Safety Evaluation of Early Site Permit Application in the Matter of Exelon Generation Company, LLC, for the EGC Early Site Permit Site

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

ABSTRACT

This draft safety evaluation report (DSER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's technical review of the site safety analysis report (SSAR) and emergency planning information included in the early site permit (ESP) application submitted by Exelon Generation Company (EGC), LLC (Exelon or the applicant), for the EGC ESP site, with the exception of the staff's review of the information in SSAR Section 2.5, "Geology, Seismology, and Geotechnical Engineering," and Section 3.4.2, "10 CFR 100.23—Geologic and Seismic Siting Criteria." The staff will issue a supplemental DSER at a future date that documents its technical review of SSAR Sections 2.5 and 3.4.2.

By letter dated September 25, 2003, Exelon submitted the ESP application for the EGC ESP site in accordance with Subpart A, "Early Site Permits," of Title 10, Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," of the *Code of Federal Regulations* (10 CFR Part 52). The EGC ESP site is located approximately 6 miles east of the city of Clinton in central Illinois, and is adjacent to an existing nuclear power reactor operated by AmerGen, which is a subsidiary of Exelon Generation Company. In its application, Exelon seeks an ESP that could support a future application to construct and operate additional nuclear power reactors at the ESP site with a total nuclear generating capacity of up to 6800 megawatts (thermal).

This DSER presents the results of the staff's review of information submitted in conjunction with the ESP application. In addition, this report discusses the status of the staff's review of information submitted to the NRC through November 30, 2004. The staff has identified open and confirmatory items that the applicant needs to address before the staff can complete its review of the ESP application. Section 1.6 of this report summarizes these items. To resolve these items, the staff needs the additional information identified in this report. The staff will provide its conclusions on the review of the Exelon ESP application in a final safety evaluation report.

The staff has also identified certain site-related items that will need to be addressed at the combined license or construction permit stage, should an applicant desire to construct one or more new nuclear reactors on the EGC ESP site. The staff determined that these items do not affect the staff's regulatory findings at the ESP stage and are, for reasons specified in Section 1.7 of the DSER, more appropriately addressed at later stages in the licensing process.

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In accordance with U.S. Nuclear Regulatory Commission Review Standard (RS)-002, "Processing Applications for Early Site Permits," Attachment 2, the chapter and section layout of this safety evaluation report is essentially consistent with the format of (1) NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (hereafter referred to as the SRP), (2) Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," and (3) the applicant's site safety analysis report. Numerous sections and chapters in the SRP are not within the scope of or addressed in an early site permit (ESP) proceeding. The reader will therefore note "missing" chapter and section numbers in this document. Other licensing actions (e.g., design certification, construction permit, and/or combined license) will address the subjects of chapters and sections in the SRP not discussed herein, as appropriate and applicable, for a reactor(s) that might be constructed on the EGC ESP site.

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EXECUTIVE SUMMARY

Title 10, Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," of the *Code of Federal Regulations* (10 CFR Part 52) contains requirements for licensing new nuclear power plants.[1] These regulations address early site permits (ESPs), design certifications, and combined licenses (COLs). The ESP process (10 CFR Part 52, Subpart A, "Early Site Permits") is intended to address and resolve site-related issues. The design certification process (10 CFR Part 52, Subpart B, "Standard Design Certifications") provides a means for a vendor to obtain U.S. Nuclear Regulatory Commission (NRC) certification of a particular reactor design. Finally, the COL process (10 CFR Part 52, Subpart C, "Combined Licenses") allows an applicant to seek authorization to construct and operate a new nuclear power plant. A COL may reference an ESP, a certified design, both, or neither. A COL applicant must resolve any licensing issues that were not resolved as part of an ESP or design certification proceeding before the NRC issues a COL.

This draft safety evaluation report (DSER) describes the results of a review by the NRC staff of an ESP application submitted by Exelon Generation Company, LLC (Exelon or the applicant), for the Exelon Generation Company (EGC) ESP site. The staff's review verified, with noted exceptions, the applicant's compliance with the requirements of Subpart A of 10 CFR Part 52. The DSER serves to identify the status of completion of the NRC's safety review, with the exception of the staff's review of the information in Section 2.5, "Geology, Seismology, and Geotechnical Engineering," and Section 3.4.2, "10 CFR 100.23—Geologic and Seismic Siting Criteria," of the site safety analysis report (SSAR), and to identify remaining items to be addressed before the staff issues its final safety evaluation report (FSER). The staff will issue a supplemental DSER at a future date to identify the status of completion of its review of SSAR Sections 2.5 and 3.4.2.

The NRC regulations also contain requirements for an applicant to submit an environmental report pursuant to 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Activities." The NRC reviews the environmental report as part of the Agency's responsibilities under the National Environmental Policy Act of 1969, as amended. The NRC presents the results of that review in a draft environmental impact statement, which is a report separate from this DSER.

By letter dated September 25, 2003, Exelon submitted an ESP application (ADAMS Accession No. ML032721596)[2] for the EGC ESP site. The EGC ESP site is located in DeWitt County in

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[1]Applicants may also choose to seek a construction permit and operating license in accordance with 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," instead of using the 10 CFR Part 52 process.

