September 14, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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| In the Matter of | ) | |
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| EXELON GENERATION COMPANY, LLC. | ) | Docket No. 52-007-ESP |
| | ) | |
| (Early Site Permit for Clinton ESP Site) | ) | |

# NRC STAFF's BRIEF IN RESPONSE TO THE LICENSING BOARD'S ORDER OF AUGUST 2, 2006

## I. INTRODUCTION

This proceeding concerns the application filed by Exelon Generation Company, LLC. ("Exelon" or "the Applicant") for an early site permit ("ESP") under 10 C.F.R. Part 52. In an Order dated August 2, 2006 ("Order"), in furtherance of its duties with respect to the mandatory hearing on the application, the Atomic Safety and Licensing Board ("Board") requested briefing by the NRC Staff ("Staff") and the Applicant.[1] The Board instructed the Staff to address in its brief how the Application and the record in the proceeding support certain findings pertaining to whether the ESP should be issued.[2]

## II. PROCEDURAL BACKGROUND

In addition to establishing a preliminary schedule for the proceeding and requiring the production of certain documents, the Board's Order instructed the Staff to file a brief

> expressly indicating how the Application and the record of this proceeding support: (a) a negative finding as to whether the issuance of an ESP will be inimical to the common defense and security or to the health and safety of the public; and (b) a positive finding as to whether, taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having characteristics that fall within the parameters for the site,

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[1] *See Order* (Addressing: (a) Commission Order dated 7/26/06; (b) requiring briefings in preparation for a public hearing; and (c) establishing a preliminary schedule), unpublished Order, dated August 2, 2006.

[2] *Id.* at 6.

> can be constructed and operated without undue risk to the health and safety of the public; and (c) a finding that the requirements of section 102(2)(A),(C), and (E) of [NEPA] and subpart A of 10 C.F.R. Part 51 have been complied with in the proceeding; and (d) its view of the balance among conflicting environmental factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and (e) its view (and that of the Applicant) of the consideration of reasonable alternatives (within the constraints of Commission guidance on this matter), and how that affects the determination regarding whether the ESP should be issued, denied, or appropriately conditioned to protect environmental values.

Order at 6. The Board noted that the brief could be in outline form and could reference relevant material in the record. *Id.*

In this brief, the Staff identifies the key safety and environmental findings to be made by the Board pursuant to the Commission's Notice of Hearing and applicable regulations. Second, the Staff describes the major elements of the Clinton ESP record – primarily portions of the Staff's Safety Evaluation Report ("SER") and Final Environmental Impact Statement ("FEIS") – that constitute the basis for these findings.[3] Finally, the Staff summarizes why the Board will have adequate grounds for these findings and should, therefore, adopt the Staff's conclusions and recommendations with respect to issuance of the ESP.

## III. OVERVIEW OF KEY CONCLUSIONS TO BE REACHED BY THE BOARD

In this ESP proceeding, the Commission's "Notice of Hearing and Opportunity to Petition for Leave to Intervene[;] Early Site Permit for the Clinton ESP Site" of December 12, 2003 ("Hearing Notice"), identified the key issues to be addressed as follows:

> (1) Whether the issuance of an ESP will be inimical to the common defense and security or to the health and safety of the public (Safety Issue 1); and,
> (2) whether, taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having characteristics that fall within the parameters for the site, can be constructed and operated without undue risk to the health and safety of the public (Safety Issue 2)

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[3] Because the five issues identified by the Board are closely interrelated, the Staff has presented its discussion of the record support for these Board findings cumulatively in Part IV of the brief, rather than allocate pages separately to each issue.

> [...and, pursuant to NEPA,] [w]hether, in accordance with the requirements of Subpart A of 10 C.F.R. Part 51, the ESP should be issued as proposed.

68 Fed. Reg. 69427 (Dec. 12, 2003).

The Hearing Notice also focused the Board's inquiry on certain issues relevant for this ESP proceeding, regardless of whether the hearing is contested or uncontested:

> (1) Determine whether the requirements of Section 102(2) (A), (C), and (E) of NEPA and Subpart A of 10 C.F.R. Part 51 have been complied with in this proceeding; (2) independently consider the final balance among the conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and (3) determine, after considering reasonable alternatives, whether the ESP should be issued, denied, or appropriately conditioned to protect environmental values.

