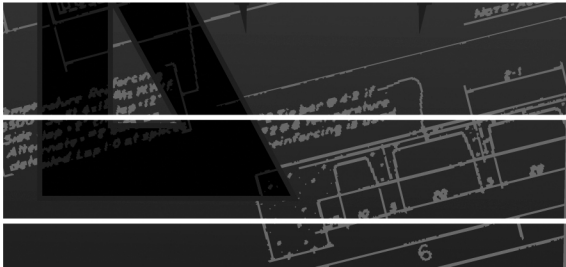


Safety Evaluation Report for an Early Site Permit (ESP) at the Exelon Generation Company, LLC (EGC) ESP Site

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

May 2006



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**Division of New Reactor Licensing
Office of Nuclear Reactor Regulations
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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.

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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.

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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