[2]ADAMS (Agencywide Documents Access and Management System) is the NRC's information system that provides access to all image and text documents that the NRC has made public since November 1, 1999, as well as bibliographic records (some with abstracts and full text) that the NRC made public before November 1999. Documents available to the public may be accessed via the Internet at http://www.nrc.gov/reading-rm/adams/web-based.html. Documents may also be viewed by visiting the NRC's Public Document Room at One White Flint North, 11555 Rockville Pike, Rockville, Maryland. Telephone assistance for using web-based ADAMS is available at (800) 397-4209 between 8:30 a.m. and 4:15 p.m., eastern standard time, Monday through Friday, except Federal holidays. The staff is also making this DSER available on the NRC's new reactor licensing public web site at http://www.nrc.gov/reactors/new-licensing/esp/clinton.html.

east-central Illinois about 6 miles east of the city of Clinton. The site is located between the cities of Bloomington and Decatur to the north and south, respectively, and Lincoln and Champaign-Urbana to the west and east, respectively, and is adjacent to an existing nuclear power reactor, Clinton Power Station, operated by AmerGen Energy Company, LLC (AmerGen).

In accordance with 10 CFR Part 52, the Exelon ESP application includes (1) a description of the site and nearby areas that could affect or be affected by a nuclear power plant(s) located at the site, (2) a safety assessment of the site on which the facility would be located, including an analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site, and (3) the proposed major features of an emergency plan. The application describes how the site complies with the requirements of 10 CFR Part 52 and the siting criteria of 10 CFR Part 100, "Reactor Site Criteria."

The DSER presents the status of the staff's review of information the applicant submitted to the NRC through November 30, 2004. The staff has identified open and confirmatory items that the applicant must resolve before the NRC can complete its review of the ESP application. Section 1.6 of this DSER summarizes these items. To close these items, the staff needs the additional information identified in this DSER. The staff will provide the conclusions of its review of the Exelon ESP application in the FSER.

The staff has identified, in Section 1.7 of the DSER, proposed permit conditions that it will recommend that the Commission impose, should an ESP be issued to the applicant. The staff has also identified certain site-related items that will need to be addressed at the COL or construction permit stage, should an applicant desire to construct one or more new nuclear reactors on the EGC ESP site. The staff determined that these items do not affect the staff's required findings at the ESP stage and are, for reasons specified in Section 1.7, more appropriately addressed at these later stages in the licensing process.

Inspections conducted by the NRC have verified, where appropriate, the conclusions in this DSER. The scope of the inspections consisted of selected information in the ESP application and its references. The DSER identifies applicable inspection reports as reference documents.

The NRC's Advisory Committee on Reactor Safeguards (ACRS) will also review the bases for the conclusions in this report. The ACRS will independently review those aspects of the application that concern safety, as well as the DSER and, will report the results of its review to the Commission. The NRC will include the ACRS comments and recommendations, and the staff's responses to them, in the FSER.

As required by 10 CFR 52.21, "Hearing," the review process for the ESP will include a hearing. The NRC published a notice of hearing in the *Federal Register* on December 12, 2003 (68 FR 69426). The Environmental Law and Policy Center, the Blue Ridge Environmental Defense League, the Nuclear Energy Information Service, the Nuclear Information and Resource Service, and Public Citizen collectively filed a petition for leave to intervene on January 12, 2004 (ADAMS Accession No. ML040350609) and, on May 3, 2004, filed several contentions alleging deficiency in Exelon's application (ADAMS Accession Nos. ML041340416

and ML041270457). In a memorandum and order issued August 6, 2004, the Atomic Safety and Licensing Board admitted a part of one contention (ADAMS Accession No. ML042260071). The admitted contention does not relate to the safety review that is the subject of this DSER, but is related to the applicant's environmental review, which is the subject of the NRC's draft environmental impact statement.

ABBREVIATIONS

ABWR	Advanced Boiling Water Reactor
ACR-700	Advanced CANDU Reactor
ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
ALARA	as low as reasonably achievable
ALWR	advanced light water reactor
ANS	American Nuclear Society
ANSI	American National Standards Institute
AP1000	Advanced Plant 1000
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AT	area type
BWR	boiling water reactor
CAR	corrective action report
CFR	*Code of Federal Regulations*
COL	combined license
CP	construction permit
CPS	Clinton Power Station
CPT	cone penetrometer test
DBA	design-basis accident
DCD	design control document
DCM	document control manager
DCO	dosimetry control officer
DEIS	draft environmental impact statement
DOE	U.S. Department of Energy
DSER	draft safety evaluation report
EAB	exclusion area boundary
EAS	emergency alert system
ECO	exposure control officer
EGC	Exelon Generation Company
ENS	Emergency Notification System
EOC	emergency operations center
EOF	emergency operations facility
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPZ	emergency planning zone
ERDS	Emergency Response Data System
ERF	emergency response facility
ERO	emergency response organization
ESBWR	Economic and Simple Boiling Water Reactor
ESDA	DeWitt County Emergency Services and Disaster Agency
ESP	early site permit
ETE	evacuation time estimate
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation

FEMA	Federal Emergency Management Agency
FRERP	Federal Radiological Emergency Response Plan
FSER	final safety evaluation report
GDC	general design criterion/criteria
GIS	geographic information system
GRL	GRL Engineers, Inc.
GT-MHR	Gas Turbine Modular Helium Reactor
HMR	Hydrometeorological Report
HPN	health physics network
IDNR	Illinois Department of Natural Resources
IDNS	Illinois Department of Nuclear Safety
IDOT	Illinois Department of Transportation
IEMA	Illinois Emergency Management Agency
INEEL	Idaho National Engineering and Environmental Laboratory
IPRA	Illinois Plan for Radiological Accidents
IRIS	International Reactor Innovative and Secure
ISCO	Illinois State Climatologist Office
ISP	Illinois State Police
ISWS	Illinois State Water Survey
KI	potassium iodide
LOCA	loss-of-coolant accident
LPZ	low population zone
LWR	light-water reactor
M&TE	measuring and test equipment
MW	megawatt
MWe	megawatt electric
MWt	megawatt thermal
MWROG	Mid-west Regional Operating Group
NARS	nuclear accident reporting system
NCDC	National Climatic Data Center
NEI	Nuclear Energy Institute
NOS	Nuclear Oversight Department (Exelon)
NPHS	normal plant heat sink
NRC	U.S. Nuclear Regulatory Commission
NWS	U.S. National Weather Service
OCA	owner controlled area
OL	operating license
OSC	operations support center
QA	quality assurance
QMS	quality management system
PA	protected area or public address
PAG	protective action guide
PBMR	Pebble Bed Modular Reactor
PMF	probable maximum flood
PMP	probable maximum precipitation
PNNL	Pacific Northwest National Laboratories
PPE	plant parameter envelope
PQP	project quality plan
PSHA	probabilistic seismic hazard analysis

R	roentgen
RAFT	radiological assessment field team
RAI	request for additional information
RCTS	resonant column and torsional shear
REAC/TS	Radiation Emergency Assistance Center/Training Site (DOE)
RG	regulatory guide
RPM	radiation protection manager
RS	review standard
RTM	NRC's Response Technical Manual, Revision 4
S&L	Sargent & Lundy
SEOC	State emergency operations center
SER	safety evaluation report
SFCP	State forward command post
SOG	Seismic Owners Group
SOP	standard operating procedure
SPT	standard penetration test
SSAR	site safety analysis report
SSC	structure, system, and component
SSE	safe-shutdown earthquake
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimetry
TSC	Testing Services Corporation or technical support center
USAR	updated final safety analysis
UFSAR	updated final safety analysis
UHS	ultimate heat sink
USGS	U.S. Geological Survey
UT	University of Texas
UTM	Universal Transverse Mercator
V&V	verification and validation

1. INTRODUCTION AND GENERAL DESCRIPTION

1.1 Introduction

Exelon Generation Company, LLC (Exelon or the applicant), filed an application with the U.S. Nuclear Regulatory Commission (NRC), docketed on October 27, 2003, for an early site permit (ESP) for a site the applicant designated as the Exelon Generation Company (EGC) ESP site. Exelon requested an ESP with a permit duration of 20 years pursuant to Subpart A, "Early Site Permits," of Title 10, Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," of the *Code of Federal Regulations* (10 CFR Part 52). The proposed site is located approximately 6 miles east of the city of Clinton in east-central Illinois.

Exelon states that the purpose of its application for an ESP is to set aside the proposed site for future energy generation and sale on the wholesale energy market. This site would be reserved for a nuclear facility to be operated as a merchant generator plant. In addition, a component of the site redress plan supports (limited work) authorization for approval of construction activities in accordance with 10 CFR 50.10(e)(1) and 10 CFR 52.17(c).

To the extent possible at this time, the staff has completed its review of the information presented in the Exelon ESP application concerning the site's meteorology and hydrology, as well as the potential hazards to a nuclear power plant that could result from manmade facilities and activities on or in the vicinity of the site. The staff also assessed the risks of potential accidents that could occur as a result of the operation of a nuclear plant(s) at the site and evaluated whether the site would support adequate physical security measures for a nuclear power plant(s). The staff evaluated whether the applicant's quality assurance measures were equivalent in substance to the measures discussed in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The NRC found that the applicant's measures provide reasonable assurance that the information derived from ESP activities that could be used in the design and/or construction of structures, systems, and components (SSCs) important to safety would support satisfactory performance of such SSCs once they were in service. The staff also evaluated the adequacy of the applicant's program for compliance with 10 CFR Part 21, "Reporting of Defects and Noncompliance." Finally, the staff reviewed the proposed major features of the emergency plan that Exelon would implement if a new reactor(s) is eventually constructed at the ESP site. The NRC will review the complete and integrated emergency plan in a separate licensing action.

The Exelon ESP application included a description and a safety assessment of the site, as required by 10 CFR 52.17, "Contents of Applications." The public may inspect copies of the ESP application via the Agencywide Documents Access and Management System (ADAMS) using ADAMS Accession No. ML032721596. The application is also available for public inspection at the NRC's Public Document Room at One White Flint North, 11555 Rockville Pike, Rockville, Maryland, and at the Vespasian Warner Public Library, 310 North Quincy Street, Clinton, Illinois. Exelon has committed to revise its application to address the NRC staff requests for additional information. Updated versions of the ESP application will also be available at these same locations. The NRC will verify that Exelon's future revision of its ESP

application is consistent with information provided in its RAI responses. This verification is identified as **Confirmatory Item 1.1-1.**

This draft safety evaluation report (DSER) summarizes the results of the staff's technical evaluation of the suitability of the proposed EGC ESP site for construction and operation of a nuclear power plant(s) falling within the plant parameter envelope (PPE) that Exelon specified in its application. The DSER delineates the scope of the technical matters that the staff considered in evaluating the suitability of the site. NRC Review Standard (RS)-002, "Processing Applications for Early Site Permits," Attachment 2, provides additional details on the scope and bases of the staff's review of the radiological safety and emergency planning aspects of a proposed nuclear power plant site. RS-002, Attachment 2, contains regulatory guidance based on NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (hereafter referred to as the SRP). The SRP reflects the staff's many years of experience in establishing and promulgating guidance to enhance the safety of nuclear facilities, as well as in evaluating safety assessments.

