	60 years	Not Applicable	ER
17.5	Plant Population			
17.5.1	Operation	580 people	Not Applicable	ER

Table J-1. (contd)

PPE	Section	PPE Value	Site Characteristic Value	Usage
17.5.2	Refueling/Major Maintenance	1000 people	Not Applicable	ER
				ER
18.	Construction			
18.2	Acreage			
18.2.1	Laydown Area	29 ac	Not Applicable	ER
18.2.2	Temporary Construction Facilities	52 ac	Not Applicable	ER
18.3	Construction			
18.3.1	Noise	76-101 dBa at 50 ft	Not Applicable	ER
18.4	Plant Population			
18.4.1	Construction	3150 people (max.)	Not Applicable	ER
18.5	*Site Preparation Duration*	18 months	Not Applicable	ER

(a) Surrogate PPE value not used since actual site characteristic value is available.
(b) 5 percent margin added to vendor supplied PPE quantity to establish value.
(c) LPZ = low population zone
(d) EAB = exclusion area boundary
(e) DBA = design basis accident

Appendix K

Key Statements Made in the Environmental Report Considered in the NRC Staff's Environmental Review

Appendix K

Key Statements Made in the Environmental Report Considered in the NRC Staff's Environmental Review

Throughout the Environmental Report (ER) supporting the Exelon ESP application, Exelon provides

(1) commitments to address certain issues in the design, construction, and operation of the facility

(2) statements of planned compliance with current laws, regulations, and requirements

(3) commitments to future activities and actions that it will take should it decide to apply for a construction permit (CP) or combined operating license (COL)

(4) descriptions of Exelon's estimate of the environmental impacts resulting from the construction and operation of a new nuclear unit on the ESP site

(5) descriptions of Exelon's estimates of future activities and actions of others and the likely environmental impacts of those activities and actions that would be expected should Exelon decide to apply for a CP or COL.

Those statements are discussed throughout this environmental impact statement (EIS) and are listed in this Appendix.[a] Some of those statements considered by the staff in determining the level of impacts to a resource are related to matters that are within Exelon's control. Table K-1 lists those matters that were considered in the staff's evaluation of the environmental impacts related to the construction and operation of a new nuclear unit at the Exelon ESP site. The table shows the section and page number where the matter is addressed in the ER, Exelon's statement that addresses the matter, and the location in the EIS where the item was considered in the staff's evaluation. Table K-2 lists those matters that are identified in the ER, but were not directly considered by the staff in its evaluation. Table K-3 lists statements related to likely activities and actions of others that were considered by the staff.

In some cases the same statement or similar statements are made in more than one place in the ER. Where statements contain essentially the same information, the location of the more comprehensive statements are listed first in the table, and the text provided is the text from that location. Locations of similar statement and information are listed, but the text is not included.

(a) The listings are not intended to be a complete list of the commitments described in the ER.

Table K-1. Key Statements Made in the Environmental Report Related to Future Actions and Activities by Exelon and the Impacts of Those Activities Considered in the NRC Staff's Environmental Analysis

Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1.1.4 3.4.2.3	1.1-2 3.4-3	The approach velocity to the intake will be limited to a maximum velocity of 0.50 feet per second (fps) at the normal lake elevation of 690 ft above mean sea level (msl). The intake water for the facility will pass through bar racks or similar devices in order to remove large debris. In addition, it will also pass through traveling screens in order to remove smaller debris before entering the pump suction chamber.	3.2.2.2, 5.4.2.1, 7.5
2.1	2.1-1	The EGC ESP Facility will be colocated on the site of the existing facility and adjacent to the CPS 4,895-ac man-made cooling reservoir; Clinton Lake (IDNR, 2002). The EGC ESP Facility will be located just south of the CPS Facility.	2.1, 4.1.1
2.2.1 2.5.2.2	2.2-2 2.5-2	The EGC ESP Site will not conflict with the proposed zoning for the site, since the facility will be constructed within the CPS Site, which is already designated for transportation and utilities.	2.2, 4.1.1, 5.1, 7.1
2.4.1.3.1 4.3.1.4.1 4.3.2.4.1.1 5.3.3.3.1.1 5.6.2.1.1 5.10.3.12.2.1 6.5.2.1.1 6.5.2.2.1	2.4-4 4.3-2 4.3-5 5.3-8 5.6-4 5.10-18 6.5-2 6.5-5	Federal wildlife agencies will be formally contacted at a date closer to the facility construction to confirm the absence of federal listed threatened and endangered species, since confirmation letters are valid for only one year after issuance.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6
2.4.1.3.2 4.3.1.4.1 4.3.2.4.1.2 5.3.3.3.1.2 5.6.2.1.2 5.10.3.12.2	2.4-5 4.3-2 4.3-5 5.3-8 5.6-4 5.10-18	State wildlife agencies will be formally contacted at a date closer to the facility construction to confirm the absence of state-listed threatened and endangered species, since conformation letters are valid for only two years after issuance.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6,
2.4.2.3.1 5.3.3.3.1 5.6.2.1.1	2.4-9 5.3-8 5.6-4	Applicable federal agencies, including the National Marine Fisheries Service and the USFWS will be formally contacted in order to confirm the presence or absence of any federally-listed (or proposed for listing) threatened or endangered fish or other aquatic species.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6,
2.5.3	2.5-12	If additional area within the EGC ESP Site will be required, further evaluation will be performed to determine if additional archaeological review is required.	2.9, 4.6, 5.6, 7.6, 8.5, 8.6
2.6	2.6-2	Excavated material will be disposed either on site or off site. Normal methods will be used to mitigate the potential for erosion of material at the disposal site, such as reseeding and drainage control. Excavated slopes or soil surfaces exposed during construction will be protected from erosion.	4.8.1

Table K-1. (contd)

Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
2.7.5.1	2.7-17	[A] new [meteorological] system is being designed to be fully compliant with Regulatory Guide 1.23.	2.3.3
3.1.4	3.1-3	Any visual impacts from the visible plumes from the EGC ESP Facility will be similar to those associated with the CPS. There is the potential that an additional visible plume will result from the heat dissipation system. The viewshed of the EGC ESP Facility is limited to a few residences and recreational users in the vicinity. Based on the fact that the EGC ESP Site will have similar visual impacts as the CPS (with the exception of the new plume from the heat dissipation system assumed for the EGC ESP Facility), the EGC ESP Site will have a minor impact on aesthetic quality for nearby residences and recreational users of Clinton Lake. Therefore, no mitigation will be provided.	4.5.3.4, 5.5.1.4, 7.6,
3.4	3.4-1	Details regarding the design of intake and discharge structures and cooling system comparison tables for the proposed reactor cooling systems will be presented at the COL phase.	4.4, 5.4, 7.4
3.5	3.5-1	Detailed information regarding the description of the liquid and gaseous radioactive waste management and effluent control systems; process/instrumentation diagrams; system process flow diagrams of the liquid and gaseous radioactive waste management and effluent control systems; identification of principal release points; identification of sources of radioactive liquid and gaseous waste materials to the environment; and identification of direct radiation sources stored on site as solid waste will be provided at the COL phase.	3.2.3, 5.9, 6.1, 7.8, 8.11.8
3.5.1	3.5-1	The process systems will be designed to minimize the releases to, and impact on, the aquatic environment. Discharges will be via the existing discharge plume of the CPS.	5.9
3.6	3.6-1	Detailed information regarding the description of the nonradioactive waste management and effluent control systems, process/instrumentation diagrams, and system process flow diagrams will be provided at the COL phase.	3.2.4, 5.8, 7.7, 8.11.7
3.6.2	3.6-2	Sanitary systems installed for preconstruction and construction activities will include the use of portable toilets, which are supplied and serviced by an off-site vendor. Sanitary system wastes that are anticipated to be discharged to Clinton Lake during actual station operations include discharges from the potable and sanitary water treatment system.... As with the CPS, these discharges will be controlled in compliance with an approved NPDES permit for the EGC ESP Facility, to be issued by IEPA.	4.8, 5.8

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	3.7.1.1	3.7-1	EGC plans to develop a merchant generator facility at the site; the proposed site will be set aside for a unit that generates power for sale on the open wholesale market. The facility owner will not be responsible for building transmission lines. Rather, it will interconnect with the transmission system owner.	4.4.1, 5.4.1, Chapters 2, 3, 8
2	3.8.1	3.8-3	The LWR technologies being considered will use either Zircaloy or ZIRLO rods and therefore meet this subsequent evaluation condition.	Chapter 6, Appendix G
3	3.8.1	3.8-3	The LWR technologies being considered will have average burnup of less than or equal to 62,000 MWd/MTU for the peak rod and therefore meet this subsequent evaluation condition.	Chapter 6, Appendix G
4	3.8.1	3.8-3	The LWR technologies being considered will solidify and package their radioactive waste.	Chapter 6, Appendix G
5	3.8.1	3.8-4	The LWR technologies being considered will comply with this transport mode requirement.	Chapter 6.0, Appendix G
6	3.8.1	3.8-4	The gas-cooled technologies being considered will solidify and package their radioactive waste.	Chapter 6.0, Appendix G
7 8	4.0 4.1.1.1	4-1 4.1-1	It is estimated that site preparation activities (preconstruction) will take up to eighteen months to complete. Based on estimates provided by the reactor vendors, assuming that appropriate licenses are obtained, actual construction is expected to take from three to five years. The construction laydown area will be approximately 29 ac with an additional 52 ac needed for temporary construction facilities, and another 15 ac for a substation (see SSAR Table 1.4-1). To the extent possible, the CPS roads will be used for construction traffic. The site has at least one access road that can be used to transport heavy construction equipment. Construction of the EGC ESP Facility will occur at a location approximately 700 ft to the south of the CPS.	2.2, 3.2.1, 4.1, 4.4.1, 5.1, 7.1, 8.5
9	4.1.1.1	4.1-1	No construction activities within the site will take place within a floodplain (IDNR, 1986), coastal zone (USGS, 1990), or wild and scenic river (USFWS, 2002). There are four minor areas (less than 1 ac) within the site boundary that have been identified as wetland areas. They are all palustrine unconsolidated bottom (IDNR, 1987). None are within the power block footprint, cooling tower footprint, or intake areas of the EGC ESP Facility, and therefore will not be impacted by construction. Additionally, care will be taken so that these areas are not impacted by other construction activities such as construction laydown, and disposal of fill material. As defined by ESRP Section 4.1.1, since the expected disturbance of construction is less than 1,236 ac and does not have any special resources that will be affected, "it may be concluded that the expected impacts of construction on land use are not a major significance and there are no land use changes that will influence the decision on a construction permit" (USNRC, 1999).	Chapters 2, 3, 4, 7

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	4.1.1.2	4.1-2	Normal recreational practices near the site will not be altered during construction. Access to the lake and camp areas will still be afforded to the recreational public.	4.1, 4.5, 8.5
2	4.1.1.2	4.1-2	In Section 2.2.1, Figure 2.2-3 shows the highways, RR, and utilities that cross the site and the vicinity. None of these facilities will be physically impacted by construction. Approximately 3,200 additional worktrips and 100 truck deliveries during peak hours will occur on the roads and highways during construction, but the roads and highways will not be unduly congested, except for brief periods (10 to 15 minutes) during the beginning and end of shifts.	4.1, 4.5, 7.6,
3	4.1.1.4	4.1-3	Mitigation measures, designed to lessen the impact of construction activities, will be specific to erosion control, controlled access roads for personnel and vehicle traffic, and restricted construction zones. The site preparation work will be completed in two stages. The first stage will consist of stripping, excavating, and backfilling the areas occupied by the structure and roadways. The second stage will consist of developing the site with the necessary facilities to support construction, such as construction offices, warehouses, trackwork, large unloading facilities, water wells, construction power, construction drainage, etc. In addition, structures will be razed and holes will be filled. Grading and drainage will be designed to avoid erosion during the construction period. Action will be taken to restore areas consistent with existing and natural vegetation. A total of approximately 96 ac will be required for construction facilities including permanent facility structures and laydown. To the extent possible, CPS roads will be used for construction traffic. If necessary, temporary stone roads will be installed along with site grading and drainage facilities. This will permit an all weather use of the site for travel and storage of materials and equipment during construction.	2.2, 3.1, 4.1, 4.4.1, 7.1, 8.5, 8.6
4	4.1.2.1	4.1-4	In both normal and special condition construction, the methods used will be selected to minimize the impact on the local environment.	4.1, 4.4.1, 7.1
5	4.1.3	4.1-9	If additional areas within the EGC ESP Site will be required for development, further evaluation will be performed to determine if additional archaeological review is necessary.	2.9, 4.6, 5.6, 7.6, 8.5, 8.6
6	4.2	4.2-1	The construction will be confined to the station site and the existing transmission corridor. Proper mitigation and management methods implemented during construction will limit the potential water quantity and quality impacts to the surface water (e.g., Clinton Lake, stream crossings, and intermittent drainage ways) and adjacent groundwater.	4.4.2, 4.3