68 Fed. Reg. at 69427. Therefore, in accordance with the applicable agency regulations and the Commission's notice of hearing in this proceeding, the Board should, after reviewing the material portions of the record, make the findings discussed below (based on the support in the record as summarized below in Part IV).

A. With respect to safety-related matters, the Commission's Hearing Notice directed that the Board determine "whether the application and record of the proceeding contain sufficient information, and the review of the application by the Commission's staff has been adequate to support [the safety findings] proposed to be made by the Director, Office of Nuclear Reactor Regulation[.]"[4] 68 Fed. Reg. at 69427. In examining the principal Exelon and Staff review documents in the record, the Board should determine whether the record would enable it to conclude that the Staff had a reasonable basis for its stated conclusions on safety matters. The Board may assume that such a reasonable basis would be present if the facts underlying a Staff determination are clear and the Staff's decision logically flows from those

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[4] Thus, the Board has an obligation to determine whether the application and the record of the proceeding support the Staff's findings; but, as part of that determination, it examines whether the Staff findings – made evident in the Staff's formal review documents – demonstrate the adequacy of the Staff's review. As the Commission advised, the Board should approach this task by conducting an examination of the factual and logical foundation for the Staff's conclusions regarding the sufficiency of the application.

facts and from appropriate regulatory guidance. The Board should not, however, undertake any independent review of, or attempt to verify, technical results presented in the Exelon application or in the Staff's review documents.

Consequently, the Board should determine that (1) the issuance of an early site permit will not be inimical to the common defense and security or to the health and safety of the public; and (2) taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having characteristics that fall within the parameters for the site, can be constructed and operated without undue risk to the health and safety of the public. *Id.*

B. With respect to environmental matters, i.e., matters stemming from the agency's NEPA obligations, the Hearing Notice required the Board to determine "whether the review conducted by the Commission pursuant to NEPA has been adequate." *Id.*; *see also* 10 C.F.R. § 2.104(b)(2)(ii). The Staff's FEIS addresses (1) the results of the NRC Staff's analyses, which consider and weigh the environmental effects of the proposed action (issuance of the ESP) and of constructing and operating one or more new nuclear units at the ESP site, (2) mitigation measures for reducing or avoiding adverse effects, (3) the environmental impacts of alternatives to the proposed action, and (4) the NRC Staff's recommendation regarding the proposed action based on its environmental review. FEIS at xxviii.

Consequently, the Board should find that (1) the requirements of sections 102(2)(A), (C), and (E) of NEPA and Subpart A of 10 C.F.R. Part 51 have been complied with; (2) it has independently considered the final balance among the factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and (3) after considering reasonable alternatives (including an analysis to determine that none of the alternative sites identified is obviously superior to the proposed Clinton ESP site), the ESP should be issued, and protection of the environment does not require denial or any further conditioning of the permit.

In Part IV, below, the Staff will describe the aspects of the SER and FEIS that represent the primary basis for these ultimate safety and environmental findings.

## IV. SUPPORT IN THE RECORD OF THIS PROCEEDING, INCLUDING THE STAFF'S REVIEW, FOR THE FINDINGS TO BE MADE BY THE BOARD

### A. Safety-Related Matters

#### 1. Applicable Regulatory Guidance

The NRC Staff's SER delineates the scope of technical matters the Staff considered in evaluating the ESP application and the suitability of the proposed site. NRC Review Standard (RS)-002, "Processing Applications for Early Site Permits," issued in May 2004 [ADAMS Accession No. ML040700094], provides detail concerning the scope and bases of the Staff's review of the radiological safety and emergency planning aspects of a proposed nuclear power plant site. SER at 1-2. Prepared specifically to address the evaluation of ESPs, this review standard contains regulatory guidance derived from NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (hereinafter referred to as the Standard Review Plan or "SRP"), which reflects the NRC Staff's historical experience in establishing and promulgating guidance concerning the safety of nuclear facilities, as well as in evaluating safety assessments.[5] SER at 1-2. The format of the Clinton SER is essentially consistent with that of the SRP; however, because not all portions of the SRP are within the scope of an ESP proceeding, some sections were not addressed by the Staff's findings.