The staff has not, at this time, completed its review in the areas of seismology and geology. Therefore, the staff plans to issue a supplemental DSER, at a later date, that will summarize the results of its technical evaluation of the suitability of the proposed EGC ESP site in terms of the site's seismology and geology. Issuance of the supplemental DSER is identified as **Confirmatory Item 1.1-2.**

The applicant also filed an environmental report for the EGC ESP site in which it evaluated those matters relating to the environmental impact assessment that can be reasonably reviewed at this time. The staff will discuss the results of its evaluation of the environmental report for the EGC ESP site in an environmental impact statement (EIS). The applicant has also provided a site redress plan, in accordance with 10 CFR 52.25(a), to seek authorization for limited site activities allowed by 10 CFR 50.10(e)(1). The EIS will summarize the results of the staff's evaluation of the Exelon site redress plan.

Appendix A to the DSER details a chronology of the principal actions and correspondence related to the staff's review of the ESP application for the EGC ESP site. Appendix B provides the reference list for the DSER.

1.2 General Site Description

The EGC ESP facility will be co-located on the property of the existing Clinton Power Station (CPS) facility. The CPS site, with its associated 4895-acre, man-made cooling reservoir (Clinton Lake), is an irregular U-shaped site in DeWitt County in east-central Illinois about 6 miles east of the city of Clinton. The site is located between the cities of Bloomington and Decatur to the north and south, respectively, and Lincoln and Champaign-Urbana to the west and east, respectively. The total area encompassed by the ESP site boundary is about 14,180 acres. The site includes an area that extends approximately 14 miles along Salt Creek and 8 miles along the North Fork of Salt Creek, and is about 3 miles northeast of the confluence of Salt Creek and the North Fork of Salt Creek. Figure 1.2-1 in the site safety analysis report (SSAR) depicts the site location; Section 2.1 of the DSER discusses the site location in more detail.

With regard to the existing development of the site, CPS Unit 1 is a boiling water reactor 6 (BWR-6), with a rated core thermal power level of 3473 megawatts (thermal) (MWt) and a gross electrical output of 1138.5 megawatts (electric) (MWe). AmerGen Energy Company, LLC (AmerGen) owns and operates CPS. AmerGen is wholly owned by the EGC and its subsidiaries. SSAR Figure 1.2-2 provides an aerial view of the EGC ESP site showing the existing development.

With regard to the proposed development of the site, AmerGen owns the real estate on which the EGC ESP facility will sit, including the exclusion area, with the exception of a right-of-way for the township road that traverses the exclusion area. The applicant entered an access and indemnity agreement with AmerGen to obtain the rights to conduct preliminary studies and perform other activities necessary to support the Exelon ESP application process. The applicant anticipates entering a similar agreement with AmerGen for its required pre-construction activities and the right to the land needed for the EGC ESP facility. The agreement will grant the applicant an exclusive and irrevocable option, which can be exercised before the start of construction, to purchase, enter a long-term lease for, and/or procure other legal right in the land required for the EGC ESP facility. The staff has determined that the applicant needs to demonstrate that it has the legal right to control the exclusion area, or has the irrevocable right to obtain such control. The staff identified this issue as an open item, as discussed in Sections 1.6 and 2.1.2 of this report.

The applicant has not selected a specific reactor type for the EGC ESP site. However, to support its ESP application, Exelon used available information from a range of possible facilities to characterize the proposed development. The EGC ESP facility would be located approximately 700 feet south of the current CPS facility on the existing CPS property. SSAR Figure 1.2-3 shows the location of the EGC ESP site footprint and the distance by sector from the outside boundary of the footprint to the CPS property line. Depending on the reactor type selected, the EGC ESP facility could have a total core thermal power rating between approximately 2400 and 6800 MWt. The EGC ESP facility would consist of a single reactor or multiple reactors (or modules) of the same reactor type. SSAR Section 1.3 provides an overview of the reactor designs considered in developing the information necessary to support Exelon's ESP application. The EGC ESP facility could be any of the reactor designs described in the application or a new design that falls within the range of the information developed to characterize the facility (i.e., the plant parameter envelope (PPE)).

According to the applicant, the EGC ESP facility would be constructed as a large industrial facility similar in general appearance to the existing CPS facility. However, unlike the existing plant, which uses the Clinton Lake for normal cooling processes, the EGC ESP facility would use cooling towers. Clinton Lake would be used as the source of makeup water for the EGC ESP facility cooling water systems.