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	4.2.1.2.1	4.2-4	The construction area will be temporarily isolated from the lake by cofferdams, or similar structures, and dewatered. The water will be pumped to a sedimentation basin if necessary and allowed to drain back into the lake at a location away from the CPS intake structure. Construction of the intake structure will be designed to control shoreline and bank erosion and minimize impacts on Clinton Lake, the UHS, and the CPS intake structure. Special erosion and siltation control measures will be incorporated with lakeshore construction to minimize these impacts. Any sediment deposition in the vicinity of the intake structure will be removed following construction. This work will be bounded by the requirements of the SWPPP. Appropriate USACOE Section 404, IEPA 401 Water Quality Certification, and NPDES permits will be obtained for these activities.	4.4.2, 4.3
2	4.2.1.2.2	4.2-4	Comprehensive construction erosion control measures will be employed to minimize the effects of the runoff and minimize siltation in the adjacent drainage ways and Clinton Lake. Runoff from construction areas will be diverted to the south or to the discharge side of the Clinton Lake cooling system in order to avoid impacts to the CPS intake and cooling system. A limited amount of silt deposition in the drainage ways and Clinton Lake will be unavoidable; however, erosion will be monitored and control measures implemented to minimize the potential for additional sediment deposition during the construction period. Proper safeguards (such as sediment basins, silt fencing, and revegetation of disturbed areas) will be used to minimize sediment and nutrient transport to Clinton Lake in order to prevent long-term effects on downstream habitats. Surface disturbance due to construction of overhead transmission lines is expected to be limited to temporary disturbance from removal of trees and shrubs, movement of construction equipment, and excavation for the foundation of the transmission line towers. This disturbance is expected to be minimal, as the disturbances will be short-term or isolated at individual tower pads. The appropriate erosion control measures will be incorporated into the design contract documents to minimize the impacts of disturbances that occur near the lake or other surface waters. Ground disturbance will be minimized and native ground vegetation will be reestablished following construction in order to minimize erosion.	4.4.2, 4.3, 4.4, 7.3, 7.4, 7.5

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	4.3.1.2	4.3-1	As previously discussed, transmission system improvements will be required to support the EGC ESP Facility. These modifications will be located within or immediately adjacent to the existing substation at the CPS and along the existing transmission corridor. The proposed transmission line improvements will be sited within the existing utility rights-of-way to the greatest extent possible. Construction of the proposed transmission line improvements will temporarily habitats within the existing rights-of-way; however, the agricultural and open field areas will be allowed to revegetate to preconstruction conditions. There will be no significant loss of agricultural or open field habitats resulting from construction of the transmission systems. Where right-of-way expansion is required in forested lands, clearing will be required. Forested habitats do not make up a significant amount of the proposed utility corridor; therefore, significant impacts to forested lands are not anticipated.	4.4.1, 5.4.1,
2 3	4.3.1.4.2.4 Table 10.1-1	4.3-4 10 T-1	The wetlands and floodplains will be restored and there will be no net loss of wetland resources. It is assumed that any pole placement will occur outside of the designated wetland areas. Therefore, the project is not anticipated to adversely affect any wetlands or floodplains within the site or vicinity.	4.4.1, 5.4.1, 7.4, 7.5, 8.5, 8.6
4 5 6	4.4.1.1 4.6.3.2 Table 10.1-1	4.4-1 4.6-2 10 T-1	Noise levels will be controlled by using the following criteria: • The Occupational Safety and Health Administration (OSHA) noise exposure limit to workers and workers' annoyance that are determined through consideration of acceptable noise levels for offices, control rooms, etc. (29 CFR 1910); • Federal (40 CFR 204) noise pollution control regulations; and • State regulation or local (35 Illinois Administrative Code [IAC] Subtitle H, 1987) noise pollution control rules. ... activities with significant noise impacts, such as blasting, will be limited to normal weekday business hours.	4.8, 7.7
7 8	4.4.1.3 4.6.1.3	4.4-2 4.6-2	Some recreational users of Clinton Lake will be able to view the construction areas. However, the construction area will not visually impact most recreational users and areas of the Clinton Lake. Therefore, overall aesthetic impacts during construction are minimal. Mitigation measures designed to lessen the minor visual impact of construction activities include restricting construction laydown to as small of an area as possible, and removing construction debris from the site in a timely and suitable manner.	4.5.3.4, 7.6, 8.5, 8.6

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	4.4.2.7	4.4-4	Also, since private security guards will be used at the site, dependence on local police forces will not be required.	4.5
2	4.5.2.	4.5-1	During the construction of the EGC ESP Facility, the construction workers will be exposed to direct radiation and to the radioactive effluents emanating from the routine operation of the CPS. The direct radiation exposure has two principal sources: (1) the cycled condensate storage tank located on the northern boundary of the protected area adjacent to the existing switchyard; and (2) the skyshine from the –16 activity present in the reactor steam in the high pressure and low pressure turbines, the intercept valves, and the associated piping located on the main floor of the turbine building. The design basis radiation source term for the cycled condensate storage tank is listed in the CPS USAR Table 12.2-8 (CPS, 2002). The –16 activity that is present in the reactor steam in the primary steam lines, turbines, and moisture separators provides an air-scattered radiation dose contribution to locations outside the CPS plant structure. The design basis radiation source inventory in these pieces of equipment is listed in the CPS USAR Table 12.2-7 (CPS, 2002). To reduce the turbine skyshine doses, radiation shielding has been provided. The CPS Facility releases airborne effluents via two gaseous effluent release points to the environment. These are the common station heating, ventilating, and air conditioning stack and the standby gas treatment system vent. The expected radiation sources in the gaseous effluents are listed in the CPS USAR Table 11.3-8 (CPS, 2002). The CPS Facility has achieved zero liquid radioactivity release from the plant in the past nine years. Therefore, the radiation sources expected to be present in liquid effluents in the future are considered negligible.	4.9
3	4.6.3.2	4.6-3	Procedures and a hearing conservation program will be developed at the construction site for any employees exposed to excessive noise, which is defined as an 8-hr exposure of 85 dB or more.	4.8, 7.7

Table K-1. (contd)

Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
4.6.3.3 10.3.1 Table 10.1-1	4.6-3 10.3-1 10 T-1	During construction, a number of controls will be imposed to mitigate air emissions from construction sources including good drainage and dry weather wetting. In addition, the most traveled construction roads will be paved in order to reduce dust generated by vehicular traffic. Bare areas will be seeded to provide ground cover, where necessary. Applicable air pollution control regulations will be adhered to as they relate to open burning or the operation of fuel burning equipment. Permits and operating certificates will be secured where required. Fuel burning equipment will be maintained in good mechanical order to reduce excessive emissions. Reasonable precautions will be taken to prevent accidental brush or forest fires. The concrete facility will be equipped with dust control systems to avoid excessive releases of cement dust. ... Nevertheless, dust emissions will be mitigated to the extent practical and will be in compliance with local, state, and federal air emissions standards.	4.2, 4.8, 7.2, 7.7
4.6.3.4	4.6-3	If construction activities are not properly controlled and monitored, erosion from improperly graded or excavated areas will lead to the runoff of large amounts of sediments to nearby areas or surface waters. Therefore, the construction activities at the EGC ESP Site will conform to the following goals and criteria, as applicable. • Erosion and sedimentation controls will comply with the requirements specified in this section and, if appropriate, with a stormwater pollution prevention plan. • Implement erosion and sediment controls during construction in order to retain sediment on site to the greatest extent practicable. • Select, install, and maintain control measures in accordance with the manufacturer's specifications and good engineering practices. If periodic inspections or other information indicate that a particular erosion control measure is ineffective, the control measure will be modified or replaced as necessary. • If practical and if required, remove off-site accumulations of sediment in order to minimize the off-site impacts in the event that sediment escapes the construction site. • Routinely remove sediment from sediment traps or sedimentation routinely. • Implement construction practices that prevent litter, construction debris, and construction chemicals exposed to stormwater from becoming pollutant sources for stormwater discharges. • Control erosion and sediment runoff through the use of structural and/or stabilization practices. Structural control practices may include the use of straw bales, silt fences, earth dikes, drainage swales, sediment traps, and sediment basins. Sediment traps and basins will be designed to accommodate the large potential load from the deep	4.3.3, 4.4.1.1, 4.4.1.2, 4.4.2

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1			excavation dewatering operations. Stabilization practices may include temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, and preservation of mature vegetation. Several different structural controls may be used to regulate the quality of the stormwater running off the construction site. Table 4.6-1 lists the controls that may be instituted during construction activities. Based on site conditions, the final location of these controls will be determined just prior to the commencement of construction. Stabilization practices that may be implemented are listed in Table 4.6-2. Final stabilization will consist of grading and revegetation areas in which potential pollutant sources are used.	
2	4.6.3.4	4.6-4	In addition, the following general erosion control requirements will be implemented during construction activities, as appropriate: • Where practical, disturbed soil areas will be reseeded with maintenance seed (if activities are temporary) or permanent seed mix (for permanent or final cover) as soon as possible after redress activities are either temporarily or permanently stopped. • Where practical, excelsior blankets will be mulched or installed and slopes greater than 3:1 will be reseeded, depending on the length, exposure, and texture of the soils on the slope. Mulch may be natural and consist of slash, brush, manure, and vegetation previously chipped and stockpiled; clean straw, free from noxious weed seed, mold, and other harmful elements; or wood cellulose fiber. Mulch will be applied as soon as possible after seeding to reduce runoff and promote vegetation. • Sidehill slopes will be furrow-contoured as practical. Otherwise the final grading will be performed in a manner that will result in tracks and depressions contoured across the slope instead of down the "fall-line." This will not only minimize wind erosion, but will also "roughen" the earth to provide a microclimate of wind protection for new plants, and will help conserve precipitation for use in growth of new seed. This results in a reduction of sediment erosion. • The time that bare soil is exposed before stabilized will be minimized. • The disturbance to existing vegetation will be minimized. • Where slope cuts have developed from erosion (particularly along the faces of flood detention structures), loose material will be removed, and the area will be filled with suitable soils to the original profile of the bank or slightly above the original profile. If the cut is not completely filled, the steeper area at the brow of the cut will encourage erosion and may cause redevelopment of the cut. The area upstream from the cut will be carefully inspected to determine if there is an irregularity in the ground profile that will cause stormwater to concentrate and erode	4.2.1, 4.3.3, 4.4.1.1, 4.4.1.2, 4.4.2

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1			the soils. Any such irregularity will be removed. This will allow the water to run off the site as sheet flow. • No solid materials including demolition materials will be discharged to waters of the United States (U.S.), unless authorized under an approved permit. The erosion and sediment control measures and other protection measures will be maintained in effective operating condition. Maintenance will be performed on an "as needed" basis and as specified by state and local permits. Specific maintenance requirements include, but are not limited to: • Routine removal of sediment and other debris collected behind silt fences or hay bales; • Routine cleaning of sediment from detention ponds; and • Based on visual inspection, replacement of gravel and sediment from entrances/exits.	
2	4.6.3.5.1	4.6-5	The fueling stations will have temporary secondary containment around the fuel tanks. For specifics, see Section 4.6.3.5.8.	4.8
3	4.6.3.5.5.1	4.6-6	In general, excavated soils and stockpiles will be managed; management techniques are described below. • Stockpiles of excavated soils will be placed on plastic sheeting or other suitable material, if required, near the excavation areas. • If practical, stockpiles will be provided with liner, cover, and perimeter berm in order to prevent rupture, release or infiltration of liquids, and to prevent the re-suspension dispersion of dust. If it is not possible to cover stockpiles, it may be necessary to install a temporary sprinkler system to inhibit dust dispersion. • Polyethylene sheeting or other suitable material will be used for liners and covers. • A perimeter berm, typically hay bales placed beneath the liner, will be constructed to allow for collection of any free liquids draining from the stockpile. • Accumulated free liquids will be pumped, treated, and removed, as required. • Covers and perimeter berms will be secured in place when not in use and at the end of the workday, or will be secured as necessary in order to prevent wind dispersion or runoff from major precipitation events.	4.1, 4.4.1
4	4.6.3.5.6	4.6-6	Sediment and the generation of dust will be minimized using the methods noted in Section 4.6.3.3, thereby minimizing the amount that is tracked off site by vehicles.	4.4.1

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	4.6.3.5.8.1	4.6-7	Fuel and waste tanks located on soil will be bermed with a perimeter dike of native material, or placed inside an open tank capable of containing its' maximum capacity, in case of rupture. When practical, areas inside the dike will be covered with an oil resistant membrane to minimize soil contamination in the event of a spill. Fuel and waste tanks located on concrete or steel foundations will be bermed with appropriate materials suitable for the application. These materials will allow for the containment of the full capacity of the tank while minimizing contamination of the surrounding area. Construction projects requiring fuel or waste tanks will maintain a sufficient number of spill kits to contain minor spills and leaks.	4.8
2	4.6.3.6	4.6-9	Traffic and traffic control impacts may include, but are not limited to: • Working adjacent to or in active roadways (day/night); • Traffic control zones; • Traffic control device installation and removal; • Flagging; • Inspection and maintenance of traffic control devices; • Equipment; and • General roadway traffic control zone safety. Regulatory guidance 29 CFR 1926 contains requirements for traffic control signs, signals, and barricades. Some state OSHA and DOT plans may have requirements that are more stringent. However, local, state, and federal requirements will be adhered to regarding traffic control on and off site from construction activities.	4.5, 5.5.1, 7.6
3	5.10.3.5	5.0-5		
4	4.6.3.7	4.6-9	The construction will be confined to the EGC ESP Site and the existing transmission corridor. Proper mitigation and management methods implemented during construction will limit the potential water quantity and quality impacts to the surface water (e.g., Clinton Lake, stream crossings, and intermittent drainage ways) and adjacent groundwater.	4.4.2
5	4.6.3.7.1	4.6-11	*Construction erosion control measures and comprehensive stormwater* pollution prevention plans (SWPPP) are required under the Illinois Environmental Protection Act, the Illinois Pollution Control Rules, and the federal CWA. Where necessary, special erosion control measures will be implemented to minimize impacts to the lake and lake users and CPS operations. Typical stormwater control elements of a SWPPP are discussed in Section 4.6.3.4. A NOI will be filed with the federal and state agencies to receive authorization for land disturbance under the general stormwater permit. A SWPPP will also be prepared in accordance with the requirements of the general permit. A NOT will be filed with the IEPA upon completion of construction and stabilization of the disturbed areas.	4.5.1.4, 7.6
6	4.2.1	4.2-2		

