

ABSTRACT

This safety evaluation report (SER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's technical review of the site safety analysis report (SSAR) and emergency planning information in the early site permit (ESP) application submitted by Exelon Generation Company, LLC (EGC or the applicant), for the EGC ESP site. 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 of the *Code of Federal Regulations* (10 CFR) Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants." 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, EGC 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 SER presents the results of the staff's review of information submitted in conjunction with the ESP application. The staff has identified, in Appendix A to this SER, certain site-related items that will need to be addressed at the combined license or construction permit stage, if an applicant desires 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, more appropriately addressed at later stages in the licensing process. Appendix A to this SER also identifies the permit conditions that the staff recommends the Commission impose, if an ESP is issued to the applicant.

CONTENTS

In accordance with U.S. Nuclear Regulatory Commission Review Standard (RS)-002, "Processing Applications for Early Site Permits," the chapter and section layout of this safety evaluation report is consistent with the format of (1) NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," (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 NUREG-0800 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. The subjects of chapters and sections in NUREG-0800 not addressed herein will be addressed, as appropriate and applicable, in other regulatory actions (design certification, construction permit, operating license, and/or combined license) for a reactor or reactors that might be constructed on the EGC ESP site.

ABSTRACT	iii
CONTENTS	v
EXECUTIVE SUMMARY	xiv
ABBREVIATIONS	xvii
1. INTRODUCTION AND GENERAL DESCRIPTION	1-1
1.1 Introduction	1-1
1.2 General Site Description	1-4
1.3 Plant Parameter Envelope	1-5
1.4 Identification of Agents and Contractors	1-7
1.5 Summary of Principal Review Matters	1-7
1.6 Summary of Open and Confirmatory Items	1-8
1.7 Summary of Combined License Action Items	1-9
1.8 Summary of Permit Conditions	1-9
2. SITE CHARACTERISTICS	2-1
2.1 Geography and Demography	2-1
2.1.1 Site Location and Description	2-1
2.1.2 Exclusion Area Authority and Control	2-4
2.1.3 Population Distribution	2-7
2.2 Nearby Industrial, Transportation, and Military Facilities	2-11
2.2.1–2.2.2 Identification of Potential Hazards in Site Vicinity	2-11
2.2.3 Evaluation of Potential Accidents	2-15

2.3 Meteorology	2-18
2.3.1 Regional Climatology	2-18
2.3.2 Local Meteorology	2-34
2.3.3 Onsite Meteorological Measurements Program	2-40
2.3.4 Short-Term Diffusion Estimates	2-43
2.3.5 Long-Term Diffusion Estimates	2-49
2.4 Hydrologic Engineering	2-56
2.4.1 Hydrologic Description	2-56
2.4.2 Floods	2-70
2.4.3 Probable Maximum Flood on Streams and Rivers	2-80
2.4.4 Potential Dam Failures	2-94
2.4.5 Probable Maximum Surge and Seiche Flooding	2-99
2.4.6 Probable Maximum Tsunami Flooding	2-104
2.4.7 Ice Effects	2-107
2.4.8 Cooling Water Canals and Reservoirs	2-127
2.4.9 Channel Diversions	2-143
2.4.10 Flooding Protection Requirements	2-146
2.4.11 Low-Water Considerations	2-149
2.4.12 Ground Water	2-156
2.4.13 Accidental Releases of Liquid Effluents to Ground and Surface Waters	2-164
2.4.15 Thermal Discharges	2-169
2.4.16 Site Characteristics Related to Hydrology	2-175
2.5 Geology, Seismology, and Geotechnical Engineering	2-177
2.5.1 Site and Regional Geology	2-177
2.5.2 Vibratory Ground Motions	2-200
2.5.3 Surface Faulting	2-273
2.5.4 Stability of Subsurface Materials and Foundations	2-277
2.5.5 Stability of Slopes	2-307
2.5.6 Embankments and Dams	2-308
3. SITE SAFETY ASSESSMENT	3-1
3.5.1.6 Aircraft Hazards	3-1
11. RADIOLOGICAL EFFLUENT RELEASE DOSE CONSEQUENCES FROM NORMAL OPERATIONS	11-1
11.1 Source Terms	11-1

11.1.1	Technical Information in the Application	11-1
11.1.2	Regulatory Evaluation	11-1
11.1.3	Technical Evaluation	11-1
11.1.4	Conclusion	11-3
13.	CONDUCT OF OPERATIONS	13-1
13.3	Emergency Planning	13-1
13.3.1	Significant Impediments to the Development of Emergency Plans	13-2
13.3.2	Contacts and Arrangements with Federal, State, and Local Agencies	13-14
13.3.3	Major Features of the Emergency Plans	13-17
13.6	Industrial Security	13-80
13.6.1	Technical Information in the Application	13-80
13.6.2	Regulatory Evaluation	13-81
13.6.3	Technical Evaluation	13-81
13.6.4	Conclusions	13-82
15.	ACCIDENT ANALYSES	15-1
15.1	Technical Information in the Application	15-1
15.2	Regulatory Evaluation	15-3
15.3	Technical Evaluation	15-4
15.3.1	Selection of DBAs	15-5
15.3.2	Design-Specific (Postulated) χ/Q Values	15-5
15.3.3	Site-Specific χ/Q_s	15-6
15.3.4	Source Terms and Radiological Consequence Evaluations	15-6
15.4	Conclusions	15-9
17.	EARLY SITE PERMIT QUALITY ASSURANCE MEASURES	17-1
17.1	Introduction	17-1
17.1.1	Technical Information in the Application (Organization)	17-2
17.1.2	Regulatory Evaluation	17-3
17.1.3	Technical Evaluation	17-3
17.1.4	Conclusion	17-4
17.2	Quality Assurance Program	17-4
17.2.1	Technical Information in the Application (QA Program)	17-4
17.2.2	Regulatory Evaluation	17-5
17.2.3	Technical Evaluation	17-5
17.2.4	Conclusion	17-7