A new intake structure, located on Clinton Lake adjacent to the existing CPS Unit 1 intake structure, would provide raw water for cooling tower makeup and other plant services. Cooling tower blowdown and other plant discharges would use the existing CPS Unit 1 discharge flume as a discharge path to Clinton Lake. The additional discharge flow from the EGC ESP facility would be insignificant relative to the capacity of the existing discharge flume. The CPS facility's safety-related systems and equipment would not be shared or cross-connected with the EGC ESP facility. However the EGC ESP facility would use the existing CPS ultimate heat sink as its source of makeup water.

The ESP facility might share some structures, such as the warehouse and training buildings and parking lots, with CPS. Some support facilities, such as the domestic water supply and sewage treatment, might also be shared. The applicant would expand the existing switchyard to accommodate the output of the new facility and to provide the necessary offsite power. Exelon would use the switchyard area intended for the canceled CPS Unit 2 for this purpose. The applicant would also use the existing transmission right-of-way. SSAR Figure 1.2-4 identifies the location of the EGC ESP facility's new structures relative to the existing CPS facilities.

1.3 Plant Parameter Envelope

The regulations at 10 CFR Parts 52 and 100, "Reactor Site Criteria," that apply to an ESP do not require that an ESP applicant provide specific design information. However, some design information may be required to address 10 CFR 52.17(a)(1), which calls for "an analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site under the radiological consequence evaluation factors identified in § 50.34(a)(1) of this chapter."

In Section 1.4 of the SSAR, the applicant provides a list of postulated design parameters, referred to as the "plant parameter envelope." The applicant states that the PPE is a set of design parameters that are expected to bound the characteristics of a reactor(s) that might later be deployed at a site. This means that the design characteristics of potential designs would be no more demanding from a site suitability perspective than the bounding design parameters listed in the PPE tabulation.

The applicant states that it developed the listing of plant parameters necessary to define the plant-site interface based on previous industry and Department of Energy-sponsored work performed in the early 1990s as part of the ESP Demonstration Program, as well as current reactor vendor design input data. As a result of earlier and current efforts, the applicant has identified appropriate design parameters to include in the PPE through a systematic review of regulatory criteria and guidance, ESP application content requirements, and experience with previous site suitability studies. The plant parameters characterize (1) the functional or operational needs of the plant from the site's natural or environmental resources, (2) the plant's impact on the site and surrounding environs, and (3) the site-imposed requirements on the plant. The PPE values are generally based on certified design information and the best available information for as yet uncertified designs. Some of the values have been modified to include margin.

A set of plant parameter values is developed by considering the values provided by various reactor vendors and by applying appropriate conservatism where required to characterize the surrogate facility. As applicable, the most limiting (maximum or minimum) bounding value is selected. The complete set of plant parameter values describes, or envelops, the site-facility interface. This type of facility characterization is considered sufficient to assess the future use of the site for a nuclear electric generating facility.

Tables 1.4-1 through 1.4-8 of the applicant's SSAR present the listing of parameters used, the PPE values selected, and the site characteristic values used in assessing the safety and environmental impact of constructing and operating the EGC ESP facility. SSAR Table 1.4-9

provides a description or definition and bases for the plant parameters used to evaluate the safety and/or environmental impact of locating the proposed nuclear generating capacity at the EGC ESP site.

The applicant has provided, through the PPE, sufficient design information to allow it to perform the evaluation required by 10 CFR 52.17(a)(1) to determine the adequacy of the proposed exclusion area and low-population zone (LPZ) for the site. Section 3.3 of the SSAR reports the results of this evaluation in which the applicant used design information limited to the release rate of radioactivity to the environment resulting from a design-basis accident for hypothetical reactors similar to two representative reactor types that vendors have offered for construction in the United States.

In addition to the information required to support the dose consequence evaluation, the applicant provides other design information in the PPE. Because the applicant is not requesting the issuance of an ESP referencing a particular reactor design, the staff's review criterion for the PPE is that the PPE values should not be unreasonable for a reactor that might be constructed on the ESP site. The applicant's PPE is based on various reactor designs that are either certified by the NRC, are in the certification process, or may be submitted for certification in the future. The PPE references the following designs:

- Advanced Canada Deuterium Uranium (CANDU) Reactor (ACR-700) (Atomic Energy of Canada, Ltd.)
- Advanced Boiling Water Reactor (ABWR) (General Electric)
- Advanced Plant 1000 (AP1000) (Westinghouse Electric Company)
- Economic and Simplified Boiling Water Reactor (ESBWR) (General Electric)
- Gas Turbine Modular Helium Reactor (GT-MHR) (General Atomics)
- International Reactor Innovative and Secure Project (IRIS) (consortium led by Westinghouse)
- Pebble Bed Modular Reactor (PBMR (Pty) Ltd.)

The staff reviewed the applicant's PPE values and found them to be reasonable, as discussed in the individual sections in the DSER. The staff has identified individual PPE values and site characteristics that will be included in an ESP, should the NRC issue an ESP for the EGC ESP site. In such a case, any entity that wishes to reference that ESP in a combined license (COL) or construction permit (CP) application would need to demonstrate that the chosen design falls within the PPE values and site characteristics specified in the ESP. Otherwise, the COL or CP applicant would need to demonstrate that the new design, in conjunction with the site characteristics, complies with the applicable NRC regulations.