#### 2. Safety-Related Findings

The Staff completed its review and made findings on the safety-related matters addressed in Exelon's application, including seismology, geology, meteorology, and hydrology, as well as hazards to a nuclear power plant that could result from manmade facilities and

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[5] Selected topics in SRP Sections 1.8, 2.4.8, and 2.4.10 relate to design and are not material to a decision on an ESP application. Accordingly, they were omitted from RS-002. Similarly, SRP chapters omitted from RS-002 relate to design and are also not material to a decision on an ESP application.

activities on or in the vicinity of the site. SER at 1-1. The Staff also assessed the risks of potential accidents that could occur as a result of the operation of a nuclear power plant(s) at the site and evaluated whether the site would support adequate physical security measures for a nuclear power plant(s). SER at 1-1. 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 Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," of the *Code of Federal Regulations* (10 C.F.R. Part 50). SER at 1-1. The NRC has previously found that such measures provide reasonable assurance that any 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 in service. SER at 1-1. The Staff also evaluated the adequacy of the Applicant's program for compliance with the requirements of 10 C.F.R. Part 21, "Reporting of Defects and Noncompliance." SER at 1-1. Finally, the Staff reviewed the Applicant's assessment that no physical characteristics unique to the proposed site could pose a significant impediment to the development of emergency plans (pursuant to 10 C.F.R. § 52.17(b)(1)), and reviewed the proposed major features of the emergency plan that Exelon would implement if a new nuclear unit(s) were eventually to be constructed at the ESP site. SER at 1-1. As discussed below, the Staff conclusions and recommendations flowed from the analyses documented in each chapter of the SER.

a. SER, Chapter 1, "Introduction and General Description"

Chapter 1 of the SER presents the Staff's overview of the ESP review process and the procedural background of the Exelon application, as well as a general description of the Applicant and of the proposed site.

The Clinton ESP[6] facility would be located approximately 700 feet south of the current Clinton Power Station ("CPS") facility, on the existing CPS property (with its associated 4895-acre, man-made cooling reservoir, Clinton Lake) in DeWitt County in east-central Illinois, about 6 miles east of the city of Clinton. SER at 1-4. Although Exelon has not selected a specific reactor type for the Clinton ESP site, it used available information from a range of possible facilities to create a plant parameter envelope ("PPE") representing bounding values for the proposed development. SER at 1-4. Depending on the reactor type selected, the ESP facility would consist of a single reactor or multiple reactors (or modules) of the same reactor type and could have a total core thermal power rating between approximately 2400 and 6800 MWt. SER at 1-4. Unlike the existing CPS Unit 1, which uses Clinton Lake for normal cooling processes, the Clinton ESP facility would use cooling towers; Clinton Lake would be used as the source of makeup water for the Clinton ESP facility cooling water systems. SER at 1-5.

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. SER at 1-6. As discussed throughout the SER, the Staff reviewed the Applicant's PPE values and found them to be reasonable (the values are listed in Appendix A to the SER). SER at 1-7. Because the PPE is intended to bound multiple reactor designs, the NRC would review the actual design selected in a COL or construction permit application referencing any Clinton ESP to ensure that the design falls within the bounding parameter values. SER at 1-7.

The Staff also identified 32 COL action items (compiled in SER Appendix A) in order to ensure that particular significant issues are tracked and considered during the COL or CP

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[6] The ESP site will be referred to in this brief as the Clinton ESP site; however, in the SER and FEIS, it is also referred to as the "EGC [Exelon Generation Company] ESP" or the "Exelon ESP."

stage.[7] The Staff determined that these COL action items do not affect its regulatory findings at the ESP stage and are more appropriately addressed at later stages in the licensing process. SER at 1-9. Finally, the Staff identified 6 safety-related permit conditions (also listed in Appendix A) that it will recommend the Commission impose if an ESP is issued. SER at 1-9, 1-10.

b. SER, Chapter 2, "Site Characteristics"

In Chapter 2 of the SER, the Staff evaluated a range of information concerning the site characteristics of the proposed Clinton ESP site. In particular, the Staff reviewed the application with respect to geography and demography; nearby industrial, transportation, and military facilities; meteorology; hydrology; and geology, seismology, and geotechnical engineering.