17.3	Design Control	17-7
17.3.1	Technical Information in the Application (Design Control)	17-7
17.3.2	Regulatory Evaluation	17-8
17.3.3	Technical Evaluation	17-8
17.3.4	Conclusion	17-9
17.4	Procurement Document Control	17-10
17.4.1	Technical Information in the Application (Procurement Document Control)	17-10
17.4.2	Regulatory Evaluation	17-10
17.4.3	Technical Evaluation	17-10
17.4.4	Conclusion	17-11
17.5	Instructions, Procedures, and Drawings	17-11
17.5.1	Technical Information in the Application (Instructions, Procedures, and Drawings)	17-11
17.5.2	Regulatory Evaluation	17-12
17.5.3	Technical Evaluation	17-12
17.5.4	Conclusion	17-13
17.6	Document Control	17-13
17.6.1	Technical Information in the Application (Document Control)	17-13
17.6.2	Regulatory Evaluation	17-14
17.6.3	Technical Evaluation	17-14
17.6.4	Conclusion	17-15
17.7	Control of Purchased Material, Equipment, and Services	17-15
17.7.1	Technical Information in the Application (Control of Purchased Material, Equipment, and Services)	17-15
17.7.2	Regulatory Evaluation	17-16
17.7.3	Technical Evaluation	17-16
17.7.4	Conclusion	17-20
17.8	Identification and Control of Materials, Parts, and Components	17-20
17.8.1	Technical Information in the Application (Identification and Control of Materials, Parts, and Components)	17-20
17.8.2	Regulatory Evaluation	17-21
17.8.3	Technical Evaluation	17-21
17.8.4	Conclusion	17-21
17.9	Control of Special Processes	17-22

17.9.1	Technical Information in the Application (Control of Special Processes)	17-22
17.9.2	Regulatory Evaluation	17-22
17.9.3	Technical Evaluation	17-23
17.9.4	Conclusion	17-23
17.10	Inspection	17-23
17.10.1	Technical Information in the Application (Inspection)	17-23
17.10.2	Regulatory Evaluation	17-23
17.10.3	Technical Evaluation	17-24
17.10.4	Conclusion	17-24
17.11	Test Control	17-24
17.11.1	Technical Information in the Application (Test Control)	17-24
17.11.2	Regulatory Evaluation	17-25
17.11.3	Technical Evaluation	17-25
17.11.4	Conclusion	17-26
17.12	Control of Measuring and Test Equipment	17-27
17.12.1	Technical Information in the Application (Control of M&TE)	17-27
17.12.2	Regulatory Evaluation	17-27
17.12.3	Technical Evaluation	17-27
17.12.4	Conclusion	17-28
17.13	Handling, Storage, and Shipping	17-28
17.13.1	Technical Information in the Application (Handling, Storage, and Shipping)	17-28
17.13.2	Regulatory Evaluation	17-29
17.13.3	Technical Evaluation	17-29
17.13.4	Conclusion	17-29
17.14	Inspection, Test, and Operating Status	17-29
17.14.1	Technical Information in the Application (Inspection, Test, and Operating Status)	17-29
17.14.2	Regulatory Evaluation	17-30
17.14.3	Technical Evaluation	17-30
17.14.4	Conclusion	17-31
17.15	Nonconforming Materials, Parts, or Components	17-31
17.15.1	Technical Information in the Application (Nonconforming Materials, Parts, or Components)	17-31
17.15.2	Regulatory Evaluation	17-31
17.15.3	Technical Evaluation	17-32

17.15.4	Conclusion	17-32
17.16	Corrective Action	17-32
17.16.1	Technical Information in the Application (Corrective Action)	17-32
17.16.2	Regulatory Evaluation	17-33
17.16.3	Technical Evaluation	17-33
17.16.4	Conclusion	17-34
17.17	Quality Assurance Records	17-34
17.17.1	Technical Information in the Application (Quality Assurance Records)	17-34
17.17.2	Regulatory Evaluation	17-35
17.17.3	Technical Evaluation	17-35
17.17.4	Conclusion	17-37
17.18	Audits	17-37
17.18.1	Technical Information in the Application (Audits)	17-37
17.18.2	Regulatory Evaluation	17-37
17.18.3	Technical Evaluation	17-38
17.18.4	Conclusion	17-40
17.19	Conclusions	17-40
18.	REVIEW BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS	18-1
19.	CONCLUSIONS	19-1