1.4 Identification of Agents and Contractors

Exelon is the applicant for the ESP and has been the only participant in the review of the suitability of the EGC ESP site for a nuclear power plant. CH2MHILL, under contract with Exelon, served as the primary contractor for the development of the ESP application, supplying personnel, systems, and project management.

Several subcontractors also assisted in the development of Exelon's ESP application. Parsons Power Group, Inc., provided engineering services in preparing the SSAR; Testing Service Corporation provided engineering, technical, and laboratory services associated with geotechnical activities; Geomatrix Consultants, Inc., performed seismic and geologic data collection, site response studies, and safe shutdown earthquake determinations; GRL Engineers, Inc., conducted standard penetration test measurement work; Stratigraphics performed cone penetrometer measurements and testing used for the geotechnical aspects of the ESP; and the University of Texas performed soil sample resonant column and torsional shear testing.

1.5 Summary of Principal Review Matters

This DSER summarizes the results of the NRC staff's technical evaluation of the EGC ESP site. The staff's evaluation included a technical review of the information and data the applicant submitted, with emphasis on the following principal matters:

- population density and land use characteristics of the site environs and the physical characteristics of the site, including meteorology and hydrology, to evaluate whether the applicant has adequately described and given appropriate consideration to these characteristics to determine whether the site characteristics are in accordance with the NRC siting criteria (Subpart B, "Standard Design Certifications," of 10 CFR Part 100) (The staff's technical evaluation of the site's seismology and geology will be contained in a supplemental DSER that will be issued at a later date.)

- potential hazards to a nuclear power plant(s) that might be constructed on the ESP site posed by manmade facilities and activities (e.g., mishaps involving storage of hazardous materials (toxic chemicals, explosives), transportation accidents (aircraft, marine traffic, railways, pipelines)

- potential capability of the site to support the construction and operation of a nuclear power plant(s) with design parameters falling within those specified in the applicant's PPE under the requirements of 10 CFR Parts 52 and 100

- suitability of the site for development of adequate physical security plans and measures for a nuclear power plant(s)

- proposed major features for a future emergency plan, should an applicant decide to seek a license to construct and operate a nuclear power plant(s) on the ESP site, any significant impediments to the development of emergency plans for the EGC ESP site, and a description of contacts and arrangements made with Federal, State, and local government agencies with emergency planning responsibilities

- quality assurance measures Exelon applied to the information submitted in support of the ESP application and safety assessment

- the acceptability of the applicant's proposed exclusion area and LPZ under the dose consequence evaluation factors of 10 CFR 50.34(a)(1)

During its review, the staff held several meetings with representatives of Exelon and its contractors and consultants to discuss various technical matters related to the staff's review of the EGC ESP site (see Appendix A to this report). The staff also visited the site to assist it in evaluating safety matters.

1.6 Summary of Open and Confirmatory Items

As of the completion of this DSER, the staff requires additional information from the applicant regarding certain matters. The individual sections of the DSER refer to these issues as open items. The staff assigns each of these issues an identifying number for tracking purposes. Table 1.6-1 lists each open item, the DSER section in which it appears, and the subject matter to which it is related. Completion of the staff's final safety evaluation report (FSER) on the current schedule depends on the applicant's timely submission of sufficient information to allow the staff to review and resolve each open item.

Table 1.6-1 Open Items

Open Item No.	DSER Section	Subject
2.1-1	2.1.2.3	Demonstrate that the applicant has the legal right to control the exclusion area, or has an irrevocable right to obtain such control.
2.3-1	2.3.1.3	Identify the meteorological data to use in evaluating the performance of a mechanical draft cooling tower ultimate heat sink (UHS) with respect to maximum evaporation and minimum water cooling as discussed in Regulatory Guide 1.27.
2.3-2	2.3.1.3	Identify an additional UHS design basis site characteristic for use in evaluating the potential for water freezing in the UHS water storage facility.
2.3-3	2.3.4.3	Use appropriately conservative meteorological data and appropriately conservative distances from postulated release points to calculate relative concentrations for accidental airborne releases of radioactive materials.

Open Item No.	DSER Section	Subject
2.4-1	2.4.1.3	Define the extent of the vertical disturbance and the bounding elevations of all structures, systems, and components (SSCs). Additionally, SSAR Figure 1.2-4 does not identify either the elevations or the areal locations of the safety-related piping corridors. Since the intake pumps for the ESP facility UHS makeup water are safety-related structures, the applicant must state whether it covers these through the site grade specified in the PPE or proposes separate criteria for these structures.
2.4-2	2.4.1.3	(a) Provide a schematic representation of the complete UHS system for a future facility on the ESP site, including the intake, piping, any potential storage basins, the UHS cooling loop, and the cooling tower(s), clearly showing all components and water flow including discharges through these components. (b) Demonstrate that PPE make-up flow rate, an average of 555 gpm and a maximum of 1400 gpm, at the maximum inlet temperature of 95EF, is sufficient to remove all waste heat from the UHS cooling tower(s) and that there are no limits on plant operation due to limited water supply or due to elevated water temperatures at the UHS intake for any facility constructed on the ESP site.
2.4-3	2.4.1.3	Provide an authoritative source that may include State or county planning officials that can either provide details of a development plan in Clinton Lake's watershed or verify the absence of such a plan.
2.4-4	2.4.1.3	Provide additional justification for why an increase in impervious area will not increase soil erosion.
2.4-5	2.4.2.3	Provide a revised probable maximum precipitation (PMP) estimate using the current criteria of HMR 51.
2.4-6	2.4.2.3	Provide additional justification for why an increase in area with impervious surface will decrease the duration of low-flow events.
2.4-7	2.4.2.3	Provide references to projections from State or local authorities responsible for development plans in the area of concern to substantiate any prediction of future development.