i. Geography and Demography

The Applicant provided information on several aspects of the site location, including the site boundary for a new unit in reference to the existing CPS; the site location with respect to political subdivisions and prominent natural and manmade features of the area within the 2.5-mile low-population zone ("LPZ") and 50-mile population zone; the surrounding topography; the distance (defined as a circular radius of 0.64 miles) to the nearest exclusion area boundary ("EAB"); the location of potential radioactive material release points; the distance from U.S. and State highways; and confirmation that no physical characteristics unique to the proposed ESP site were identified that could pose a significant impediment to the development of emergency plans. SER at 2-1, 2-2. No persons live within either the CPS EAB or the proposed ESP site EAB, and the Staff verified that the exclusion area distance is consistent with the distance used

[7] 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 a Clinton ESP. SER at 1-9.

in the radiological consequence analyses performed by both the Applicant and the Staff. SER at 2-2, 2-3. The Staff found that the Application contained sufficient information for the Staff to evaluate compliance with the siting evaluation factors in 10 C.F.R. Part 100 and 10 C.F.R. § 52.17, as well as with the radiological consequence evaluation factors in 10 C.F.R. § 50.34(a)(1).

The Staff found that the Applicant provided and substantiated information concerning its plan to obtain legal authority to determine all activities within the designated exclusion area, and that it appropriately described the exclusion area and the methods by which it will control access and occupancy of this exclusion area during normal operation and in the event of an emergency situation. SER at 2-6. The Staff concluded that the Applicant's exclusion area is acceptable and meets the requirements of 10 C.F.R. Part 100, subject to two proposed permit conditions requiring 1) an agreement granting Exelon an exclusive and irrevocable option to purchase, enter a long-term lease, and/or other legal right in the land, before submission of an application for an ESP-referencing COL, and 2) that an ESP holder seeking to perform any authorized 10 C.F.R. § 52.25 limited work activities obtain the authority to undertake such activities on the ESP site, as well as the corresponding right to implement the site redress plan if no plant is actually built on the ESP site. SER at 2-6, 2-7.

With respect to population density, the Staff compared and verified the Applicant's population data against U.S. Census Bureau data. The Staff reviewed population projections (extending to the year 2060), finding that the Applicant's projected population data, including for the transient population, cover an appropriate number of years (through the projected year for end of plant life) and are therefore reasonable. SER at 2-9. The Staff also determined that population densities for the proposed ESP site would be well below 500 persons per square mile, in conformance with Regulatory Position C.4 in RG 4.7, Revision 2. SER at 2-10. Finally, as the LPZ is located entirely within the 10-mile emergency planning zone ("EPZ"), and

comprehensive emergency planning for the protection of all persons within the 10-mile EPZ would include those persons within the LPZ, the Staff concluded that appropriate protective measures could be taken on behalf of the populace enclosed within the LPZ in the event of a serious accident. SER at 2-10. Therefore, the Staff found that the proposed LPZ and population center distance meet the definitions in 10 C.F.R. § 100.3, and it concluded that the Applicant's population data and population distribution meet the requirements of 10 C.F.R. § 52.17 and 10 C.F.R. Part 100. SER at 2-10.

ii. Nearby Industrial, Transportation, and Military Facilities

The Application provided information on the relative location and separation distance of the ESP site from industrial, military, and transportation facilities and routes, including air, ground, and water traffic; pipelines; and fixed manufacturing, processing, and storage facilities. SER at 2-11. Noting that the ESP site is in a rural and agricultural area, the Applicant stated that only 3 small industrial facilities exist within 5 miles of the ESP site, and that no industrial facilities, pipelines, or other developments are located in the proposed exclusion area other than CPS. SER at 2-11. Five pipelines cross the CPS property, one of which passes within 1 mile of the ESP site. SER at 2-11. The Applicant identified four small private airstrips within 6 miles of the ESP site, and it stated that Clinton Lake is the only navigable waterway in the vicinity of the ESP site. SER at 2-13. The Staff in its review applied the regulatory positions and criteria in RG 1.91 and RG 1.78, Revision 1, and, because the ESP facility would be located adjacent to the existing CPS facility, the Staff considered the CPS updated safety analysis report ("USAR"), which identifies and evaluates the potential hazards from nearby industrial facilities. SER at 2-14. The Staff did not identify any relevant facilities not previously noted by the Applicant and, after consideration of the Application and RAI responses and its independent review, the Staff concluded that the Applicant identified all potentially hazardous activities on and near the site. SER at 2-14, 2-15.