Appendices

Appendix A - Permit Conditions, COL Action Items, Site Characteristics, and Bounding Parameters	A-1
Appendix B - Chronology of Early Site Permit Application for the EGC ESP Site	B-1
Appendix C - References	C-1
Appendix D - Principles Contributors	D-1

Figures

2.2.1-1	Industrial Facilities in the Vicinity of the ESP Site.	2-12
2.4-1	Clinton Lake	2-57
2.4-2	CPS once-through discharge and subsequent mixing and cooling path	2-58
2.4-3	Proposed locations of ESP facility UHS intake and discharge	2-59

2.4-4	The watershed draining into Clinton Lake, delineated manually using topographic contours	2-64
2.4-5	Depth-area-duration curves prepared for bracketing Clinton Dam drainage. The dotted horizontal line corresponds to a drainage area of 289.2 mi ² , equal to that of Clinton Dam's drainage area.	2-85
2.4-6	Inflow and outflow from Clinton Lake during the PMF event calculated using the instantaneous-translation level-pool routing method	2-88
2.4-7	Water surface elevation in Clinton Lake during the PMF event calculated using the instantaneous-translation level-pool routing method	2-89
2.4-8	Inflow and outflow Hydrographs for Clinton Lake during the PMF event using the HEC-HMS model and the seven sub-basins + lake method	2-91
2.4-9	Water surface elevation of Clinton Lake during the PMF event using the HEC-HMS model and the seven sub-basins + lake method	2-92
2.4-10	Dawson Lake and Dam located approximately 17.1 miles north-northeast of the ESP site. Dawson Lake is located on the North Fork of Salt Creek.	2-98
2.4-11	Clinton Power Station site and fetch length	2-103
2.4-12	Stage-discharge relationship for Salt Creek at Rowell, IL	2-115
2.4-13	Accumulated degree-days since December 1, 1977, at the Decatur meteorologic station	2-116
2.4-14	AFDD during 1977-78 as calculated by Engineering Research and Development Center, Hanover, New Hampshire.	2-122
2.4-15	Figure 2.4-15 The proposed facility boundary for the ESP site	2-176
2.5.1-1	Major structural features in Illinois and neighboring States	2-181
2.5.1-2	Schematic diagram showing the Reelfoot scarp and selected features in the area of the NMSZ	2-185
2.5.1-3	Central fault system of NMSZ	2-187
2.5.1-4	Historical seismicity and estimated centers of large prehistoric earthquakes in site region	2-189
2.5.1-5	Map showing surveyed stream banks and evidence for paleoliquefaction in the site vicinity	2-191
2.5.2-1	Updates to seismicity catalog	2-202
2.5.2-2	Reference earthquake response spectra for mean 10 ⁻⁴ and mean 10 ⁻⁵ hazard	2-212
2.5.2-3	Deaggregation results for mean 10 ⁻⁴ hazard	2-215
2.5.2-4	Mean site amplification functions for deaggregation earthquakes and weighted average site amplification functions for reference earthquakes for mean 10 ⁻⁴ hazard	2-217
2.5.2-5	Rock reference earthquake spectra scaled by weighted average site amplification functions and soil envelope spectra	2-219
2.5.2-6	Comparison of performance-based SSE spectrum for the ESP site and the mean 10 ⁻⁴ and 10 ⁻⁵ UHRS	2-222
2.5.2-7	Four mean seismic hazard curves (1 Hz, 2.5 Hz, 5 Hz, and 10 Hz) for EGC ESP site plotted on a log-log scale. Dashed lines indicate annual probability of exceedance intervals of 10 ⁻⁴ per year and 10 ⁻⁵ per year.	2-224
2.5.2-8	Lognormal PDF for different values of the lognormal standard deviation value, <i>b</i>	2-226
2.5.2-9	Lognormal CDF for different values of the lognormal standard deviation value, <i>b</i> .	2-227
2.5.2-10	Significant parameter and quantile values for lognormal PDF, including the HCLPF value	2-228

2.5.2-11 Significant parameter and quantile values for lognormal CDF, including the HCLPF value	2-229
2.5.2-12 EGC ESP 5-Hz mean seismic hazard curve and seismic fragility curve in terms of the lognormal PDF	2-232
2.5.2-13 Product of EGC ESP 5-Hz mean seismic hazard curve and seismic fragility curve.	2-233
2.5.2-14 Comparison of exact and approximate DF . Exact DF varies with both A_R and b , while approximate DF depends only on A_R .	2-237
2.5.2-15 Seismic core damage in terms of mean ground motion recurrence interval for 25 nuclear power plants.	2-241
2.5.2-16 EGC ESP horizontal and vertical ESP SSE as well as the RG 1.60 DRS anchored at 0.3g	2-243
2.5.2-17 Seismic core damage in terms of mean ground motion recurrence interval for EGC ESP site and 25 nuclear power plants.	2-266
2.5.2-18 Comparison of UHR_{10-4} with estimated ground motion response spectra for the Springfield earthquake	2-271
2.5.4-1 Site-specific geologic cross section	2-278
2.5.4-2 G/G_{max} plot resonant column and cyclic torsion test results	2-281
2.5.4-3 Material damping plot resonant column and cyclic torsion test results	2-282
2.5.4-4 EGC ESP geotechnical investigation locations	2-285
2.5.4-5 S- and P-wave velocities and other soil properties	2-288
2.5.4-6 Modulus reduction and damping test results compared to EPRI (1993) soil property curves for test UTA-34-A	2-299