Open Item No.	DSER Section	Subject
2.4-8	2.4.2.3	Address the differences between the applicant's and the staff's estimates of local intense precipitation at the ESP site for a 1-hour duration and for a 5-minute duration.
2.4-9	2.4.7.3	Provide more details regarding the method and air temperature data set used in estimating the thickness of an ice sheet that may form on the surface of Clinton Lake and demonstrate that the ice thickness estimate is adequate.
2.4-10	2.4.7.3	Provide a schematic diagram clearly showing the bounding dimensions and critical elevations of the ESP facility intake structure, including its conceptual plan and cross section, clearly indicating elevation of the basemat, elevation of the screen house opening, elevation of the normal plant heat sink makeup water intake pipe, elevation of the UHS makeup water intake pipe, and their relationship to the existing lake bed.
2.4-11	2.4.7.3	Quantify the reduction in water storage capacity of the submerged UHS pond in the event of a complete loss of Clinton Dam coincident with the presence of surface ice.
2.4-12	2.4.8.3	Address the difference between the applicant's and the staff's estimates of the 30-day makeup water needed for the ESP facility UHS system.
2.4-13	2.4.8.3	Provide a commitment to specific ESP facility normal and ultimate heat sink systems for the staff to conclude this review.
2.4-14	2.4.8.3	Provide the volume requirements of the UHS for the CPS taking into consideration the latest power uprate.
2.4-15	2.4.8.3	Address the staff's conclusion that the applicant has not adequately established the rationale for using the 5-year drought duration as opposed to a shorter duration drought with a significantly lower inflow estimate.
2.4-16	2.4.8.3	Establish that the submerged UHS pond has adequate capacity to provide makeup water to the ESP facility UHS.
2.4-17	2.4.8.3	Establish the monitoring and dredging needs for the UHS pond for the combined operation of the CPS facility and a future facility consistent with the PPE parameter for maximum thermal discharge.

Open Item No.	DSER Section	Subject
2.4-18	2.4.12.3	Provide the potential impact of future construction for the ESP facility on the piezometric gradient for the ESP site.
2.4-19	2.4.12.3	Explain why the limited data used to estimate the three values required to calculate the average ground water velocity represent a basis for a velocity estimate. Provide values for the hydraulic gradient, saturated hydraulic conductivity, and effective porosity measured at the ESP site.
2.4-20	2.4.13.3	Specify the maximum elevation at which any liquid radioactive waste releases can occur in the proposed ESP facility.
2.4-21	2.4.13.3	Provide a thorough description of the local hydrologic setting, both that which exists currently and that which is expected after the disruption associated with the ESP construction activities, to ensure that an inward gradient will be maintained.
3.3-1	3.3.3.4	Use appropriate meteorological data and appropriate distances from postulated release points to the EAB and the LPZ to estimate the site specific χ/Q values used in the radiological consequence evaluations.
13.3-1	13.3.1.3	Provide a response to RAIs 13.3-20(a–j).
13.3-2	13.3.2.3	Provide copies of documentation of contacts and arrangements with local government agencies having emergency planning responsibilities within the plume exposure EPZ (potentially DeWitt, Macon, McLean, and Piatt Counties; the municipalities of Clinton, Wapella, and Weldon; and the Village of DeWitt) that address the expanded responsibilities associated with an additional reactor(s) at the Clinton site.
13.3-3	13.3.3.9.3	Address the adequacy of the OSC, TSC, and EOF, and related equipment, in support of emergency response, and address with specificity such facility and equipment areas as location, size, structure, function, habitability, communications, staffing and training, radiological monitoring, instrumentation, data system equipment, power supplies, technical data and data systems, and record availability and management.
13.3-4	13.3.3.11.3	Address the estimated time required for confirmation of evacuation and provide a response to RAIs 13.3-20(k–v)

Open Item No.	DSER Section	Subject
13.3-5	13.3.3.11.3	Provide information related to protective measures in State and local emergency plans and address the review of the draft ETE submitted by State and local organizations involved in emergency response for the site.
13.3-6	13.3.3.12.3	Provide a description of State and local organizations' means for radiological decontamination of emergency personnel wounds, supplies, instruments, and equipment.
17.1-1	17.7.3	Address 10 CFR Part 21 for ESP activities.

In addition, the staff has identified one item that it considers resolved based on the applicant's commitment to action, but for which it needs confirmation that the applicant has taken the planned actions. Table 1.6-2 lists this confirmatory item, the DSER section in which it appears, and the subject matter to which it is related. Completion of the staff's FSER on the current schedule depends on the applicant's timely confirmation of its completion of the planned actions to allow the staff to review and, if appropriate, close the confirmatory item.