The Staff also reviewed the Applicant's probability analyses of potential accidents involving hazardous materials or activities on and near a new nuclear unit at the ESP site, including flammable vapor clouds, aircraft crashes, and toxic chemicals. SER at 2-15. The Staff also reviewed the Applicant's analyses of the consequences of accidents involving nearby industrial, military, and transportation facilities to determine if any should be identified as design-basis events. SER at 2-15. Based on the discussion in the existing CPS USAR (concerning airway and airport facilities, rail shipments and onsite chemical storage at CPS), and also the distance of the potential ESP facility from the worst-case train tank explosion accident, the Staff determined that the Applicant's analyses used the appropriate data and analytical models, that the Applicant properly identified potential accidents related to the presence of hazardous materials or activities on or near the ESP site that could affect a nuclear unit represented by the chosen PPE, and that the Applicant also properly identified accidents that should be considered as design-basis events at the COL or CP stage according to 10 C.F.R. Part 100. SER at 2-15, 2-17, 2-18. As Exelon has not determined the specific design of the ESP facility, the Staff concluded that it will need to review certain potential accidents (including some that might affect control room habitability) at the COL stage, using the guidance in Section 6.4 of the SRP. SER at 2-15, 2-17, 2-18. Therefore, the Staff concluded that the site location is acceptable with regard to potential accidents that could affect a nuclear unit (based on the Applicant's PPE) that might be constructed on the site, and that the site location meets the requirements of 10 C.F.R. § 52.17(a)(1)(vii), 10 C.F.R. § 100.20(b), and 10 C.F.R. § 100.21(e). SER at 2-18.

iii. Meteorology

As part of its review of meteorologic characteristics, the Staff evaluated regional and local climatological information, including climate extremes and severe weather occurrences that may affect design and siting. The Staff reviewed information concerning the atmospheric

dispersion characteristics of the proposed nuclear power plant site to determine whether the radioactive effluents from postulated releases, as well as routine operational releases, are within Commission guidelines. The Staff prepared Sections 2.3.1 through 2.3.5 of the SER in accordance with the review procedures in RS-002, Attachment 2, using information presented in Section 2.3 of the site safety analysis report ("SSAR"), responses to Staff RAIs, and generally available reference materials, as described in the applicable sections of RS-002, Attachment 2. SER at 2-18.

Regional Climatology: The Applicant provided information concerning the averages and extremes of climatic conditions and regional meteorological phenomena that could affect the design and siting of a nuclear unit falling within the Applicant's PPE and that might be constructed on the proposed site. The Applicant characterized the regional climatology pertinent to the Clinton ESP site using data reported by the U.S. National Weather Service ("NWS") at the Peoria, Illinois, and Springfield, Illinois, first-order weather stations, as well as nearby cooperative weather stations, such as Decatur, Illinois. SER at 2-18, 2-19.

The Staff evaluated regional meteorological conditions using information that the National Climatic Data Center ("NCDC"), National Severe Storms Laboratory ("NSSL"), Illinois State Climatologist Office ("ISCO"), and American Society of Civil Engineers ("ASCE") reported. At the Staff's direction, Pacific Northwest National Laboratories ("PNNL") prepared a technical evaluation report evaluating the tornado site characteristics for the Clinton ESP site. SER at 2-27, 2-28.

The Applicant presented and substantiated information relative to the regional meteorological conditions important to the safe design and siting of a nuclear power plant falling within its PPE that might be constructed on the proposed site. The Staff reviewed the available information and concluded that the identification and consideration of the regional and site

meteorological characteristics as set forth met the requirements of 10 C.F.R. § 100.20(c) and 10 C.F.R. § 100.21(d). SER at 2-33.