Tables

2.3.1-1 Applicant's Proposed Tornado Site Characteristics	2-21
2.3.1-2 Applicant's Proposed Basic Wind Speed Site Characteristic	2-22
2.3.1-3 Applicant's Proposed Winter Precipitation Site Characteristics	2-23
2.3.1-4 Applicant's Proposed Ultimate Heat Sink Meteorological Site Characteristics	2-24
2.3.1-5 Applicant's Proposed Ambient Air Temperature and Humidity Site Characteristics	2-25
2.3.1-6 Staff's Proposed Regional Climatology Site Characteristics	2-31
2.3.4-1 Applicant's Proposed Short-Term (Accident Release) Atmospheric Dispersion Site Characteristics	2-46
2.3.4-2 Staff's Proposed Short-Term (Accident Release) Atmospheric Dispersion Site Characteristics	2-48
2.3.5-1 Applicant's Long-Term (Routine Release) Diffusion Estimates	2-50
2.3.5-2 Staff's Proposed Long-Term (Routine Release) Atmospheric Dispersion Site Characteristics	2-53
2.4-1 Pre-dam and Post-dam Floods Corresponding to Several Return Periods Estimated According to NRC Guidelines	2-75
2.4-2 Local Intense Precipitation (1-mi ² PMP) at the Early Site Permit Site	2-76
2.4-3 PMP Values in Inches Near Clinton Dam's Drainage Area	2-85

2.4-4	PMP Depth-Duration Values in Inches for Clinton Dam's Drainage Area	2-86
2.4-5	Time Distribution of PMP for Clinton Dam's Drainage Area	2-86
2.4-6	Summary of Maximum PMF Water Surface Elevations (ft MSL) at the ESP Site . . .	2-93
2.4-7	Proposed Site Characteristics Related to Hydrology	2-175
2.5.1-1	Updated Magnitude Distributions for Characteristic New Madrid Earthquakes . .	2-197
2.5.2-1	High- and Low-Frequency Controlling Earthquakes	2-211
2.5.2-2	Controlling and Deaggregation Earthquakes	2-216
2.5.2-3	Computation of the Horizontal SSE Spectrum for the ESP Site	2-221
2.5.2-4	Comparison of Performance-Based SSE Values	2-263
2.5.2-5	Unacceptable Performance Frequency Values for β from 0.3 to 0.6 Values	2-264
2.5.2-6	SCDF Values for Clinton Performance-Based SSE	2-265
2.5.2-7	High- and Low-Frequency Controlling Earthquakes	2-269
3.5.1.6-1	Public Airports in the Vicinity of the Proposed ESP Site	3-5
3.5.1.6-2	Probability of Aircraft Impacts from Federal Airways	3-5
13.3-1	State of Illinois Dose Limits for Emergency Workers	13-66
15.3-1	AP1000 χ/Q Values (s/m^3)	15-6
15.3-2	Site-Specific χ/Q Values	15-9

EXECUTIVE SUMMARY

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants,” 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. It is incumbent on a COL applicant to resolve issues related to licensing that were not resolved as part of an ESP or design certification proceeding before the NRC can issue a COL.

This safety evaluation report (SER) describes the results of a review by the NRC staff of an ESP application submitted by Exelon Generation Company, LLC (EGC or the applicant), for the Exelon Generation Company ESP site. The staff’s review verified the applicant’s compliance with the requirements of Subpart A of 10 CFR Part 52. This SER serves to identify the matters resolved in the safety review and to identify remaining items to be addressed by a future COL applicant.

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 final environmental impact statement, which is a report separate from this SER.

By letter dated September 25, 2003, EGC submitted an ESP application (ADAMS² Accession No. ML032721596) for the EGC ESP site. The EGC ESP site is located 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

¹Applicants 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.

²ADAMS (Agencywide Documents Access and Management System) is the NRC’s information system. It 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>.

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, Exelon submitted an ESP application that 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."³

This SER presents the conclusions of the staff's review of information the applicant submitted to the NRC in support of the ESP application. The staff has reviewed the information provided by the applicant to resolve the open and confirmatory items identified in the draft safety evaluation report (DSER) and the supplemental DSER for the EGC ESP. In Section 1.6 of this SER, the staff provides a brief summary of the process used to resolve these items; details of the resolution for each open item are presented in the corresponding section of this report.

The staff has identified, in Appendix A to this SER, the proposed permit conditions that it will recommend the Commission impose if an ESP is issued to the applicant. Appendix A also includes a list of COL action items or certain site-related items that will need to be addressed at the COL or construction permit stage, if an applicant desires 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, more appropriately addressed at these later stages in the licensing process. In addition, Appendix A lists the site characteristics and the bounding parameters identified by the staff for this site.

Inspections conducted by the NRC have verified, where appropriate, the conclusions in this SER. The inspections focused on selected information in the ESP application and its references. This SER identifies applicable inspection reports as reference documents.