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	4.6.3.7.1.2	4.6-11	Construction erosion control measures will be applied during the phases of site development to contain eroded soil on the construction site and remove sediment from stormwater prior to leaving the site. Design measures will be incorporated to avoid concentrated flow that has a high potential to transport sediment. Visual inspections of construction erosion control measures will	4.1, 4.3, 4.4.1
2			be incorporated into the construction project to monitor the effectiveness of the control measures and to aid in determining if other mitigation measures are necessary. Mitigation measures will be incorporated into the requirements of the construction contracts and the SWPPP. Beyond the construction activity, stormwater management practices will be incorporated into the site design to minimize the long-term delivery of sediment to the lake.	
3 4	4.6.3.7.1.3 4.2.1.3	4.6-12 4.2-6	The dewatering effluent obtained from the station excavation will be pumped and eventually discharged to an adjacent drainage way and into Clinton Lake. Measures will be implemented, such as sedimentation or filtration, so that erosion or siltation caused by the dewatering will be negligible. Existing sediment basin facilities will be considered or new facilities constructed to accommodate dewatering flows. Where possible, dewatering flows will be diverted to the south or to the discharge side of Clinton Lake in order to avoid impacts to the CPS intake and cooling system. A limited amount of silt deposition in the drainage ways and Clinton Lake will be unavoidable; however, the impacts from these activities will be confined to the construction period and will be monitored and controlled using best management practices for sediment control. Proper safeguards will be implemented to prevent long-term effects on downstream habitats resulting from the construction activities.	4.3.1, 4.3.2
5 6	4.6.3.7.2.1 4.2.1.2.2	4.6-13 4.2-4	The limited amount of additional sediment in stormwater related to construction activities will be first controlled by sight specific practices identified in the SWPPP. During construction of the new EGC ESP intake structure, the CPS intake structure will be protected to prevent suspended sediment from entering the cooling system. Special construction techniques, such as watertight sheet piling with dewatering of submerged areas to expose the construction zone, will be implemented where necessary to prevent migration of suspended solids. Water collected from dewatering operations will be settled or filtered before water is allowed to return to the lake. Where appropriate, stormwater runoff and treated dewatering water will be diverted to the discharge side of the lake to reduce CPS impacts.	4.3.3

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	5.1.1.2	5.1-2	Quantification of impacts associated with salt drift will be reassessed, as appropriate, once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted at or before a later licensing stage.	5.1
2	5.2.1.1.1	5.2-2 5.2-6	The dam that forms Clinton Lake is operated to provide a minimum downstream release of 5 cfs from Clinton Lake to Salt Creek. This flow rate will not change under the operation of the EGC ESP Facility.	2.6, 5.3, 7.3
3	5.2.2.2.1	5.2-7	The EGC ESP Facility operation will comply with federal laws related to hydrology and water quality.	5.3.3
4	5.2.2.2.2	5.2-7	The combined discharge of the two plants will be within with the limits of the NPDES permit for the CPS.	5.4.2.2
5	5.2.2.3	5.2-7	As discussed above, it is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility, and that groundwater will not be used as a source of water. In addition, based on the proposed design of the plant, no permanent groundwater dewatering system will be implemented.	5.3.2
6	5.3	5.3.-1	As described in Section 3.3, either mechanical draft or natural draft hyperbolic type cooling towers will be used for normal non-safety plant cooling and for safety-related cooling. The makeup water for the normal (non-safety) plant operations will be taken up through a new intake structure located next to the CPS intake structure on the northern basin of Clinton Lake. The intake will include a screening system similar in function to the CPS intake, but for a significantly smaller flow rate. Makeup water for the safety-related cooling towers will be supplied from the same intake structure, which will draw water from the bottom of the submerged impoundment within Clinton Lake (i.e., the UHS). The cooling tower(s) blowdown will be discharged to the CPS discharge flume that flows to the southern basin of Clinton Lake.	Lance
7	5.3.1.1.1	5.3-2	Design of the intake structure will include features that maintain an even distribution of intake flows. Where necessary, the intake area will be protected to prevent local areas of erosion.	2.7, 4.4, 5.4, 7.5, 8.5, 8.6
8 9	5.3.1.1.3 5.10.3.9.2.2	5.3-2 5.10-11	In addition, the piping system will need to be kept clean of aquatic organisms such as algae and shellfish. Standard practices that have been used by the utility industry include scraping, backwash with the heated cooling water and chemical treatment including certain biocides, anti-corrosion, and anti-scaling chemicals. These chemicals will ultimately be discharged to Clinton Lake through the thermal discharge piping, as described in Section 3.6.1. If a chemical addition is required to protect the new cooling system, this same approach may be used in the intake piping. It is anticipated that there will be a minor change in the quality of the water discharged. The selection of chemicals will be done in order to minimize the impacts on	2.7, 4.4, 5.4, 7.5

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1			water quality. It is assumed that the discharges will be comparable to those associated with the CPS as approved under their NPDES permit.	
2	5.3.2.1.2	5.3-4	The chemicals used will be subject to review and approval for use by the IEPA, and releases will be in compliance with water quality standards and an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA.	2.7, 4.4, 5.4, 7.5,
3	5.3.3.3.2.1	5.3-9	The proposed system will not inhibit access to or use of the terrestrial system surrounding Clinton Lake.	5.1
4	5.3.4.2	5.3-11	Quantification of these ambient impacts will necessarily require a more in depth assessment once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted at or before a later licensing stage.	5.2.1
5	5.4.1.3	5.4-3	Contained sources of radiation at the EGC ESP Facility will be shielded as was done at the CPS. It is assumed that the direct radiation from any of the EGC ESP Facility designs remains bounded by the CPS direct and skyshine dose from the turbine building.	5.9, 7.8, 8.11.8
6	5.5.1.2.1	5.5-1	Drains from radioactive sources or potentially radioactive sources will not be connected to the chemical waste drain system. Chemical waste discharges will be collected in a tank for sampling and pH adjustment before being discharged as neutralized wastes to Clinton Lake. The chemical wastes will be routed to the discharge flume of the CPS, which flows to Clinton Lake.	5.9, 7.8
7	5.5.1.2.2	5.5-2	Sanitary system wastes that are anticipated to be discharged to Clinton Lake during actual station operations include discharges from the potable and sanitary water treatment system. It is anticipated that the sanitary system effluents will receive tertiary treatment consisting of presettling, filtration, and chlorination prior to release to the environment via the circulating water discharge flume. The normal and maximum amount of sanitary discharges to Clinton Lake based on PPE data for the composite reactor (see SSAR Table 1.4- 1) is presented in Chapter 3. These discharges will comply with the approved NPDES permit for the EGC ESP Facility.	5.8, 7.7
8	5.5.1.3	5.5-3	Air emissions will be in compliance with the limits that will be established and imposed by state and local regulations.	5.2.2
9	10.2.1.6	10.2-2		
10	10.3.2	10.3-2		

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	5.5.2	5.5-4	However, if mixed waste is generated, the volume may be reduced or eliminated by one or more of the following basic types of treatment prior to disposal: decay, stabilization, neutralization, filtration, and chemical or thermal destruction by an off-site vendor. If required, programs will be implemented and mixed waste storage facilities constructed to store mixed waste for decay or for storage prior to shipment to an approved off-site treatment or disposal area. It is not the Applicant's intention to dispose of mixed waste on site.	5.8, 7.7
2	5.8	5.8-1	The operation workforce will consist of up to 580 people (see SSAR Table 1.4-1).	5.5.1, 7.6
3	5.8.1	5.8-1	The physical impacts are defined as noise, air, and aesthetic disturbances. Physical impacts will be controlled as specified by applicable regulations and will not significantly impact the site, vicinity, or region.	5.5.1, 7.6
4	5.8.1.1	5.8-1	The two largest cities within the vicinity include DeWitt, with a population of 188, and Weldon, with a population of 440 (U.S. Census Bureau, 2001). These two cities are small rural communities that include small businesses, houses, and farm buildings. These communities will not experience any physical impact from station operation.	5.5.1, 7.6
5	5.8.2.7	5.8-5	Also, since private security guards will be used, dependence on local police forces will not be required.	5.5.3.6
6	5.8.3	5.8-6	Noise and air pollution will be controlled by following any federal, state, and local regulation.	5.5
7	5.9	5.9-1	According to the USNRC, decommissioning of a nuclear power plant has certain environmental consequences. The impacts on the proposed site will be discussed in detail at the COL stage.	6.3
8	5.9	5.9-1	As decommissioning plans are developed, efforts will be made to minimize or mitigate any adverse impacts from decommissioning.	6.3
9	5.10.3.3	5.10-3	The following goals and criteria will be applied, as applicable: • Erosion and sedimentation controls will be implemented in order to retain sediment on site to the greatest extent practicable. • In accordance with the manufacturer's specifications and good engineering practices, control measures will be selected, installed, and maintained. If periodic inspections or other information indicate that a particular erosion control measure is ineffective, the control measure will be modified or replaced as necessary. • If possible and if required, off-site accumulations of sediment will be removed in the event that sediment escapes the construction site in order to minimize the off-site impacts. • Sediment from sediment traps or sedimentation ponds will be routinely removed when design capacity, as a general rule, has been reduced by approximately 50 percent. This will limit the potential for	4.4.1, 5.8, 7.7

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1			trap or pond failure. • Housekeeping practices will be implemented that prevent litter, debris, and chemicals exposed to stormwater from becoming a pollutant source for stormwater discharges. • Erosion and sediment runoff will be controlled through the use of structural and/or stabilization practices. Structural control practices may include the use of straw bales, silt fences, earth dikes, drainage swales, sediment traps, and sediment basins. Sediment traps and basins will be designed to accommodate the large potential load from the deep excavation dewatering operations. Stabilization practices may include temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, and preservation of mature vegetation.	
2	5.10.3.4.1	5.10-3	The fueling stations, as appropriate, will have secondary containment structures installed around the fuel tanks with a leak detection system to alert personnel in the event a tank leaks fuel to the secondary containment.	5.8, 7.7
3	5.10.3.4.2	5.10-4	Regular vehicle maintenance will be performed in an area designated for that purpose. Any spills will be cleaned up promptly. Precautions will be taken to prevent the release of pollutants to the environment from vehicle maintenance. Precautions will include the use of drip pans, mats, and other similar methods. No vehicle washwater will be allowed to run off the EGC ESP Site or enter local, state, or federal waters.	4.4.1
4	5.10.3.4.3	5.10-4	To prevent the mobilization of contaminants in stormwater runoff from entering and/or leaving excavated areas, the following controls on erosion and sedimentation controls will be implemented, as applicable and as found appropriate to control the material. • Stockpiles of excavated soils will be placed on plastic sheeting near the excavation areas. • Stockpiles will be provided with liner, cover, and perimeter berm to prevent rupture and release or infiltration of liquids. • Polyethylene sheeting will be used for liners and covers. • A perimeter berm, typically hay bales placed beneath the liner, will be constructed to allow for collection of any free liquids draining from the stockpile. • Accumulated free liquids will be pumped or otherwise removed to a sanctioned area or container. • Covers and perimeter berms will be secured in place when not in use and at the end of the workday, or as necessary to prevent wind dispersion or runoff from major precipitation events.	5.8, 7.7

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	5.10.3.4.4	5.10-4	The following material handling and housekeeping practices described below will be implemented during EGC ESP Facility operations, as applicable and as found appropriate. • Auxiliary fuel tanks will have secondary containment. The area will be kept free of trash and spilled fuel. • Garbage receptacles will be equipped with covers. This includes such receptacles that contain materials that may be carried by the wind or contain water-soluble materials, (e.g., paint). • Empty storage containers including drums and bags will be stored inside a designated storage building or area. • Containers will be kept closed except as necessary to add or remove material.	5.8, 7.7
2			• Containers will be stored in such a manner to prevent corrosion that could result from contact between the container and ground surface, and in a release of material. • The containers will be appropriately labeled to show the name, type of substance, health hazards, and other appropriate information, if applicable. • MSDSs for chemical substances used or stored on site will be available for review and use.	
3	5.10.3.7.3	5.10-8	It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility; groundwater will not be used as a source of water. In addition, based on the planned design of the EGC ESP Facility, no permanent groundwater dewatering system will be implemented.	5.3.2
4 5	5.10.3.8.1.1 5.10.3.7.1.1	5.10-9 5.10.7	The 5-cfs minimum discharge from Clinton Lake to Salt Creek will be maintained in accordance with the CPS NPDES requirements.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6
6	5.10.3.8.2.1	5.10-9	The EGC ESP Facility will be designed and operated to be compatible with the operation of the CPS and its NPDES permit.	5.3.3
7	5.10.3.8.2.2	5.10-9	The EGC ESP Facility operation will comply with federal laws related to hydrology and water quality.	5.3.3
8	5.10.3.8.3	5.10-10	In addition, based on the proposed design of the plant, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated groundwater use impacts resulting from the operation of the EGC ESP Facility.	5.3.3
9	5.10.3.9.2.2.	5.10-11	The chemicals used will be subject to review and approval for use by the IEPA and releases will be in compliance with water quality standards and an approved NPDES permit. The total residual chemical concentrations in the discharges to Clinton Lake will be subject to limits that will be established by the IEPA.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6,