Local Meteorology: The Applicant characterized local meteorological conditions collected from the meteorological monitoring program at the existing CPS. The Applicant used two periods of record to characterize local meteorological conditions - April 1972 through April 1977 ( pre-CPS construction) and January 2000 through August 2000 (post CPS-construction). Since the temperature and humidity data were collected 1972 - 1977 (before the installation of Clinton Lake and the operation of the CPS once-through cooling system), the Staff asked the Applicant whether these data remained representative of the Clinton ESP site, given that the site is now adjacent to a heated lake. The Applicant made quantitative comparisons of the 1972 -1977 and 2000 - 2002 temperature and humidity data sets, concluding that the two data sets were compatible, given the kinds of variations that would be expected for the two periods of record. SER at 2-34, 2-35. The Applicant used the more recent 2000-2002 data set to develop the short-term (accident release) and long-term (routine release) atmospheric dispersion site characteristics presented in SER Sections 2.3.4 and 2.3.5. SER at 2-45, 2-49.

The Staff reviewed the Applicant's description of the local meteorology and determined that it represented the conditions at and near the site. The Staff concluded that the Applicant had presented and substantiated information on local meteorology, air quality, and topographic characteristics of importance to the safe design and operation of a nuclear power unit falling within its PPE that might be constructed on the proposed site. The Staff reviewed the available information and concluded that the Applicant's identification and consideration of the meteorological, air quality, and topographical characteristics of the site and the surrounding area meet the requirements of 10 C.F.R. § 100.20(c) and 10 C.F.R. § 100.21(d) and are sufficient to determine the acceptability of the site. SER at 2-39.

Onsite Meteorological Measurements Program: The Applicant provided information concerning its onsite meteorological measurements program. The Applicant currently uses the existing onsite meteorological measurements program for the CPS facility to collect data for the Clinton ESP site. SER at 2-40. The Staff evaluated the onsite meteorological measurements program by reviewing the program description presented in the SSAR and conducting a site visit. The site visit consisted of reviewing the meteorological monitoring system location and exposure, sensor type and performance specifications, data transmission and recording, data acquisition and reduction, and instrumentation maintenance and calibration procedures. The Staff performed a quality review of the post-CPS construction hourly meteorological database. The Staff's examination of the data revealed generally stable and neutral atmospheric conditions at night and unstable and neutral conditions during the day, which was expected. SER at 2-42, 2-43.

The Staff reviewed available information relative to the meteorological measurements program and the data collected by the program. On the basis of its review, the Staff concluded that the system provides data adequate to represent onsite meteorological conditions, as required by 10 C.F.R. § 100.20. The onsite data also provided an acceptable basis for (1) making estimates of atmospheric dispersion for design-basis accident and routine releases from a nuclear unit falling within the Applicant's PPE that might be constructed on the proposed site, and (2) meeting the requirements of 10 C.F.R. Part 100 and Appendix I to 10 C.F.R. Part 50.

Short-Term Diffusion Estimates: The Applicant generated its atmospheric diffusion estimates for postulated accidental airborne releases of radioactive effluents to the EAB and LPZ using the Staff-endorsed computer code PAVAN. The Staff evaluated the applicability of the PAVAN model and concluded that no unique topographic features preclude the use of the PAVAN model for the Clinton ESP site. The Staff also reviewed the Applicant's input to the

PAVAN computer code, including the assumptions used concerning plant configuration and release characteristics and the appropriateness of the meteorological data input. The Staff found that the Applicant had made conservative assumptions by ignoring building wake effects and treating all releases as ground-level releases. SER at 2-47.

The Staff independently evaluated the resulting atmospheric diffusion estimates by running the PAVAN computer model, and it obtained PAVAN results similar to those of the Applicant. SER at 2-47, 2-48. The Staff concluded that the Applicant had made conservative assessments of post-accident atmospheric dispersion conditions using its meteorological data and appropriate diffusion models. The Staff reviewed the Applicant's proposed atmospheric dispersion site characteristics for inclusion in an ESP for the Applicant's site, should one be issued, and found these characteristics acceptable. Therefore, the Staff concluded that the Applicant's short-term atmospheric dispersion estimates are appropriate for the assessment of consequences from radioactive releases for postulated (design-basis) accidents, in accordance with 10 C.F.R. § 100.21. SER at 2-48, 2-49.