The NRC's Advisory Committee on Reactor Safeguards (ACRS) also reviewed the bases for the conclusions in this report. The ACRS independently reviewed those aspects of the application that concern safety, as well as the safety evaluation report, and provided the results of its review to the Commission in the interim report dated September 22, 2005, and in a final report dated March 24, 2006. This SER incorporates the ACRS comments and

³ The applicant has also submitted information intended to partially address some of the general design criteria (GDC) in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." Only GDC 2, "Design Bases for Protection Against Natural Phenomena," applies to an ESP application, and it does so only to the extent necessary to determine the safe-shutdown earthquake (SSE) and the seismically induced flood. The staff has explicitly addressed partial compliance with GDC 2, in accordance with 10 CFR 52.17(a)(1) and 10 CFR 50.34(a)(12), only in connection with the applicant's analysis of the SSE and the seismically induced flood. Otherwise, an ESP applicant need not demonstrate compliance with the GDC. The staff has included a statement to this effect in those sections of the SER that do not relate to the SSE or the seismically induced flood. Nonetheless, this SER describes the staff's evaluation of information submitted by the applicant to address GDC 2.

recommendations, as appropriate. Appendix E includes a copy of the report by the ACRS on the final safety evaluation report, as required by 10 CFR 52.23, "Referral to the ACRS."

ABBREVIATIONS

ABWR	Advanced Boiling Water Reactor
ac	acre(s)
ACR-700	Advanced CANDU Reactor
ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
AFDD	accumulated freezing degree days
ALARA	as low as is reasonably achievable
ALI	annual limits on intake
ALWR	advanced light water reactor
ANS	American Nuclear Society or alert notification system
ANSI	American National Standards Institute
ANSS	Advanced National Seismic System
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
BA	Blytheville arch
BP	before present
BWR	boiling water reactor
CAR	corrective action report
CDF	core damage frequency
CEUS	central and eastern United States
CFR	<i>Code of Federal Regulations</i>
cfs	cubic feet per second
CGL	commerce geophysical lineament
COL	combined license
CP	construction permit
CPS	Clinton Power Station
CPT	cone penetrometer test
CRR	cyclic resistance ratio
CRREL	Cold Regions Research and Engineering Laboratory
CSR	cyclic stress ratio
DAC	derived air concentration
DBA	design-basis accident
DCD	design control document
DCM	document control manager
DCO	dosimetry control officer
DEIS	draft environmental impact statement
DF	design factor
DOE	U.S. Department of Energy
DRS	design response spectrum
DSER	draft safety evaluation report
EAB	exclusion area boundary
EAS	emergency alert system
ECO	exposure control officer

EGC	Exelon Generation Company
EIS	environmental impact statement
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
ER	environmental report
ERDC	U.S. Army Engineering Research and Development Center
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
ESW	emergency service water
ETE	evacuation time estimate
FAA	Federal Aviation Administration
FAFC	Fluorspar Area fault complex
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FDD	freezing degree days
FOS	factor of safety
FOSID	frequency of onset of significant inelastic deformation
fps	feet per second
FRERP	Federal Radiological Emergency Response Plan
FSER	final safety evaluation report
ft	feet
GDC	general design criterion/criteria
GIS	geographic information system
gpm	gallons per minute
GPS	global positioning system
GRL	GRL Engineers, Inc.
GT-MHR	Gas Turbine Modular Helium Reactor
HCLPF	high-confidence-low-probability-of-failure
HEC	Hydrologic Engineering Center
HMR	Hydrometeorological Report
HPN	health physics network
Hz	Hertz
IDNR	Illinois Department of Natural Resources
IDNS	Illinois Department of Nuclear Safety
IDOT	Illinois Department of Transportation
IDOW	Illinois Division of Waterways
IDPH	Illinois Department of Public Health
IEMA	Illinois Emergency Management Agency
ILCS	Illinois Compiled Statute
INEEL	Idaho National Engineering and Environmental Laboratory
IPRA	Illinois Plan for Radiological Accidents

IRIS	International Reactor Innovative and Secure
ISCO	Illinois State Climatologist Office
ISGS	Illinois State Geologic Survey
ISP	Illinois State Police
ISWS	Illinois State Water Survey
KI	potassium iodide
lbf/ft ²	pounds-force per square foot
LLNL	Lawrence Livermore National Laboratory
LOCA	loss-of-coolant accident
LOOP	loss of offsite power
LPZ	low population zone
LWR	light-water reactor
M	magnitude
M&TE	measuring and test equipment
m/hr	mile(s) per hour
m/s	meter(s) per second
Mb	body wave magnitude
mi	mile(s)
mph	mile(s) per hour
MSF	magnitude scaling factor
msl	mean sea level
Mw	moment magnitude
MW	megawatt
MWe	megawatt electric
MWROG	Mid-west Regional Operating Group
MWt	megawatt thermal
mya	million years ago
NARS	nuclear accident reporting system
NCDC	National Climatic Data Center
NCEER	National Center for Earthquake Engineering Research
NEI	Nuclear Energy Institute
NHS	normal heat sink
NMSZ	New Madrid seismic zone
NN	New Madrid north
NOAA	National Oceanic and Atmospheric Administration
NOS	Nuclear Oversight Department (Exelon)
NPHS	normal plant heat sink
NRC	U.S. Nuclear Regulatory Commission
NS	New Madrid south
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
OBE	operating-basis earthquake
OCA	owner controlled area
OL	operating license
OSC	operations support center
OSID	onset of significant inelastic deformation
PA	protected area or public address
PAG	protective action guide
PBMR	Pebble Bed Modular Reactor