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	5.10.3.9.4.1	5.10-13	Monitoring will be performed, as appropriate and if required, for the presence of thermophilic organisms, and the potential health risk will be evaluated during preapplication monitoring.	5.8, 7.7
2	5.10.3.9.4.1	5.10-14	If wet cooling is selected, the cooling tower water will be treated with biocides to prevent the growth of dangerous organisms. Monitoring programs will be established to test for the presence of thermophilic microorganisms once the EGC ESP Facility is operational, both to protect on-site workers and the public.	5.8, 7.7
3	5.10.3.10.3	5.10-14	The EMP will utilize 10 CFR 50, Appendix B, compliant quality programs and processes to: Provide that personnel are trained and qualified to perform radiological monitoring; Create and approve procedures for sample collection, packaging, shipment, and receipt of samples for analysis, and prepare and analyze samples at the lab; Document lab processes such as maintenance, storage, and use of radioactivity reference standards, and document the calibration and checks of radiation, radioactivity measurement systems, and sample tracking and control; Document the processes and procedures of the monitoring program; Conduct periodic audits of analysis laboratory functions and their facilities; Maintain records of sample collection, shipment, and receipt. Lab activity records will also be maintained including sample description, receipt, lab identification, coding, sample preparation and radiochemical processing, data reduction, and verification.	5.9, 7.8
4	5.10.3.10.3	5.10-14	In addition, the following activities will be performed: • Perform duplicate analysis of the samples (excluding TLDs) to check laboratory precision; • Routinely count quality indicator and control samples; and • Participation in inter-comparison programs, such as the Environmental Resource Associates (ERA) cross-check program. The analytical results provided by the laboratory will be reviewed monthly to validate that the required minimum sensitivities have been achieved and the correct analyses have been performed.	5.9, 7.8

Table K-1. (contd)

	Environmental Report			Environmental Impact Statement
	Section	Page	Environmental Report Statement	Sections
1	6.1.1.2	6.1-2	additional preapplication monitoring will be conducted to verify and update the baseline conditions at the time of the COL application. The proposed preapplication monitoring will include the collection of minimum monthly temperature measurements from general locations described below and presented in Figure 6.1-1.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6
2			• Locations Coincident with CPS Monitoring Locations - Site 16 is located upstream from the discharge canal. Data from this site will be used to characterize thermal conditions upstream of the discharge flume. - Site 2 is located offshore from the cooling water discharge flume. Data from this site will be used to characterize lake conditions at the point of thermal discharge to the lake. - Sites 8 and 13 are located along the path of the cooling loop between the discharge of water into the lake and the CPS intake. The data from these sites will be used to characterize conditions along the cooling loop. - Site 4 is located near the CPS screen house. The data from this location will be used to characterize lake conditions at the intake.	
3	6.1.1.2	6.1-3	At each site, the temperature measurements will be collected at the surface and 0.5-m (1.5-ft) depth intervals to the bottom using a "YSI Multiprobe or Multiparameter Instrument" (or equivalent meter). The depth of the water column will also be recorded. If thermal stratification (temperature gradient of at least 1°C [about 35°F] per 3-ft depth interval) is present, the water column will be segmented into epilimnion, metalimnion, and hypolimnion. The temperature measurements at each site will be taken at consistent depths and at a time of day (morning) that minimizes the effect of diurnal solar warming.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6
4	6.1.2	6.1-3	The Preoperational Monitoring Program will consist of continuing the preapplication monitoring until the EGC ESP Facility is operational. The results of the preapplication sampling will be evaluated in order to determine if the scope and the frequency of thermal monitoring need to be modified to establish the baseline for water temperature in Clinton Lake and Salt Creek.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6
5	6.1.2	6.1-3	Modifications to the Preoperational Monitoring Program will consider the following objectives: - Determine the average, extent, and surface area of the limiting excess temperature isotherm if one has been established by the IEPA; -Determine the temperature at positions that are appropriate in order to define the extent of existing mixing zones from the discharge flume; and -Establish time-temperature relationships at monitoring stations.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6

Table K-1. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	6.2	6.2-1	The proposed radiological environmental monitoring program (REMP) for the EGC ESP Facility will be designed to monitor the radiological environment during the preconstruction and construction phases from active CPS Facility operations as well as the radiological environment surrounding the EGC ESP Facility during active facility operations.	2.5, 5.9, 7.8, 8.11.8
2	6.2.1	6.2-1	The proposed REMP will be implemented in accordance with the 10 CFR 20.1501 and Criterion 64 of 10 CFR 50, Appendix A.	2.5, 5.9, 7.8, 8.11.8
3	6.2.1	6.2-2	The scope of the program will include the monitoring of six environmental elements: • Direct radiation; • Atmospheric; • Aquatic; • Terrestrial environments; • Groundwater; and • Surface water.	2.5, 5.9, 7.8, 8.11.8
4	6.2.2	6.2-3	Analyses performed on environmental samples collected will include the following: • Gross alpha and beta analysis; • Gamma spectroscopy analysis; • Tritium analysis; • Strontium analysis; and • Gamma dose (TLD only).	2.5, 5.9, 7.8, 8.11.8
5	6.2.2.1	6.2-3	TLDs will be used to measure the ambient gamma radiation levels at many locations surrounding the EGC ESP Facility.	2.5, 5.9, 7.8, 8.11.8
6	6.5	6.5-1	Furthermore, in an effort not to duplicate monitoring efforts, the Applicant will coordinate its Ecological Monitoring Programs with existing Ecological Monitoring Programs and efforts being performed by the CPS, IDNR, IEPA, and other applicable groups or agencies.	2.7.2.3
7	6.5	6.5-1	Site preparation and. construction monitoring, preoperational monitoring, and operational monitoring programs will be provided at the COL phase, in accordance with the schedule provided in NUREG-1555.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6,
8	6.5.2.1	6.5-4	The program proposed in the CPS ER included fish sampling at five sampling locations that were identified in the preliminary baseline assessment. The CPS ER proposed that sampling be continued at these locations on a quarterly basis so that fishery resources are sampled during each season of the year (CPS, 1973). Additionally, new locations within Clinton Lake will be monitored, associated with the proposed intake structure and discharge from the EGC ESP Facility, to evaluate effects on fishery resources during operation.	2.7, 4.4, 5.4, 7.4, 8.5, 8.6,

Table K-1. (contd)

	Environmental Report			Environmental Impact Statement Sections
	Section	Page	Environmental Report Statement	
1	6.5.2.2.1.3	6.5-5	As previously discussed, specific monitoring programs used to identify impacts to fishery resources resulting from operation of the EGC ESP Facility will be recommended once the final design has been confirmed. Representatives from EGC will coordinate their efforts with the IDNR to design a monitoring program that does not duplicate any of the IDNR's ongoing data collection/sampling efforts. In addition, the proposed program will provide the ability to monitor species of commercial and recreational value within the vicinity.	2.7, 5.4, 7.5
2	7.1	7-1	Analysis of severe accidents and mitigation of those accidents will be deferred until the COL stage.	5.10.2
3	8.1	8-1	[Need for Power] Therefore, this evaluation will be provided at the time an application for a construction permit or COL is submitted, in accordance with the applicable regulations (USNRC, 1999).	Chapter 8

4

1 **Table K-2.** Key Statements Made in the Environmental Report Not Directly
2 Considered in the NRC Staff's Environmental Analysis
3

4	**Environmental Report**		
5	**Section**	**Page**	**Environmental Report Statement**
6	2.6	2.6-1	The potential effects of seismic loads, such as liquefaction and soil structure interaction, will be considered during design.
7	2.6	2.6-1	New cooling water detention ponds could be required, based on the final reactor selection. Although these ponds would have the potential to serve as a source of groundwater infiltration, the cooling water ponds will be lined to preclude such occurrences.
8	3.0	3-1	The EGC ESP Facility will be essentially independent of the CPS. With the exception of using the CPS UHS as a source of makeup water, no CPS safety-related systems or equipment will be shared or cross-connected. Raw water for cooling water makeup and other facility services will be provided from a new intake structure located on Clinton Lake adjacent to the CPS intake structure. Facility discharges will use the CPS discharge flume as a discharge path to Clinton Lake. Some structures, such as a warehouse, training buildings, and parking lots, may be shared. Some support facilities, such as domestic water supply and sewage treatment, may also be shared.
9	3.1.3	3.1-3	Raw water for cooling water makeup and other facility services will be provided from a new intake structure located on Clinton Lake adjacent to the CPS intake structure. Cooling tower blowdown and other facility discharges will use the CPS discharge flume as a discharge path to Clinton Lake.
10	3.1.3	3.1-3	The existing switchyard will be expanded to accommodate the output of the new facility and to provide the necessary off-site power. The switchyard area intended for the planned CPS Unit 2 will be utilized for this purpose. Existing transmission right-of-way will be used. Detailed information regarding this subject area is presented in Section 4.1.2.
11	3.3	3.3-1	Wastewater discharges from the proposed facility will be in strict compliance with an approved NPDES permit issued by the IEPA. This permit will make certain that discharges are controlled from systems (such as flumes, sewage treatment facilities, radwaste treatment systems, activated carbon treatment systems, water treatment waste systems, facility service water, stormwater runoff, etc.) to Clinton Lake. The effect on water quality in Clinton Lake due to the operation of the proposed facility will be carefully monitored in full compliance with the NPDES permit.
12	3.4.2.2	3.4-3	The CPS discharge flume will have to be modified to accommodate discharges from the EGC ESP Facility. The only modification to the discharge flume will be to connect discharge pipes from the EGC ESP Facility to the discharge flume. Discharge pipe connections will be in the portion of the existing flume discharge structure that was originally provided for the circulating water discharge from the cancelled CPS Unit 2.

1 **Table K-2.** (contd)

2

3 4	Environmental Report Section	 Page	 Environmental Report Statement
5	3.4.2.4	3.4-4	The UHS system will pump water from the safety-related (essential service water) cooling tower basins through the components cooled by the system. The water will then be returned to the cooling towers for heat rejection to the atmosphere. Normal makeup water for the UHS cooling tower basins will be supplied from Clinton Lake. Emergency makeup water will be supplied from the submerged pond below Clinton Lake in the event that Clinton Lake dam fails. Pumps for the normal and emergency UHS makeup water will be located in a new intake structure, the same one used for the NHS cooling towers, and positioned next to the CPS intake structure. Detailed design information regarding the new intake structure is not presently available but will be provided at the COL phase. Blowdown, from the discharge of the UHS system pumps, will be used to control the concentration of impurities in the water due to evaporation in the cooling tower.
6	3.4.2.5	3.4-4	Temperature monitoring instrumentation will be provided in the blowdown discharge pipe to monitor the discharge temperature.
7	3.5	3.5-1	Radioactive waste management and effluent control systems will be designed to minimize releases from active reactor operations to values as low as reasonably achievable (ALARA).
8	3.5.1	3.5-1	The release of radioactive liquid effluents from the plant will be controlled in such a manner as to not exceed the average annual effluent concentration limits (ECLs) specified in 10 CFR 20. The proposed EGC ESP Facility will be operated such that releases of radioactive liquid effluent to Clinton Lake are expected to be negligible.
9	3.5.2	3.5-2	The release of radioactive gaseous effluents from the plant will be controlled and monitored so that the regulatory limits specified in 10 CFR 20 and 10 CFR 50, Appendix I, are maintained.
10	3.5.3	3.5-3	In addition, the solid waste management system will provide storage of operations waste prior to processing or shipment. The system will be designed to collect and store radioactive wastes in a manner that will maintain radiation exposures ALARA and perform the following objectives: • Collect, hold for decay, monitor, package, and temporarily store the wet and dry solid radioactive wastes produced by the plant during operation and maintenance prior to • Provide a means for segregating trash by radioactivity level and temporarily store the • Minimize exposure to solid radioactive waste materials that could conceivably be hazardous to either operating personnel or the public, in accordance with 10 CFR 20 and 10 CFR 50, Appendix I. • Minimize the volume of solidified waste requiring shipment off site. • Take due account (through equipment selection, arrangement, remote handling, and shielding) of the necessity to keep radiation exposure of in-station personnel ALARA.
11	3.5.3	3.5-3	The waste will be packaged and shipped in accordance with the applicable regulatory requirements.