Long-Term Diffusion Estimates: The Applicant generated its atmospheric diffusion estimates for routine airborne releases of radioactive effluents to the site boundary, EAB, LPZ, and special receptors of interest using the MIDAS software subprogram XDCALC. The Applicant stated that the XDCALC model is consistent with the guidance in RG 1.111. SER at 2-49. The Staff reviewed the Applicant's input assumptions to the XDCALC computer code concerning plant configuration and release characteristics and found these assumptions to be appropriate. SER at 2-52. The Staff independently evaluated the Applicant's resulting atmospheric diffusion estimates by executing the Staff computer code XOQDOQ and obtaining results similar to those obtained by the Applicant. SER at 2-52. The Staff concluded that the Applicant had used an appropriate atmospheric model and adequate meteorological data to

calculate relative concentration and relative disposition at appropriate distances from postulated release points for evaluation of routine airborne releases of radioactive material. SER at 2-52.

The Staff concluded that the Applicant had provided the information necessary to address the requirements of 10 C.F.R. § 100.21(c)(1) and that the Applicant's characterization of long-term atmospheric transport and diffusion conditions is appropriate for use in demonstrating compliance with the numerical guides for doses in Appendix I to 10 C.F.R. Part 50. SER at 2-55.

iv. Hydrology

Hydrologic Description: With respect to hydrology, the Applicant indicated that the safety-related structures associated with the ultimate heat sink ("UHS"), if the reactor design selected requires a UHS, are the intake structures, the essential service water cooling towers, and other structures that will be located within the ESP facility powerblock area. SER at 2-59.

The Staff conducted a site visit in accordance with the guidance in Section 2.4.1 of RS-002, Attachment 2; used information from the site visit, digital maps, and streamflow data from the USGS; and independently verified the hydrologic description in SSAR Section 2.4.1. SER at 2-63. The Applicant provided information, including maps, charts, and data from Federal, State, and regulatory bodies, describing the hydrologic characteristics and water use in the vicinity of the ESP site. SER at 2-63.

The Staff determined that a COL or CP applicant would need to ensure that the ESP facility intake piping is installed with adequate clearance from the CPS facility piping, and that such an applicant should provide the detailed design of the UHS system if a UHS is required by the reactor type selected for the ESP facility. SER at 2-66, 2-68. The Staff concluded that, by conforming to Section 2.4.1 of RS-002, Attachment 2, the Applicant met the requirements for general hydrologic descriptions with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-70.

Floods: In Revision 4 of the SSAR, the Applicant revised the maximum rainfall site characteristic to reflect information in Hydrometeorological Report (HMR) 52. SER at 2-73. The revised maximum rate for the 1-hour probable maximum precipitation ("PMP") is 18.15 in and for the 5-min PMP is 6.08 in. SER at 2-73. The Staff noted that a COL or CP applicant should design the ESP intake structures to withstand the combined effects of Probable Maximum Flood ("PMF"), coincident wind wave activity, and wind setup, and that such an applicant should demonstrate that the flooding from local intense precipitation at the ESP site can be discharged into Clinton Lake without relying on any active drainage systems that may be blocked during such an event. SER at 2-78, 2-79. The Staff concluded that, by conforming to Section 2.4.2 of RS-002, Attachment 2, the Applicant met the requirement concerning floods at the site with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-80.

Probable Maximum Flood on Streams and Rivers: In Revision 4 of the Application, the Applicant described an assessment of the PMF static flood elevation height based on a unit hydrograph analysis of the 72-hour PMP. The PMP was estimated using current National Weather Service guidance for deriving a PMP for the Clinton watershed (HMRs 51, 52, and 53). SER at 2-82. In its evaluation, the Staff performed an independent analysis to verify the Applicant's PMF analysis. The Staff determined the PMP using HMRs 51 and 52 and ANSI/ANS-2.8-1992. SER at 2-84. The Staff concluded that the Applicant had provided sufficient information and evaluation of PMFs on streams and rivers at the site, and that, by conforming to Section 2.4.3. of RS-002, Attachment 2, the Applicant met the requirements to identify and evaluate PMFs on streams and rivers at the site with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-94.

Potential Dam Failures: In SSAR Section 2.2.4, the Applicant stated that no dams exist either upstream or downstream of the Clinton Dam. The Applicant also indicated that failure of Clinton Dam would not result in a loss of water from the submerged UHS pond. SER at 2-94.