PDF	probability density function
PGA	peak ground acceleration
PMF	probable maximum flood
PMP	probable maximum precipitation
PMWP	probable maximum winter precipitation
PMWS	probable maximum windstorm
PNNL	Pacific Northwest National Laboratories
PPE	plant parameter envelope
PQP	project quality plan
PRA	probabilistic risk assessment
PSHA	probabilistic seismic hazard analysis
QA	quality assurance
QMS	quality management system
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)
RF	Reelfoot fault
RG	regulatory guide
R_p	reference probability
RPM	radiation protection manager
RS	review standard
RTM	NRC's Response Technical Manual, Revision 4
S	shear
S&L	Sargent & Lundy
S_a	spectral acceleration
SCDF	seismic core damage frequency
SCR	stable continental region
SCS	Soil Conservation Service
SEI	Structural Engineering Institute
SEOC	State emergency operations center
SER	safety evaluation report
SFCP	State forward command post
SOG	Seismic Owners Group
SOP	standard operating procedure
SPF	standard project flood
SPS	standard project storm
SPT	standard penetration test
SRM	staff requirements memorandum
SRP	Standard Review Plan
SSAR	site safety analysis report
SSC	structure, system, and component
SSE	safe-shutdown earthquake
SSI	soil-structure interaction
TEDE	total effective dose equivalent
TID	technical information document
TIGER	Topologically Integrated Geographic Encoding and Referencing System
TLD	thermoluminescent dosimetry

TN	technical note
TSC	Testing Services Corporation or technical support center
UFSAR	updated final safety analysis report
UHRs	uniform hazard response spectrum
UHS	ultimate heat sink
USACE	U.S. Army Corps of Engineers
USAR	updated safety analysis report
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
UT	University of Texas
UTM	Universal Transverse Mercator
V/H	vertical-to-horizontal
V&V	verification and validation
V _p	compressional wave velocity
V _s	shear wave velocity
WRC	Water Resources Council
WVFS	Wabash Valley fault system
WVSZ	Wabash Valley/Southern Illinois seismic zone

1. INTRODUCTION AND GENERAL DESCRIPTION

1.1 Introduction

Exelon Generation Company, LLC (EGC 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 EGC ESP site. EGC requested an ESP with a permit duration of 20 years pursuant to Subpart A, "Early Site Permits," of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants." 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 a (limited work) authorization for approval of construction activities in accordance with 10 CFR 50.10(e)(1) and 10 CFR 52.17(c).

The staff has completed its review in the areas of the site seismology, geology, meteorology, and hydrology, as well as of hazards to a nuclear power plant that could result from man-made 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 ESP information 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 EGC would implement if new reactor unit(s) is eventually constructed at the ESP site. The NRC will review the complete and integrated emergency plan in a separate licensing action.

The EGC ESP application includes the site safety analysis report (SSAR), which describes the safety assessment of the site, as required by 10 CFR 52.17, "Contents of Applications." The public may inspect the ESP application via the Agencywide Documents Access and Management System (ADAMS) under ADAMS Accession No. ML032721596.⁴ EGC

⁴ADAMS (Agencywide Documents Access and Management System) is the NRC's information system. It 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 SER available on the NRC's new

subsequently revised its application to address requests from the NRC staff for additional information. The applicant submitted the most recent version, SSAR Revision 4 (application), to the Commission on April 14, 2006 (ADAMS Accession No. ML061100260).

Appendix B to this report provides a chronological list of the licensing correspondence between the applicant and the Commission regarding the review of the EGC ESP application under Project No. 718 and Docket No. 52-007. The application and other pertinent information and materials are available for public inspection at the NRC's Public Document Room at One White Flint North, 11555 Rockville Pike, Rockville, Maryland. The application and this safety evaluation report (SER) are also available at the Vespasian Warner Public Library, 310 North Quincy Street, Clinton, Illinois, as well as on the NRC's new reactor licensing public Web site at <http://www.nrc.gov/reactors/new-licensing/esp/clinton.html>. This SER is also available in ADAMS under Accession No. ML060470383.

This SER 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) within the plant parameter envelope (PPE) that EGC specified in its application. This SER 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 and in evaluating safety assessments. In addition, this SER documents the resolution of the open and confirmatory items identified in the draft safety evaluation report (DSER) for the EGC ESP, issued on February 10, 2005.

In the DSER, the NRC identified Confirmatory Item 1.1-1 to verify that EGC's future revision of its ESP application is consistent with the information provided in its requests for additional information (RAIs) responses. Throughout the course of the review, the staff requested that the applicant submit additional information to clarify the description of the EGC ESP site. This report discusses some of the applicant's responses to these RAIs. The staff reviewed the revisions of the EGC ESP application, up to and including Revision 2 of the SSAR, and determined that the ESP application is consistent with the information provided in its RAI responses. Therefore, the staff considers DSER Confirmatory Item 1.1-1 to be resolved.