Table K-2. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement
1	4.2.1.1	4.2-2	The impacts to Salt Creek will be reduced by lake watershed stormwater management practices and the buffering effect of the lake on the rate and volume of runoff as well as water quality. The dam operating procedures will be reviewed and revised as necessary during the construction phase, to accommodate changes in the watershed hydrology and monitoring improvements to support the minimum 5 cfs discharge. These changes will be mitigated by incorporating construction erosion practices as required by federal and state law and stormwater best management practices following construction.
2	4.2.1.2	4.2-3	Construction erosion control measures will be applied during the phases of site development to contain eroded soil on the construction site and remove sediment from stormwater prior to leaving the site. Design measures will be incorporated to avoid concentrated flow that has a high potential to transport sediment. Visual inspections of construction erosion control measures will be incorporated into the construction project to monitor the effectiveness of the control measures and to aid in determining if other mitigation measures are necessary. Mitigation measures will be incorporated into the requirements of the construction contracts and the SWPPP. Beyond the construction activity, stormwater management practices will be incorporated into the site design to minimize the long-term delivery of sediment to the lake.
3	4.2.1.2.2	4.2-5	A notice of intent (NOI) will be filed with the federal and state agencies to receive authorization for land disturbance under the General Stormwater Permit. A SWPPP will also be prepared in accordance with the requirements of the general permit. A notice of termination (NOT) will be filed with the IEPA upon completion of construction and stabilization of the disturbed areas.
4	4.2.1.2.3	4.2-5	These spoil areas will be maintained during construction in order to minimize water and wind erosion. Spoil areas will be kept graded, reasonably flat, and compacted by normal construction traffic. Spoil areas will be surrounded by a silt fence or a vegetated buffer strip, which will be maintained in order to minimize erosion. If necessary, water will be sprayed on the bare soil to minimize wind erosion during dry periods. If stockpiles are in place for more than a specified period of time, they will be vegetated in order to prevent erosion.
5	4.2.1.3	4.2-6	The excavation activities will be designed to minimize the amount of water to be handled as well as potential slope stability problems that may be caused by caving and dewatering of these unconsolidated materials.
6	4.2.1.3	4.2-6	Measures will be implemented, such as sedimentation or filtration, to ensure that erosion or siltation caused by the dewatering will be negligible. Proper safeguards will be implemented to prevent long-term effects on downstream habitats resulting from the construction activities.
7	4.2.2.3	4.2-8	Impacts from construction dewatering on the shallow wells will be evaluated during the preapplication monitoring (conducted at time of the COL application) for the EGC ESP Facility (see Section 6.3.1).

Table K-2. (contd)

	Environmental Report		
	Section	**Page**	**Environmental Report Statement**
1	4.6.3.5.7	4.6-7	The following material handling and storage practices will be implemented during construction activities, as applicable. • Materials on the construction site will be stored in areas designated for that purpose. Suitable measures will be taken in storage areas to reduce the likelihood of a discharge, such as straw bale barriers around the storage area. • Equipment not in use will be stored in a designated area. • Used oil tanks will be emptied frequently as necessary to avert overflow. The area will be kept free of trash and spilled oil. Tanks containing waste will have secondary containment. • Garbage receptacles will be equipped with covers. This includes such receptacles that contain materials that may be carried by the wind, or water soluble materials (e.g., paint). • Storage containers, including drums and bags, will be stored away from traffic to prevent accidental spills. • Containers will be kept closed except to add or remove material as necessary. • Containers will be stored in such a manner as to prevent corrosion that could result from contact between the container and ground surface, resulting in a release of material. • Containers will be appropriately labeled to show the name, type of substance, health hazards, and other appropriate information. • Material safety data sheets (MSDSs) for substances used or stored on the construction site will be available for review and use. • Hazardous substances such as used oil, anti-freeze, spent solvents, discarded paint cans, etc. will be controlled, stored and disposed of in accordance with the applicable MSDS.
2	4.6.3.5.8	4.6-7	During construction, the project specific waste management and health and safety plans will contain spill prevention, control, and response procedures that address site and activity specific conditions. These plans will be maintained on site. The general procedures for addressing spill prevention, control, and response are provided below, and will be implemented for on-site construction activities.
3	4.6.3.5.8.2	4.6-8	Fueling operations and vehicle maintenance will be performed at designated facilities, when practical. Spill sumps will be constructed around fuel and oil tanks. Drip pans will be used underneath oil barrels and other fluids that are used during construction activities. Spills of toxic or hazardous materials will be reported promptly to on-site authority (i.e., general contractor representative or site health and safety personnel) or their designee. The procedure, described below, will be followed for the clean up of small spills, as applicable. • Upon detection of any spill, personal safety is the first priority. The area of the spill and the nature of the spilled material will be evaluated in order to determine if remedial actions could result in additional health hazards, escalation of the spill, or station damage that may escalate the problem. If such conditions exist, a guard will be posted near the area (if practical), and the on-site authority or their designee will be promptly notified. • Identify the source of the spill (if possible), and then stop the flow of pollutants if it can be done in a safe manner as described above. • Record pertinent facts and information about the spill including type of pollutant, location, apparent source, estimated volume, and time of discovery.

Table K-2. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement
1			• Spread absorbent materials on the area to soak up as much of the liquid as possible and prevent infiltration into the soil, and transfer the used materials to an appropriate container. • As soon as possible, the contaminated soil and absorbent material will be excavated and transported to a designated site for collection of such material. • If prompt transfer of the contaminated soil is not practical, the contaminated soil will be excavated and placed on polyethylene sheeting or other suitable material of sufficient thickness, and form a small berm to prevent breakout or infiltration. • If the general contractor responds to the spill, notify the site health and safety representative of the spill and provide in writing the amount of material, type of contaminant, and the source (location of the spill).
2	4.6.3.5.8.2	4.6-8	The procedure, described below, will be followed for the clean up of medium to large spills, as applicable. • Upon detection of any spill, personal safety will be the first priority. The area of the spill and the nature of the spilled material will be evaluated in order to determine if remedial actions could result in additional health hazards, escalation of the spill, or facility damage that may escalate the problem. If such conditions exist, a guard will be posted near the area (if practical). In addition, the on-site health and safety personnel or their designee, and other parties will be promptly notified. The responsible on-site authority will, in turn, notify appropriate agencies (e.g., National Response Center). • Identify the source of the spill (if possible) and stop the flow of pollutants if it can be done in a safe manner as described above.
3			• Record pertinent facts and information about the spill including type of pollutant, location, apparent source, estimated volume, and time of discovery. • Promptly dispatch appropriate equipment (e.g., front-end loader) to the spill and construct a berm or berms downstream of it in order to minimize the spread. • Mobilize additional resources as necessary to address the spill. • Commence spill cleanup when the lateral spread has been contained and the notifications have been made. • Bail or pump free liquid into the appropriate container. • When the liquid has been bailed to the soil layer, apply absorbent materials to the surface, and transfer it to the appropriate container. • The remaining contaminant soils and absorbent material will be excavated and transferred to a temporary contaminant stockpile underlaid with polyethylene sheeting or other suitable material of sufficient thickness. The edges will be bermed to provide a dam to prevent inflow of water or leakage of the liquid. • Contaminated soil and absorbent material will be disposed, as appropriate.
4	4.6.3.5.8.3	4.6-9	The National Response Center will be contacted when a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity occurs during a 24- hr period, established under either 40 CFR 110, 40 CFR 117, or 40 CFR 302.
5	4.6.3.7.1.3	4.6-12	The excavation activities will be designed to minimize the amount of water to be handled as well as potential slope stability problems that may be caused by caving and dewatering of these unconsolidated materials.

Table K-2. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement
1	5.2.1.3	5.2-6	It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility; groundwater will not be used as a source of water. In addition, based on the planned design of the EGC ESP Facility, no permanent groundwater dewatering system will be implemented.
2	5.2.2.2.1	5.2-6	The EGC ESP Facility will be designed and operated to be compatible with the operation of the CPS and their respective NPDES permits.
3	5.2.2.2.1	5.2-6&7	Dam operation practices will be reviewed and revised where appropriate in conjunction with the CPS to maintain minimum flows in Salt Creek downstream of the dam and conserve water in the lake impoundment for power plant operation and recreational purposes.
4	5.3.1.1.3	5.3-2	The intake screens will be kept clean by mechanical means. The screens will be washed or scraped to remove algae, dead fish, trash, and debris that may have been drawn in. Captured material will be removed and disposed of onshore at an approved landfill site. There will be no direct discharge of these materials except for water to Clinton Lake.
5	5.3.3.2	5.3-8	Impacts to terrestrial ecosystems associated with salt drift will be assessed once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted before or during a later licensing stage.
6	5.3.3.4	5.3-10	The volume of the UHS is measured annually to track the progress of sedimentation. These annual measurements will be continued to confirm the available volume of the impoundment.
7	5.3.4.1	5.3-11	Additionally, the EGC ESP Facility thermal discharges will comply with the approved CPS NPDES permit, and therefore, operations will not increase the risk of the presence of *Naegleria fowleri* in Clinton Lake.
8	5.5.1.1	5.5-1	Solid nonradioactive and non-hazardous waste may include office waste, aluminum cans, laboratory waste, glass, metals, paper, etc., and will be collected from several on-site locations and deposited in dumpsters located throughout the site. Segregation and recycling of waste will be practiced to the greatest extent practical. The material will either be disposed of onsite or the Applicant will contract with an outside vendor who will perform weekly collections and disposal at area landfills. If collected and disposed of off site, it is not expected that the amount of solid waste generated will significantly contribute to the total amount of household waste disposed of weekly by area residents.
9	5.5.1.2.1	5.5-2	Other small volumes of wastewater, which may be released from other station sources, are described in the SSAR for the EGC ESP Facility. These will be discharged from sources such as the service water and auxiliary cooling systems, water treatment, laboratory and sampling wastes, floor drains, and stormwater runoff. These waste streams will be discharged as separate point sources or will be combined with the cooling water discharges.

Table K-2. (contd)

Environmental Report Section	Environmental Report Page	Environmental Report Statement
5.5.1.2.3	5.5-3	A Storm Water Pollution Prevention Plan (SWPPP) will be written, if deemed appropriate, that will meet the requirements of a permit for stormwater discharges from the EGC ESP Facility. The plan will include aspects of stormwater pollution prevention common to areas of the EGC ESP Facility that have a potential to discharge stormwater to waters of the U.S. The aspects common to activities will include site description and assessment, erosion and sediment control, stormwater management, identification and control of potential sources of pollution, implementation, maintenance, inspection, and stabilization.
5.5.1.2.4	5.5-3	The nonradioactive liquid wastes will be checked for proper pH and the presence of radiological and hazardous constituents, discharged as a separate point source or combined with plant circulating water prior to discharge to Clinton Lake. These discharges comply with the approved NPDES permit for the EGC ESP Facility issued by the IEPA.
5.5.2	5.5-4	In the event of a spill, emergency procedures will be implemented to limit any on-site impacts. Emergency response personnel will be properly trained and will be routinely provided with a facility inventory, which will include types, volumes, locations, hazards, control measures, and precautionary measures to be taken in the event of a spill.
5.5.2	5.5-4	If generated on site, mixed waste will be assessed based on the following regulatory guidance. Mixed waste (low level radioactive and hazardous waste) is waste that satisfies the definition of low level radioactive waste in the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA) and contains hazardous waste that either: 1) is listed as a hazardous waste in 40 CFR 261(d); or 2) causes the waste to exhibit any of the hazardous waste characteristics identified in 40 CFR 261(c).
5.5.2	5.5-5	The EGC ESP Facility personnel will place primary importance on source reduction efforts to prevent pollution, and eliminate or reduce the generation of mixed waste. Potential pollutants and wastes that cannot be eliminated or minimized will be evaluated for recycling. Treatment to reduce the quantity, toxicity, or mobility of the mixed waste before storage or disposal will be considered only when prevention or recycling is not possible or practical. Environmentally safe disposal will be the last option (USNRC, 1999).
5.5.2 5.10.3.11.2	5.10-16	A Pollution Prevention and Waste Minimization Program (PPWMP) will be developed, if deemed appropriate, and implemented before initial reactor operations.
5.5.2.1.1	5.5-5	Inventory management or control techniques will be used to reduce the possibility of generating mixed waste resulting from excess or out-of-date chemicals and hazardous substances. Where necessary, techniques will be implemented to reduce inventory size of hazardous chemicals, size of containers, and amount of chemicals, while increasing inventory turnover.
5.5.2.1.1	5.5-6	A chemical management system, if required, will be established, prior to initial operation, and acquisition of new chemical supplies will be documented in a controlled process that addresses, as appropriate, the following: • Need for the chemical; • Availability of non-hazardous or less hazardous substitutes or alternatives; and • Amount of chemical required and the on-site inventory of the chemical.