Table 1.6-2 Confirmatory Items

Confirmatory Item No.	DSER Section	Subject
1.1-1	1.1	Verification that ESP application revision is consistent with RAI responses
1.1-2	1.1	Verification that supplemental DSER is issued summarizing the results of the staff's technical evaluation of the suitability of the proposed EGC ESP site in terms of the site's seismology and geology.
2.4-1	2.4.11.3	Verification of the estimate of the volume of available water in the submerged UHS pond for the combined operation of the existing facility and the ESP facility.
13.3-1	13.3	Verification of acceptability of information provided by the applicant on December 15, 2004, in response to RAI 13.3-2
17.3-1	17.3	Verification of information obtained from the Internet

1.7 Summary of Permit Conditions and COL Action Items

The staff has identified certain permit conditions that it will recommend that the Commission impose, should an ESP be issued to the applicant. Table 1.7-1 summarizes these conditions.

Table 1.7-1 Permit Conditions

Permit Condition No.	DSER Section	Description
2.4-1	2.4.1.3	Maintain a minimum horizontal clearance between the existing CPS piping and the new ESP facility piping of 50 feet.
2.4-2	2.4.1.3	Maintain a minimum vertical clearance between the existing CPS piping and the new ESP facility piping of 6.6 feet or 3 times the diameter of the pipes, whichever is larger
2.4-3	2.4.2.3	Design the ESP facility's intake structures to withstand the combined effects of PMF, coincident wind wave activity, and wind setup, as discussed in Section 2.4.3 of this SER.
2.4-4	2.4.2.3	Demonstrate that the ESP site can discharge site drainage from local intense precipitation at the ESP site to Clinton Lake without relying on any active drainage systems that may be blocked during this event.
2.4-5	2.4.7.3	Demonstrate that the intake structure can withstand the effects of ice sheet crushing, bending, buckling, and splitting, or a combination of these modes.
2.4-6	2.4.7.3	Maintain a minimum water temperature of 40 EF at all times to preclude formation of frazil and anchor ice on the intake inlet.
2.4-7	2.4.7.3	Ensure that the UHS intake is located at an elevation of 668 feet MSL.
2.4-8	2.4.12.3	Ensure that ground water is not used for either normal or safety-related plant operations.
2.4-9	2.4.12.3	Establish a monitoring plan to ensure maintenance of an inward-directed gradient for all credible water table conditions.
2.4-10	2.4.13.3	Utilize a design in which radioactive liquid waste releases would not occur at any elevation greater than the minimum design water table elevation outside the facility.
3.2-1	3.2.1.1	Ensure that the maximum NPHS heat load during normal operation is 15.08×10^9 Btu/hr.
3.2-2	3.2.1.1	Ensure that the maximum NPHS discharge temperature during normal operation is 100 EF.

Permit Condition No.	DSER Section	Description
3.2-3	3.2.2.3	Ensure that the maximum UHS load during normal operation is 411.4×10^6 Btu/hr.
3.2-4	3.2.2.3	Ensure that the maximum UHS discharge temperature during normal operation is 95 EF.

The staff has also identified certain site-related items that will need to be addressed at the COL or CP stage, should a COL or CP applicant desire to construct one or more new nuclear reactors on the EGC ESP site. The staff determined that these items do not affect the staff's regulatory findings at the ESP stage and are, for the reasons specified in Table 1.7-2 for each item, more appropriately addressed at these later stages in the licensing process.

Table 1.7-2 Site-Related COL Action Items

Action Item No.	DSER Section	Subject To Be Addressed	Reason for Deferral
2.1.-1	2.1.1.3	Provide Universal Transverse Mercator coordinates for new unit(s) on the EGC ESP site.	Exact UTM coordinates for new unit(s) will depend on specific reactor technology selected for deployment
2.1-2	2.1.2.3	Make arrangements with the appropriate local, State, Federal, or other public agencies to provide control of the portion of Clinton Lake that is within the exclusion area. These public agencies, together with the ESP holder, will need authority over these bodies of water sufficient to allow for the exclusion and ready removal, in an emergency, of any persons present on them.	Such arrangements not required at ESP stage
2.2-1	2.2.1.3-2.2.2.3	Evaluate design-specific interactions between the existing unit and new unit(s).	New unit design and specific location not known at ESP stage
2.3-1	2.3.1.3	Determine the 3-second gust wind speed based on the current applicable design standard.	Applicant preference to define this characteristic based on standards in effect at time of COL application

Action Item No.	DSER Section	Subject To Be Addressed	Reason for Deferral
2.3-2	2.3.2.3	Address how potential increases in atmospheric moisture and icing during winter months due to the use of natural draft cooling towers or mechanical draft cooling towers or both will impact plant design and operation.	ESP facility's cooling system configuration and design parameters not defined at ESP stage
2.3-3	2.3.4.1	Evaluate dispersion of airborne radioactive materials to the control room.	Control room location and design features not known at ESP stage
2.3-4	2.3.5.3	Confirm specific release point characteristics and locations of potential receptors for routine release dose computations.	Exact release points and receptor locations not known at ESP stage
3.1-1	3.1.4	Verify that calculated radiological doses to members of the public from radioactive gaseous and liquid effluents for ESP facility are bounded by the radiological doses included in the SSAR for the ESP application and reviewed by the NRC staff.	Specific details of how ESP facility will control, monitor, and maintain radioactive gaseous and liquid effluents not known at ESP stage
3.4.1.6-1	3.4.1.6.3	Provide specific designs for protected area barriers.	Specific design information is not known at the ESP stage.