At the time the DSER was issued, the staff had not completed its review in the areas of seismology and geology. In the DSER, the staff identified Confirmatory Item 1.1-2 for issuance of a supplemental DSER at a later date to summarize the results of its technical evaluation of the suitability of the proposed EGC ESP site with respect to the site's seismology and geology. The supplemental DSER was issued on August 26, 2005 (ADAMS Accession No. ML052310459). Therefore, the staff considers Confirmatory Item 1.1-2 to be resolved.

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 discussed the results of its evaluation of the environmental report for the EGC ESP site in a draft environmental impact statement (DEIS) issued on March 2, 2005 (ADAMS Accession No. ML050610364). The applicant also provided a site redress plan, in accordance with 10 CFR 52.17(c), for performing the site preparation and limited construction activities allowed by 10 CFR 52.25(a) (i.e., the activities listed in 10 CFR 50.10(e)(1)). The DEIS also includes the results of the staff's evaluation of that plan.

As described above, the applicant supplemented the information in the SSAR by providing revisions to the document. The staff reviewed these revisions to determine their impact on the conclusions in this SER. On February 17, 2006, the NRC issued its SER for the EGC ESP site and made it publically available. EGC identified that the site characteristic for the probable maximum flood (PMF) elevation proposed by the staff in the SER was somewhat higher than that calculated by EGC in its ESP application. By letters dated March 24, 2006, and April 12, 2005, EGC requested that the staff review its revised PMF analysis and adopt its corresponding PMF level as the site characteristic. By letter dated April 14, 2006, EGC provided Revision 4 to the EGC ESP application, which documented EGC's revised PMF analysis. The changes reflected in Revision 4 of the application included revisions to the tables, figures and text in Section 2.4 to reflect EGC's revised PMF analysis. This included changes to the maximum rainfall rate, the maximum hydrostatic PMF water surface elevation, the coincident wind wave activity, and the maximum storm surge. EGC presented PMF calculations using two different synthetic unit hydrograph methods (the Synder method and the Soil Conservation Service method) with two different conceptual watershed layouts (a two-basin plus lake model and a seven-basin plus lake model). The staff completed its review of the most recent version, Revision 4, of the SSAR, as documented throughout this report and, for the reasons set forth herein, finds it to be acceptable. The changes to the application in Revision 4 resulted in minor modifications to the staff's SER issued February 17, 2006, including the following changes: Section 2.4 of this SER was modified to incorporate EGC's revised PMF analysis and the staff's independent confirmatory analysis; Appendix A of this SER was modified to reflect the new site characteristics related to the revised PMF elevation; Appendix B of this SER was modified to include Revision 4 of the application; and Appendix C of this SER was modified to include reference documents used by the staff in its review of EGC's revised PMF elevation. The changes to this SER also include modifications to Section 2.4 to better describe the technical information in the application regarding EGC's ice thickness calculations. The scope of all other changes to the SER issued on February 17, 2006, resulting from Revision 4, are limited to corrections of factual inaccuracies; these changes did not impact the staff's conclusions.

Appendix A to this SER contains the list of site characteristics, permit conditions, combined license (COL) action items, and the bounding parameters that the staff recommends that the Commission include in any ESP that might be issued for the proposed site. Appendix B to this SER is a chronology of the principal actions and correspondence related to the staff's review of the ESP application for the EGC ESP site. Appendix C lists the references for this SER, Appendix D lists the principal contributors to this report, and Appendix E includes a copy of the report by the ACRS.

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 this SER 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), is the licensed owner and operator of the CPS. AmerGen is a wholly owned subsidiary of EGC. EGC is a wholly owned subsidiary of Exelon Ventures Company, LLC, which in turn is a wholly-owned subsidiary of Exelon Corporation. 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 EGC ESP application process. The applicant has stated that before any construction, it plans to enter into an agreement with AmerGen, that will grant EGC an exclusive and irrevocable option to purchase, enter a long-term lease, and/or procure other legal right in the land required for the EGC ESP facility. The staff proposes to include a permit condition to govern exclusion area control on any ESP that may be issued in connection with this application. Section 2.1.2 of this report discusses this issue in detail.

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. EGC 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 Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," and 10 CFR Part 100, "Reactor Site Criteria," that apply to an ESP do not require an ESP applicant to 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 provided 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 or reactors 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 list 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 on current reactor vendor design input data. As a result of earlier and current efforts, the applicant 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 envelopes, 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 list the 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 stated that through the PPE, it had 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 this SER. As previously noted, the applicant identified certain PPE values as appropriate for inclusion in an ESP, if one is issued. The staff also reviewed the applicant's proposed list of PPE values and identified certain PPE values as bounding parameters or controlling PPE values as discussed in the individual sections of this SER. A controlling PPE value, or bounding parameter value, is one that necessarily depends on a site characteristic. As the PPE is intended to bound multiple reactor designs, the NRC would review the actual design selected in a COL or construction permit (CP) application referencing any ESP that might be issued in connection with this application to ensure that the design falls within the bounding parameter values. Appendix A to this SER lists the bounding parameters identified for the EGC ESP site.