Table K-2. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement
1	5.5.2.1.1	5.5-6	Excess chemicals will be managed in accordance with the station's chemical management procedures. Excess chemicals that are deemed usable will be handled through an excess chemical program. Material control operations will be revised or expanded to reduce raw material and finished product loss, waste material, and damage during handling, production, and storage. The inventory management procedures will be periodically assessed and updated, as appropriate, using criteria that include the following considerations: • If existing inventory management techniques are in accordance with existing pollution prevention and waste minimization guidelines, and regulatory guidelines; • How existing inventory management procedures can be applied more effectively; • Whether new techniques will be added to or substituted for current procedures; • If the review and evaluation approval procedures for the purchase of materials will be revised;
2			• If additional employee training in the principles of inventory management is needed; • How specifications for the review and revision of procurement limit the purchase of environmentally sound products; and • How to increase the purchase of recycled products.
3	5.5.2.1.2	5.5-6	Equipment maintenance programs will be periodically reviewed to determine whether improvements in corrective and preventive maintenance can reduce equipment failures that generate mixed waste. The methods for maintenance cost tracking and preventive maintenance scheduling and monitoring will be examined. Maintenance procedures will be reviewed in order to determine which are contributing to the production of waste in the form of process materials, scrap, and cleanup residue. In addition, the need for revising operational procedures, modifying equipment, and source segregation and recovery will be determined.
4	5.5.2.1.3	5.5-6	Recycling of the waste types will be considered. Opportunities for reclamation and reuse of waste materials will be explored whenever feasible. Decontamination of tools, equipment, and materials for reuse or recycle will be used whenever possible to minimize the amount of waste for disposal.
5	5.5.2.1.4	5.5-7	When radiological or hazardous waste is generated, proper handling, containerization, and separation techniques will be employed, as applicable.
6	5.5.2.1.6	5.5-7	Prejob planning will be completed to determine what materials and equipment are needed to perform the anticipated work.
7 8	5.5.2.1.7	5.5-7	A tracking system will be developed, if required, to identify waste generation data and PPWMP opportunities.
9	5.5.2.1.8	5.5-8	A PPWMP will be developed and implemented, as required, that incorporates the following: • A waste minimization plan that will be routinely reviewed, revised, and implemented during the phases of the EGC ESP Facility construction and operation; • Educate employees of general environmental activities and hazards at the EGC ESP Facility and pollution prevention program and waste minimization requirements, goals, and accomplishments;

Table K-2. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement
1			• Inform employees of specific environmental issues; • Train employees on their responsibilities in pollution prevention and waste minimization; • Recognize employees for efforts to improve environmental conditions through pollution prevention and waste minimization; and • Encourage employees to participate in pollution prevention and waste minimization.
2	5.5.2.1.9	5.5-8	The EGC ESP Facility will implement procurement practices that comply with regulatory guidance, and other requirements for the purchase of products with recovered materials. This includes the elimination of the purchase of ozone depleting substances and the minimization of the purchase of hazardous substances.
3	5.5.2.1.10	5.5-8	Policies and procedures will be developed, as applicable, to reflect a focus on integrating PPWMP objectives into EGC ESP Facility activities. The Environmental, Health, and Safety departments will review new procedures for EGC ESP Facility activities. The procedures will determine whether the elimination or revision of procedures can contribute to the reduction of waste (hazardous, radiological, or mixed). This will include incorporating PPWMP into the appropriate on-site work procedures. Changes to procurement procedures to require affirmative procurement of IEPA-designated recycled products, and reduction of procurement of ozone-depleting substances will also be completed.
4	5.5.2.2.1	5.5-8	The EGC ESP Facility Environmental Health and Safety management will implement and enforce the following guides if it is necessary to store mixed wastes on site: • Use the area only for storage of mixed waste and not for storing unrelated materials or equipment, or for other functions; • Follow proper storage protocols for different kinds of mixed waste; • Label the containers properly and in accordance with regulatory requirements; • Follow the container label requirements; • Post applicable material safety data sheets, emergency spill response procedures, and have a spill kit in the area; • Install fire detection and suppression equipment (if required), alternate water supply, telephone, and alarm at the area; • Make an emergency shower/eyewash station immediately available, where it is tested weekly and functioning; • Fence and lock the gate to the accumulation area or long-term storage area when authorized personnel are not present; • Post "MIXED HAZARDOUS WASTE AREA" and "DANGER—UNAUTHORIZED PERSONNEL—KEEP OUT" signs at the entrance; • Provide secondary containment for liquid mixed hazardous waste; • Conduct weekly inspections; and • Post "NO SMOKING OR OPEN FLAME" signs.
5	5.5.2.2.1	5.5-9	The EGC ESP Facility management will also develop and implement contingency plans, emergency preparedness, and prevention procedures that will be utilized in the event of a mixed waste spill. The EGC ESP Facility personnel who are designated to handle mixed waste or whose job function it is to provide emergency response to mixed waste spills will receive appropriate training in order to perform their work properly and safely.

Table K-2. (contd)

	Environmental Report		
	Section	**Page**	**Environmental Report Statement**
1	5.5.2.2.1	5.5-9	If mixed waste is generated and shipped for treatment and disposal rather than stored, EGC ESP Facility management will identify potential disposal facilities considering the following selection criteria: • The desired method of treatment or disposal (e.g., incineration vs. land disposal); • The disposal facility's permit (e.g., can they accept polychlorinated biphenyls (PCBs), hazardous waste, or radioactive waste); • The disposal facility's turnaround time on approvals; • The form of waste, (e.g., is it soil, debris, semi-solid, or liquid); • The mass or volume of waste; and • The cost of transportation and disposal.
2	5.5.2.2.1	5.5-10	The EGC ESP Facility management will also identify one disposal facility as the primary facility, and a second facility will be identified as an alternate in the event that laboratory testing or other observations prove the waste to be different than initially determined.
3	5.5.2.2.2	5.5-10	If stored at the facility, the USEPA mandates that waste storage containers must be inspected on a weekly basis, and certain aboveground portions of waste storage tanks must be inspected on a daily basis. The purpose of these inspections is to detect leakage from, or deterioration of, containers (40 CFR 264). The USNRC recommends that waste in storage be inspected on at least a quarterly basis (10 CFR 20). The methods used for these inspections may include direct visual monitoring or the use of remote monitoring devices for detecting leakage or deterioration. The remote methods would reduce exposures due to direct visual inspections. Additionally, measures will be provided to promptly locate and segregate or remediate leaking containers.
4	5.8.1.2	5.8-2	Equipment manufacturers will be required to guarantee that specifications on allowable octave bands will be
5	5.8.1.2	5.8-2	noise control devices will be used when necessary.
6	5.8.1.3	5.8-2	Depending on the reactor technology selected, air pollution control devices may be needed and will be used to meet applicable regulations.
7	5.8.2.7	5.8-5	The EGC ESP Site will use their own on-site water and septic facilities.
8	5.10.3.1	5.10-2	Procedures and a Hearing Conservation Program will be developed for any employees exposed to excessive noise, which is defined as an 8-hr exposure of 85 dB or more.
9	5.10.3.10.3.	5.10-14	To establish confidence and credibility that any radiological environmental monitoring data collected and reported are accurate and precise, monitoring activities will be incorporated into the construction phase quality assurance program established pursuant to 10 CFR 50, Appendix B, in concurrence with COL activities.
10	5.10.3.11.1.1	5.10-16	Solid nonradioactive and non-hazardous waste may include office waste, aluminum cans, laboratory waste, glass, metals, paper, etc., and will be collected from several on-site locations and deposited in dumpsters located throughout the site.
11	5.10.3.11.1.2	5.10-16	The nonradioactive liquid wastes will be combined with plant circulating water and checked for proper pH and the presence of radiological and hazardous constituents prior to discharge to Clinton Lake. These discharges will comply with an approved NPDES permit for the EGC ESP Facility issued by the IEPA.
12	5.10.3.11.1.3	5.10-16	The nonradioactive air emissions will be in compliance with the limits that will be established and imposed by the IEPA. These limits will be protective of the air quality in and around the EGC ESP Facility.

Table K-2. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement
1	5.10.3.11.2	5.10-16	The EGC ESP Facility personnel will place primary importance on source reduction efforts to prevent pollution and eliminate or reduce the generation of mixed waste. Potential pollutants and wastes that cannot be eliminated or minimized will be evaluated for recycling.
2	5.10.3.14.1.1	5.10-20	Any equipment that exceeds the noise abatement criteria will use noise control devices.
3	6.1.1.1	6.1-2	Although the existing thermal database is sufficient to describe the thermal conditions in Salt Creek, additional preapplication monitoring will be conducted to verify and update the baseline conditions at the time of the COL application. In addition to continued collection and evaluation of data collected at these locations, the proposed preapplication water quality monitoring will include monthly temperature measurements at a location downstream of the Clinton Lake Dam (Site E-3 on Figure 6.1-1). At each site, temperature measurements will be collected at the surface and 1.5-ft depth intervals to the bottom using a "YSI Multiprobe or Multiparameter Instrument" (or equivalent meter). The depth of the water column will also be recorded.
4	6.1.3	6.1-4	The Operational Thermal Monitoring Program will be implemented in order to establish changes in water temperature resulting from facility operation. The specific operational monitoring requirements will be developed in consultation with IEPA, relative to NPDES permit requirements and the monitoring requirements for the CPS at that time.
5	6.2.2.1	6.2-4	Monitoring stations will be placed in the facility proximity and approximately 5 mi from the proposed reactor in locations representing the 16 meteorological compass sectors. Other locations will be chosen to measure the radiation levels at places of special interest, such as nearby residences, meeting places, and population centers.
6	6.2.2.2	6.2-4	The inhalation and ingestion of radionuclides in the air is a direct exposure pathway to man. A network of ten active air samplers will be used to monitor this pathway.
7	6.2.2.2	6.2-4	The air sampling equipment will be maintained and calibrated by facility personnel using reference standards that are traceable back to the National Institute of Standards and Technology (NIST).
8	6.2.2.2	6.2-4	Air samples will be collected every week and analyzed for gross beta and Iodine-131 activities. Quarterly, the air particulate filters collected throughout this period will be combined and counted for gamma isotopic activity.
9	6.2.2.3	6.2-4	Aquatic monitoring will provide for the collection of fish and shoreline sediments to detect the presence of any radioisotopes related to the operation of the EGC ESP Facility. These samples will be analyzed for naturally occurring and manmade radioactive materials.
10	6.2.2.3.1	6.2-5	Various samples of fish will be collected from Clinton Lake and Lake Shelbyville... These samples will be collected semi-annually and analyzed by gamma spectroscopy.
11	6.2.2.3.2	6.2-5	Samples of shoreline sediments will be collected at Clinton Lake and Lake Shelbyville...Samples will be collected semi-annually and analyzed for gross beta, gross alpha, Strontium-90, and gamma isotopic activities.
12	6.2.2.4	6.2-5	In addition to direct radiation, radionuclides that are present in our atmosphere expose receptors when they are deposited on plants and soil, and subsequently consumed. To monitor this food pathway, samples of green leafy vegetables, grass, and milk will be analyzed. ... These samples will be analyzed by gamma spectroscopy.

Table K-2. (contd)

	Environmental Report		
	Section	**Page**	**Environmental Report Statement**
1	6.2.2.4.1	6.2-5	Milk samples will be collected from a dairy located about 14-mi west southwest of the facility (twice a month during May through October, and once a month during November through April). These samples will be analyzed for Iodine-131, Stronium-90, and gamma isotopic activities.
2	6.2.2.4.2	6.2-5	Grass samples will be collected at three indicator locations and at one control location. These samples will be collected twice a month during May through October, and once a month during November through April (when available). Grass samples will be analyzed for gamma isotopic activity including Iodine-131.
3	6.2.2.4.3	6.2-6	Broadleaf vegetable samples will be obtained from three indicator locations and at one control location. The indicator locations will be in the meteorological sectors with the highest potential for surface deposition. The control location will be a meteorological sector and distance approximately 13-mi downwind, which is considered to be unaffected by unit operations. Samples will be collected once a month during the growing season (June through September) and will be analyzed for gross beta and gamma isotopic activities including Iodine-131.
4	6.2.2.5	6.2-6	Water monitoring (e.g., the collection of drinking water, surface water, and groundwater [well water] samples) will be used to detect the presence of any radioisotopes relative to the operation of the EGC ESP Facility. ... Samples taken will be analyzed for naturally occurring and manmade radioactive isotopes.
5	6.2.2.5.1	6.2-6	A composite water sampler will be located at the service building for the EGC ESP Facility. ... This monthly composite sample will then be analyzed for gross alpha, gross beta, and gamma isotopic activities. ... This quarterly composite sample will then be analyzed for Tritium.
6	6.2.2.5.2	6.2-6	Composite water samplers will be installed at three locations to sample surface water from Clinton Lake. ... This water sample will be collected on a monthly basis. ...Tritium analyses will be performed quarterly from the monthly composites from the water composite sample locations.
7	6.2.2.5.3	6.2-7	Every quarter, both the treated and untreated well water samples will be collected from the well serving the Village of DeWitt and from a well serving the Illinois Department of Conservation at the Mascoutin State Recreational Area. Samples will be analyzed for Iodine-131, gross alpha, gross beta, Tritium, and gamma isotopic activities. See Table 6.2-2 for location of sample points.
8	6.2.3	6.2-7	To establish confidence and credibility that the data collected and reported are accurate and precise, EMP activities will be incorporated into the construction phase Quality Assurance Program established pursuant to 10 CFR 50, Appendix B, in pursuance of COL activities. The EMP will utilize quality programs and processes to: • Personnel will be trained and qualified to perform radiological monitoring. • Procedures for sample collection, packaging, shipment, and receipt of samples for analysis will be created and approved, and samples at the lab will be prepared and analyzed.