If an ESP is issued for the EGC ESP site, an entity may wish to reference the ESP, as well as a certified design, in a COL or CP application. Such a COL or CP applicant must demonstrate that the site characteristics established in the ESP bound the postulated site parameters established for the chosen design and that the design characteristics of the chosen design fall within the bounding parameter values specified in the ESP. Otherwise, the COL or CP applicant must demonstrate that the new design, given the site characteristics in the ESP, complies with the Commission's regulations. If an entity wishes to reference the ESP and a design that is not certified, the COL or CP applicant must demonstrate that the design characteristics of the chosen design, in conjunction with the site characteristics established for the ESP, comply with the Commission's regulations.

1.4 Identification of Agents and Contractors

EGC 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 EGC, 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 EGC'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 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 SER 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 matters:

- population density and land use characteristics of the site environs and the physical characteristics of the site, including seismology, meteorology, geology, and hydrology, to evaluate whether these characteristics were adequately described and appropriately considered in determining whether the site characteristics are in accordance with the Commission's siting criteria (10 CFR Part 100, Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications on or After January 10, 1997")
- potential hazards of man-made facilities and activities to a nuclear power plant or plants that might be constructed on the ESP site (e.g., mishaps involving storage of hazardous materials (toxic chemicals, explosives), transportation accidents (aircraft, marine traffic, railways, pipelines), and the existing nuclear power plant at the nearby CPS)
- potential capability of the site to support the construction and operation of a nuclear power plant(s) with design parameters within the parameters 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 if an applicant decides 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 EGC 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 EGC and its contractors and consultants to discuss various technical matters related to the staff's review of the EGC ESP site (refer to Appendix B to this report). The staff also visited the site to evaluate safety matters.

1.6 Summary of Open and Confirmatory Items

As a result of its review of Exelon's application for the EGC ESP, the staff identified several issues that remained open at the time the DSER and supplemental DSER were issued. The staff considers an issue to be open if the applicant has not provided requested information and the staff is unaware of what will ultimately be included in the applicant's response. For tracking purposes the staff assigned each of these issues a unique identifying number that indicates the section of this report describing it. The resolution of each open item is discussed in the SER section in which the item appears. For example, Section 2.1 of this report discusses Open Item 2.1-1.

In addition, the staff identified several confirmatory items in the DSER. An item is identified as confirmatory if the staff and the applicant have agreed on a resolution of the particular item, but the resolution has not yet been formally documented. For example, Section 1.1 of this report discusses Confirmatory Items 1.1-1 and 1.1-2.

The DSER was issued with 33 open items and 5 confirmatory items; the supplemental DSER was issued with 7 open items. As set forth in this report, all open items have been resolved and the confirmatory items have been completed. This SER documents the resolution of all the open and confirmatory items identified in the DSER and the supplemental DSER.

1.7 Summary of Combined License Action Items

The staff has also identified certain site-related items that will need to be addressed at the COL or CP stage if a COL or CP applicant desires to construct one or more new nuclear reactors on the EGC ESP site. This report refers to these items as COL action items. The COL action items relate to issues that are outside the scope of this SER. The COL action items do not establish requirements; rather, they identify an acceptable set of information to be included in the site-specific portion of the safety analysis report submitted by a COL or CP applicant referencing the EGC ESP. An applicant for a COL or CP should address each of these items in its application. The applicant may deviate from or omit these items, provided that the COL or CP application identifies and justifies the deviation or omission. The staff determined that the COL action items do not affect its regulatory findings at the ESP stage and are, for reasons specified in this report for each item, more appropriately addressed at later stages in the licensing process.

The DSER was issued with nine COL action items and the supplemental DSER was issued with eight COL action items. The staff reviewed the applicant's responses to the DSER and supplemental DSER open items and identified a number of new COL action items as a result. This report highlights these COL action items, and the staff explains them in the applicable sections of this SER. Appendix A to this SER includes a list of COL action items that must be addressed by a future COL or CP applicant. The staff identified COL action items in order to ensure that particular significant issues are tracked and considered during the COL or CP stage. The COL action items focus on matters that may be significant in any COL or CP application referencing the ESP for the EGC site, if one is issued. Usually, COL action items are not necessary for issues covered by permit conditions or explicitly covered by the bounding parameters. The list of COL action items is not exhaustive.

1.8 Summary of Permit Conditions

The staff has identified certain permit conditions that it will recommend the Commission impose, if an ESP is issued to the applicant. Appendix A to this SER summarizes these conditions. These permit conditions, or limitations on the ESP, are based on the provisions of 10 CFR 52.24, "Issuance of Early Site Permit."

The staff proposed 14 permit conditions in the DSER and 1 permit condition in the supplemental DSER. The applicant's responses to the DSER and supplemental DSER open items resulted in the resolution of some proposed DSER permit conditions. In addition, the staff determined that a permit condition is not necessary when an existing NRC regulation requires a

future regulatory review and approval process to ensure adequate safety during design, construction, or inspection activities for a new plant. Based on this criterion, the staff removed a number of permit conditions proposed in the DSER and, in some cases, added new permit conditions, COL action items, or site characteristics, as appropriate, to account for the concern.

Appendix A to this SER contains the final list of permit conditions, which have been highlighted throughout this report. Each permit condition has been reassigned a number identifying the order which appears in this SER. The staff has provided an explanation of each permit condition in the applicable section of this report.