Table K-2. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement
1			• Lab processes will be documented, such as maintenance, storage, and use of radioactivity reference standards; calibration and checks of radiation radioactivity measurement systems and sample tracking and control. • The processes and procedures of the monitoring program will be documented. • Periodic audits of analysis laboratory functions and their facilities will be conducted. • Records of sample collection, shipment and receipt will be maintained. Records will also be maintained of lab activities including sample description, receipt, lab identification, coding, sample preparation and radiochemical processing, data reduction, and verification. In addition, the following activities will be performed: • Duplicate analysis of the samples (excluding TLDs) will be performed to check laboratory precision. • Quality indicator and control samples will be routinely counted. • Inter-comparison programs will be participated in, such as the ERA cross-check program. • The analytical results provided by the laboratory will be reviewed monthly to validate that the required minimum sensitivities have been achieved, and that the correct analyses have been performed.
2	6.3.1.1	6.3-2	Although the hydrologic data collected provide a sufficient database to describe hydrologic conditions in Salt Creek, additional preapplication monitoring will be conducted in order to verify and update the baseline conditions at the time of the COL application. The proposed preapplication monitoring will include the following: • The continued collection and evaluation of mean daily flow in Salt Creek downstream of the dam at the Rowell gauging station; and • Monthly stream flow will be measured at Site E-3, concurrent with thermal and chemical monitoring (see Figure 6.1-1). Measurements will be made using a "Marsh McBirney Flowmeter" (or equivalent instrument) at a depth of 3-ft below the surface.
3 4	6.3.1.2	6.3-2	Although the existing database is sufficient to describe the conditions in Clinton Lake as presented in Section 2.3.1.2, additional preapplication monitoring will be conducted in order to verify and update the baseline conditions at the time of the COL application. The proposed preapplication monitoring for Clinton Lake will include the collection of the following data: • Mean daily stage of Clinton Lake; • Mean daily flow being discharged from Clinton Lake (namely through the dam); • Monthly current velocity, concurrent with thermal and chemical monitoring, measured at a depth of 3 ft from the surface using a "Marsh McBirney Flowmeter" (or equivalent instrument) (see Figure 6.1-1 for locations); and • Depth of water column at regular intervals along transects across the impoundment used to estimate the current volume of Clinton Lake.

Table K-2. (contd)

	Environmental Report Section	Page	Environmental Report Statement
1	6.3.1.3	6.3-4	The proposed preapplication monitoring for the EGC ESP Facility will be implemented at the time of the COL application and is described below. • Location and survey of previously installed CPS piezometers that have not been identified as destroyed by construction activities. • Location and identification of existing private wells within 5 mi of the site. • Installation of additional shallow water table piezometers and deep piezometers (screened in discontinuous sand layer) spaced at suitable lateral intervals away from the EGC ESP Facility, between the EGC ESP Facility and the CPS Facility. In addition, piezometers located near Clinton Lake to help define the lateral continuity of sand layers and will be used during the pumping test. • Monitoring of water levels in the piezometers on a monthly basis to verify the hydrostatic loading on the power plant foundation, flow directions, and to estimate the amount of water that may need to be controlled during the excavation activities. • Installation of a 12-in. test well and performance of a long-term pumping test to help evaluate the potential impacts that may be caused from the dewatering activities and the amount of water that may need to be controlled during the excavation activities. • Installation of points to monitor for settlement or ground movement.
2	6.3.2.1	6.3-5	
3	6.3.2.2	6.3-5	
4	6.3.2.3	6.3-5	
5	6.3.3.3	6.3-6	
6			The specific number, depths, and locations of the piezometers and the test well will be determined as the engineering design of the facility is better defined. The data collected will be used to define the baseline conditions at the time of the COL application and groundwater-related design elevations. In addition, the information will be used to identify additional locations that will be monitored during the construction of the EGC ESP Facility.
7	6.3.4	6.3-6	The Operational Hydrological Monitoring Program will be designed to establish the impacts from the operation of the EGC ESP Facility and detect any unexpected impacts from facility operation. Based on the monitoring data for the CPS, the Operational Hydrological Monitoring Program is anticipated to extend over a five-year period or until conditions appear to have stabilized based on the trend analysis. Modifications to the monitoring program (e.g., changes in monitoring locations or collection procedures) will be assessed regularly over the duration of the monitoring program.
8	6.3.4.2	6.3-7	The data from this monitoring program will be evaluated in order to determine changes in the cooling system flows, water levels in Clinton Lake, and discharges from Clinton Lake to Salt Creek.
9	6.3.4.3	6.3-7	A limited Operational Hydrological Monitoring Program will be implemented in order to establish the impacts to the groundwater system from the operation of the EGC ESP Facility and detect any unexpected impacts from facility operation. ...The monitoring will consist of extending preoperational monitoring for an additional five-year period or until conditions appear to have stabilized based on the trend analysis of groundwater and surface water conditions. The need for modifications to the monitoring program (e.g., changes in monitoring locations or frequency of collection) will be assessed regularly over the duration of the monitoring program.

Table K-2. (contd)

	Environmental Report		
	Section	Page	Environmental Report Statement
1	6.5.1.1	6.5-1	A Terrestrial Monitoring Program was established for the CPS to monitor, on a low-level basis, the wildlife and vegetation communities in the vicinity of the site. ... A similar program will be implemented for the EGC ESP Facility. This monitoring program will document changes in plant and animal species composition over time, and will build on the database gathered during the CPS preliminary baseline environmental assessment and monitoring. In addition, monitoring of terrestrial resources along the proposed transmission right-of-way will be implemented as appropriate.
2	6.5.1.1.1	6.5-1	Sampling methodologies for the five communities will continue with the generally accepted techniques of quadrant, quarter, and transect sampling.
3	6.5.1.1.2	6.5-2	The results of these surveys [bird] will be reviewed, as necessary, to document avian communities in the vicinity.
4	6.5.1.1.2	6.5-2	Monitoring surveys of waterfowl at Clinton Lake and other waterbodies within the vicinity will be performed, as appropriate, in order to confirm that changes in composition, abundance, or distribution are not occurring as a result of operation of the EGC ESP Facility.
5	6.5.1.1.3	6.5-2	The CPS ER proposed that monitoring programs for small mammal populations be conducted during May and November at five locations within the vicinity (CPS, 1973). Trap-lines were set to help determine the composition and abundance of small mammal populations, and roadside counts were performed in order to determine the presence of cottontail rabbits in the vicinity (CPS, 1973 and CPS, 1982). It is anticipated that the continuation of this program will be adequate to identify any adverse effects that the EGC ESP Facility may have on small mammal populations in the vicinity. During monitoring efforts, records will also be kept of mammal sightings or signs of presence including tracks or scat.
6 7	6.6.1.1 6.6.1.3	6.6-1 6.6-3	Although the existing chemical database is sufficient to describe the chemical conditions in Salt Creek, additional preapplication monitoring will be conducted to verify and update the baseline conditions at the time of the COL application. In addition to continued collection and evaluation of data collected at the Rowell gauging station, the proposed preapplication water quality monitoring will include sampling at a location downstream of the Clinton Lake Dam (Site E-3 on Figure 6.1-1). Water samples will be collected monthly (at a minimum), concurrent with the thermal monitoring (see Section 6.1). Dissolved oxygen, specific conductance, and pH will be measured *in situ* from the water surface, and at 1.5-ft depth intervals at each site using a "YSI Multiprobe or Multiparameter Instrument" or equivalent meter. Water samples will be collected using non-metallic Van Dorn, Kemmerer, or Beta type bottles from 3-ft below the surface. The data gathered will be used to assess conditions in Salt Creek between the Clinton Lake Dam and the Rowell gauging station.
8	6.6.1.3	6.6-4	In addition, water quality will be evaluated prior to and after the pumping test in order to monitor potential changes in water quality during the construction dewatering activities.
9	6.6.2	6.6-4	The chemical monitoring of surface water and groundwater will be conducted to provide data necessary to assess water quality changes that result from construction and operation of the EGC ESP Facility.

Table K-2. (contd)

	Environmental Report		
	Section	**Page**	**Environmental Report Statement**
1	6.6.2.1	6.6-4	The data from the preapplication sampling of Salt Creek and Clinton Lake will be evaluated. This will determine if the scope and the frequency of chemical monitoring will need to be modified in order to establish the baseline for water quality in Salt Creek. In addition, the need for changes to the monitoring program (e.g., changes in monitoring locations, parameters, collection, or analytical procedures) will be assessed regularly over the duration of the monitoring program.
2	6.6.2.2	6.6-4	The results of the preapplication sampling will be evaluated, and will determine if the scope and the frequency of chemical monitoring will be to be modified in order to establish the baseline for water quality. In addition, the need for modifications to the monitoring program (e.g., changes in monitoring locations, parameters, collection, or analytical procedures) will be assessed regularly and over the duration of the monitoring program.
3	6.6.2.3	6.6-4	The chemical monitoring of groundwater will be conducted in order to provide data necessary to assess water quality changes that result from construction dewatering and operation of the EGC ESP Facility.
4	6.6.2.3	6.6-4	The results of the preapplication sampling will be evaluated, and will determine if the scope and the frequency of chemical monitoring will be modified in order to establish the baseline for groundwater quality. In addition, the need for modifications to the monitoring program (e.g., changes in monitoring locations, parameters, collection, or analytical procedures) will be assessed regularly and over the duration of the monitoring program.
5	6.6.3	6.6-5	An Operational Monitoring Program will be implemented to identify changes in water quality that results from operation of the EGC ESP Facility. A consideration in the development of the Operational Monitoring Program is the ability to update the estimates of the effectiveness of various effluent treatment systems, and to provide real time warnings of any failures in the effluent treatment systems. The specific elements of the Operational Monitoring Program for the assessment of surface water quality will be developed in consultation with the IEPA, relative to NPDES permit requirements and with consideration of monitoring conducted for the CPS.
6	6.6.3.1	6.6-5	operational monitoring for Salt Creek ... The data will be evaluated by monitoring for water quality changes of the discharge from Clinton Lake to Salt Creek.
7	6.6.3.2	6.6-5	[Lakes and Impoundments Operational Monitoring] The data will be evaluated for chemical variability along the flow path and temporal trends. The results of the operational monitoring and previous sampling events will be evaluated to determine if the scope and the frequency of chemical monitoring will be modified. The need for modifications to the monitoring program (e.g., changes in monitoring locations, parameters, collection, or analytical procedures) will be assessed regularly and over the duration of the monitoring program.
8	6.6.3.3	6.6-5	The groundwater data from the preapplication and preoperational sampling events will be evaluated, and the scope and/or the frequency of chemical monitoring will be modified, as needed. The need for modifications to the monitoring program (e.g., changes in monitoring locations, parameters, collection, or analytical procedures) will be assessed regularly and over the duration of the monitoring program.
9	6.7.2	6.7-1	The programs that are listed in Table 6.7-1 will continue into the preoperational phase

Table K-2. (contd)

Environmental Report Section	Environmental Report Page	Environmental Report Statement
6.7.3	6.7-1	Operational monitoring is proposed to begin after construction is complete and the EGC ESP Facility is operating. ... The need for modifications (e.g., changes in monitoring locations, parameters, collection, or analytical procedures) will be assessed regularly, over the duration of the monitoring programs.
9.4	9.4-1	Based on the evaluations provided in this ER, the site will accommodate the operational and environmental requirements for any one of them. Therefore, alternative facility systems will be discussed at the COL stage, when the full spectrum of design alternatives will be available.
10.3.2	10.3-2	Radiological monitoring programs will be enacted to measure and reduce radiation levels emitted by the facility.

Table K-3. Key Statements Made in the Environmental Report Related to Actions and Activities of Others and the Impacts of Those Activities Considered in the NRC Staff's Environmental Analysis

Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
2.2.2	2.2-3	The transmission corridor does not interfere with the county's land use plan since only existing right-of-way will be used for the transmission corridor.	2.2, 4.1.1, 5.1, 7.1
2.2.2	2.2-3	The transmission corridor will not conflict with any proposed zoning for the county.	2.2, 4.1.1, 5.1, 7.1
3.7	3.7-1	An RTO or the owner, both regulated by Federal Energy Regulatory Commission (FERC), will bear the ultimate responsibility for defining the nature and extent of system improvements, and the design and routing of connecting transmission and the impacts of such improvements. Therefore, the construction described in this section is based on the existing infrastructure, Illinois Power Company system design preferences, and best transmission practices. The guiding assumption for transmission route design is that the new construction will follow in parallel with some of the existing transmission serving the CPS, and that it is only required to reach the nearest substation providing connection to the greater area grid. Impacts to the grid will be addressed by the system owner after submission of an interconnect request.	3.3, 4.4.1, 5.4.1
3.7.1.1 5.1.2 5.6	3.7-2 5.1-2 5.6-1	The EGC ESP Facility will rely on an interconnection with Illinois Power Company, and anticipates that the configuration of the transmission system and corridor will be similar to the existing system.	4.4.1, 5.4.1
3.7.2 4.1.2	3.7-2 4.1-3	However, in order to accommodate the bounding case of an output of 2,180 MWe, new lines will be required, as there is insufficient capacity on the existing system to carry the load, and the existing structures were not designed for additional circuits. Parallel lines are required in each direction because a single line can not carry the full output of both the EGC ESP Facility and CPS. Four new transmission lines will be required to connect the EGC ESP Facility to the existing transmission grid in southern Illinois. Two parallel, double circuit transmission lines will depart the station north to an interconnect point at the Brokaw substation near Bloomington, Illinois, approximately 15 mi from the site (see Figure 2.2-4). A second pair of parallel double circuit lines will depart the station south to an interconnect point on Illinois Power Company's Latham-Rising 345-kV line (Number 4571) at Oreana, approximately 9 mi from the site (see Figure 2.2-4).	2.2, 3.3, 4.1, 4.1.1, 4.4.1, 5.1.1, 5.4.1, 7.1, 8.5, 8.6

Table K-3. (contd)

Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
3.7.2 5.6.3.3 5.10.3.12.3.2	3.7-3 5.6-6 5.10-18	Transmission system design, construction, and operation will comply with the relevant local, state, and industry standards including the National Electric Safety Code (NESC) and various ANSI/Institute of Electrical and Electronics Engineers (IEEE) standards. This includes ground clearances, electromagnetic fields (EMF), radio interference (RI), television interference (TVI), audible noise, aviation safety, and other factors as appropriate.	5.8.4
3.7.4	3.7-4	The EMF reduction measures will be incorporated into the line and station designs so that the EMF strengths will be minimized.	5.8.4
3.7.5 5.6.3.5 5.10.3.12.3.4	3.7-4 5.6-7 5.10-18	To minimize these induced ground currents and distribute ground fault currents, the tangent or inline structure will be grounded. The tangent structure will have an electrical connection between the shield wire and ground lead, which will be connected to ground rods. Ground resistance tests will be made at the tangent structure before the shield wire is electrically connected to the ground lead. Sufficient ground rods will be installed to reduce the resistance to 10 ohms or less under normal atmospheric conditions. Angle or corner structures will have a low voltage insulator installed between the shield wire and down guys to avoid possible anchor corrosion problems.	5.8.4
4.1.2	4.1-3	In general, construction of transmission corridor in off-site areas will have a minimal impact on land use due to the fact that it is assumed that only existing rights-of way will be used.	2.2, 3.3, 4.1, 4.4.1, 5.4.1, 7.1, 8.5, 8.6
4.1.2	4.1-3	The northern section will run north of the EGC ESP Facility and then turn west and run towards Bloomington, Illinois. The southern section will run southeast of the EGC ESP Facility past Clinton Lake and then turn south and run towards the southern boundary of DeWitt County.	2.2, 3.3
4.1.2.1.1	4.1-4	Where temporary access is required, short routes of nongraded overland access will be constructed for as long as access to the site is required, after which they will be reclaimed. Standard design techniques, such as installing water bars and dips to control erosion, will be employed along with minimizing construction during wet seasons.	4.1.2 7.1
4.1.2.1.1	4.1-4	Any area disturbed by the storage operations, not already in use for substation operations or construction activities, will be restored consistent with existing and natural vegetation.	4.1.2 7.1
4.1.2.1.4	4.1-6	Where necessary, culverts and fence openings will be installed to allow access to and along the right-of-way during clearing and construction activities. Except where requested by landowners, the culverts and fence openings will be removed following completion of construction activities.	4.1.2 7.1

Table K-3. (contd)

	Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
1	4.1.2.1.5	4.1-6	The H-Frame structures will be direct buried in the ground except where site conditions dictate a concrete foundation. Foundation holes will typically be excavated with rubber tire or track mounted augers, which will leave a minimum footprint of disturbed ground. Following erection of the H-Frames into the foundation holes, the holes will be backfilled with the removed soil and compacted. Excess soil will be distributed evenly around the legs and graded to match the existing ground profile. The small amount of excess soil will not require off-site disposal. The poles, connecting hardware, insulators, and guys required for H-Frame construction will be delivered to the construction site from the storage yard on suitable rubber tire trucks and trailers. At the erection site, a rubber tire rough duty mobile crane will be used to move the sections during assembly and to install the completed H-Frames. During this operation an area approximately 100 ft-long by 40-ft wide will be required for component laydown, the preassembly of structures, and vehicle access at each H-Frame location.	4.1.2, 7.1
2	4.1.2.1.5	4.1-7	On completion of construction, the right-of-way will be restored as near as possible to its original condition. As the contractor completes the operations, the right-of-way will be backbladed with a bulldozer and the area will be graded. Customary practices for erosion prevention will then be used.	4.4.1
3	4.1.2.2.1	4.1-8	The transmission corridor will not cause long-term changes to special agricultural resources, such as prime or unique farmland, since the transmission corridor will be constructed in existing right-of-way. There are no known significant mineral resources (sand and gravel, coal oil, natural gas, and ores) within the transmission corridor (ISGS, 1999). No construction activities for the transmission corridor will take place within a coastal zone (USGS, 1990) or wild and scenic river (USFWS, 2002). Clinton Lake is considered a 100-yr floodplain. There are also three other 100-yr floodplains within the transmission corridor (IDNR, 1986). There are minor wetland areas within the vicinity (IDNR, 1987). Careful consideration of these floodplains and wetlands will take place when constructing the transmission corridor. Transmission towers required for the proposed transmission system will be sited in upland areas within the existing utility corridor. Adverse impacts to watercourses, wetlands, and floodplains within the existing right-of-way will be avoided to the greatest extent possible.	2.7, 4.1.2, 4.4.1, 5.4.1, 7.4, 7.5, 8.5, 8.6
4	4.2	4.2-1	The construction will be confined to the station site and the existing transmission corridor. Proper mitigation and management methods implemented during construction will limit the potential water quantity and quality impacts to the surface water (e.g., Clinton Lake, stream crossings, and intermittent drainage ways) and adjacent groundwater.	4.4.2, 4.3

Table K-3. (contd)

	Environmental Report			Environmental Impact Statement Sections
	Section	Page	Environmental Report Statement	
1	4.3.1.2	4.3-1	As previously discussed, transmission system improvements will be required to support the EGC ESP Facility. These modifications will be located within or immediately adjacent to the existing substation at the CPS and along the existing transmission corridor. The proposed transmission line improvements will be sited within the existing utility rights-of-way to the greatest extent possible. Construction of the proposed transmission line improvements will temporarily habitats within the existing rights-of-way; however, the agricultural and open field areas will be allowed to revegetate to preconstruction conditions. There will be no significant loss of agricultural or open field habitats resulting from construction of the transmission systems. Where right-of-way expansion is required in forested lands, clearing will be required. Forested habitats do not make up a significant amount of the proposed utility corridor; therefore, significant impacts to forested lands are not anticipated.	4.4.1, 5.4.1,
2	4.3.2.2	4.3-4	Construction of the proposed transmission corridor will temporarily impact watercourses existing along the proposed right-of-way. These temporary impacts will be short-term and temporary in nature, and there will be no net loss of resource area.	4.4.1, 5.4.1, 7.4, 7.5, 8.5, 8.6
3	4.6.3.7	4.6-9	The construction will be confined to the EGC ESP Site and the existing transmission corridor. Proper mitigation and management methods implemented during construction will limit the potential water quantity and quality impacts to the surface water (e.g., Clinton Lake, stream crossings, and intermittent drainage ways) and adjacent groundwater.	4.4.2
4	5.1.2	5.1-2	It has been assumed that operation and maintenance activities will be conducted in a similar manner to the existing transmission facilities because it is anticipated that the transmission corridor will, most likely, be within the existing right-of-way.	5.1, 5.4.1, 7.4, 8.4, 8.5, 8.6,
5	5.1.2.1	5.1-2-3	A major portion, approximately 88 percent, of the transmission line right-of-way that will most likely serve the EGC ESP Facility will cross agricultural land. As part of the existing right-of-way agreements, it is assumed that farmers will continue to cultivate this land except for a small area around the H-Frame structure. Therefore, it is anticipated that existing access to the right-of-way is adequate and no permanent roads will be built on the right-of-way for either construction or maintenance. However, road construction may become necessary if the landowner requires it as a condition of the right-of-way or for access to a switching structure. A road will be constructed to the following general specifications: • Aligned to avoid impacts to wetland resource areas; • Grades will be minimized to eliminate erosion; • Grading, ditches, cut and fill areas, or other disturbed areas will be re-vegetated to prevent erosion;	2.2, 3.3, 2.7, 4.1, 4.4.1, 5.1, 5.4.1

Table K-3. (contd)

	Environmental Report			
	Section	**Page**	**Environmental Report Statement**	**Environmental Impact Statement Sections**
1			• Culverts will be installed where needed to prevent erosion and prevent flooding of the road; and • The surface of the road will be paved with crushed rock or natural gravelly material to withstand expected loads. Once constructed, these roads will be permitted to "grassover"for grazing, aesthetics, and minimal maintenance.	
2	5.1.2.2	5.1.-3	Vegetation control will be performed in accordance with customary practices. With such a high percentage of the transmission right-of-way crossing productive agricultural land, there will be a minimal amount of vegetation control required. Where the transmission line crosses wooded areas, trees with the potential to impact the lines may be removed or pruned during construction. For maintenance purposes those tree species with the potential for resprouting may be controlled with an environmentally acceptable selective basal spray herbicide. It is not customary for trees to be allowed directly under the transmission lines for approximately 50 ft on either side of the centerline. Trees outside of the 50-ft limit may be maintained through periodic trimming in order to keep them out of the danger timber zone, see Figure 5.1-2. Where the transmission line crosses public roads, a screen of trees may be left to minimize visual impacts from the line. Any new access to the right-of-way, though not anticipated, may be constructed at oblique angles to the road in order to prevent line of sight down the right-of-way, see Figure 5.1-3. Routine inspections of the right-of-way for vegetation control monitoring will be conducted periodically. It is assumed that inspections will be conducted by aircraft in order to determine the need for roads and minimize associated impacts. Maintenance and repair inspections required by cause, such as storms that may down timber on or near the lines, will be conducted by air, road, or foot, as required by the circumstances.	5.1, 5.4.1,
3	5.6	5.6-1	Trees and shrubs that obstruct access along the transmission line right-of-way or pose a safety concern to the lines and pole structures will be removed. The right-of-way will periodically be maintained to control vegetative growth using mechanical mowing (e.g., brush hogs) and selective use of herbicides to control noxious species such as vines that climb poles. It has been assumed that the transmission line will be operated and maintained in accordance with existing approved Illinois Power Company plans and procedures.	2.2.2, 2.7, 3.3, 4.1.2, 4.4, 5.1.2, 5.4, 7.4, 8.5, 8.6,
4	5.6.1	5.6-1	Rights-of-way will be maintained in accordance with the transmission corridor owner or operators plans and procedures.	

Table K-3. (contd)

Environmental Report Section	Environmental Report Page	Environmental Report Statement	Environmental Impact Statement Sections
5.6.1.1.2	5.6-2	Transmission towers and lines will be located in the vicinity of existing towers and lines; therefore, mortality to any state-listed species of concern (including a variety of birds species discussed in Section 2.4) is not anticipated to increase significantly over current levels.	4.4.1, 5.4.1
5.6.1.2.3	5.6-3	Appropriate best management practices will be utilized so that adverse impacts to any environmentally sensitive areas potentially occurring along the proposed corridor are avoided during periodic maintenance activities.	5.1
5.6.2 5.10.3.12.2	5.6-4 5.10-17	Appropriate construction procedures and best management practices will be used to minimize disturbances to existing wetlands, floodplains, and other aquatic ecosystems located within or along the existing corridor, during operation and maintenance activities. In marsh and emergent growth, wetlands vegetation maintenance is typically not required. In shrub and forested wetland areas, mowing and trimming is periodically required to keep growth outside of the line areas and away from poles. Periodic maintenance will be performed in accordance with the transmission corridor owner or operators plans and procedures.	4.4.1, 5.4.1
5.6.2.3	5.6-5	Periodic maintenance activities will be performed in accordance with the transmission corridor owner or operators plans and procedures.	5.4.1
5.10.3.12.1	5.10-17	There will be no construction of new right-of-way or access roadways required for the proposed transmission system.	5.4.1
5.10.3.12.1	5.10-17	There may be temporary disturbances to agricultural activities during construction of the proposed transmission system, but following construction, the disturbed areas will be restored to preconstruction activities.	4.4.1
5.10.3.12.1.2 5.6.2 5.6.1.2.5	5.10-17 5.6-4 5.6-3	Towers required to support the proposed transmission system will be sited in upland areas to the greatest extent possible. Appropriate construction procedures and best management practices will be utilized to make certain that the adverse impacts to any environmentally sensitive areas or important habitats potentially occurring along the proposed corridor are avoided.	4.4.1, 5.4.1

NRC FORM 335
(9-2004)
NRCMD 3.7

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(See instructions on the reverse)

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(Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

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for an Early Site Permit (ESP) at the
Exelon ESP Site

Draft Report for Comment

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4. FIN OR GRANT NUMBER

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10. SUPPLEMENTARY NOTES

Docket No. 52-007

11. ABSTRACT *(200 words or less)*

This report has been prepared in response to an application submitted to the NRC by Exelon Generation Company, LLC, for an early site permit (ESP) for the Exelon ESP site located adjacent to the Clinton Power Station in Clinton, Illinois. The ESP does not authorize construction and operation of a nuclear power plant. However, the application does include a site redress plan that, if approved, would allow limited site preparation work.

The staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by Exelon; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. In addition, in making its recommendation, the staff determined that there are no environmentally preferable or obviously superior sites. Finally, the staff has concluded that the site-preparation and construction activities allowed by 10 CFR 50.10(e)(1) requested by Exelon in its application would not result in any significant adverse environmental impact that cannot be redressed.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Clinton
Early Site Permit
ESP
National Environmental Policy Act
NEPA
Exelon
Environmental Impact Statement

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