The Staff consulted maps published by the USGS to independently verify the Applicant's statement that no dams exist upstream of the Clinton Dam. SER at 2-96. The Staff identified a small impoundment called Dawson Lake. SER at 2-96. The Applicant revised SSAR Section 2.4.1.2 to state that there were no existing reservoirs or dams upstream or downstream of Clinton Lake that could affect the availability of water to Clinton Lake. SER at 2-96, 2-97. The Applicant identified four recreational reservoirs, two upstream and two downstream, one of the upstream reservoirs being Dawson Lake. SER at 2-97.

The Staff stated its plan to include 716.5 ft MSL as a site characteristic in any ESP that might be issued for this application and noted that, even if the maximum water elevation were to be augmented by 3.1 ft because of a breech of the two upstream dams, leading to a water surface elevation of 719.6 ft MSL in Clinton Lake, the ESP site located at 735 ft MSL would be safe from flooding. SER at 2-97. The Staff concluded that, by conforming to Section 2.4.4 of RS-002, Attachment 2, the Applicant met the requirements for potential dam failures with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-97, 2-99.

Probable Maximum Surge and Seiche Flooding: The Applicant stated in Revision 0 of SSAR Section 2.4.5 that there are no large bodies of water near the ESP site where significant storm surges and seiche can occur. The Applicant also stated that Clinton Lake is not large enough to develop surge and seichce conditions more critical than the PMF condition. In Revision 4 of the SSAR, the Applicant revised its approach to provide a higher level of conservatism, and the maximum storm surge at the site was stated as 0.3 ft. SER at 2-99.

The Staff conducted an independent evaluation to estimate seiche effects from which it determined that meteorologically forced resonance is not likely and that seismically induced seiche is not likely in Clinton Lake because of the large difference between the period of oscillation resulting from seiche and that of seismically induced vibrations. SER at 2-102. The Staff concluded that, by conforming to Section 2.4.5 of RS-002, Attachment 2, the Applicant

met the requirements to identify and evaluate probable maximum surge and seiche flooding at the site with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-104.

Probable Maximum Tsunami Flooding: The Applicant stated in Revision 0 of SSAR Section 2.4.6 that the site would not be subjected to the effects of tsunami flooding because the site is not adjacent to a coastal area. In Revision 3 of the SSAR, the Applicant also considered the effects of a lake tsunami caused by a hillslope failure. The Applicant's analysis produced a maximum tsunami height at 0.4 ft. Based on the elevation of the ESP site, the Applicant concluded that landslide-induced tsunamis do not pose a risk to the site. SER at 1-104.

In its independent review, the Staff found that in extreme cases along coastal areas the shoreline water level has risen to more than 50 ft for a tsunami of distant origin and over 100 ft for tsunami waves near the earthquake's epicenter. SER at 2-107. However, since the ESP site is located at an elevation of 735 ft MSL and is at a great distance from the coast and more than 93 miles from the Great Lakes, the Staff concluded that the effects of even the largest ocean tsunami or a tsunami caused in the Great Lakes would not be high enough to exceed the elevation of the ESP site. SER at 2-107. The Staff found that by conforming to Section 2.4.6 of RS-002, Attachment 2, the Applicant met the requirements to identify and evaluate tsunami flooding with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-107.

Ice Effects: The Applicant used the USGS streamflow data measured at the Rowell gauge to identify ice formation in streams. The Applicant stated that low-flow conditions resulting from ice jams on streams upstream of the EPS site would not affect the UHS because of its submerged conditions. The Applicant revised the SSAR and added a new section (Section 2.4.7.1), in which it stated that frazil ice and anchor ice can cause blockages of intake water systems. The Applicant stated in SSAR Revision 2 that an ice sheet equal in thickness to the maximum estimated thickness of 27.0 in would potentially block only a small portion of the intake opening, leaving approximately 18.75 ft of vertical opening for water intake with initial

lake water surface elevation of 690 ft MSL before ice formation, and a vertical opening of 5.75 ft if the initial lake water surface elevation were at the minimum of 667 ft MSL, an opening adequate for the intake water requirements of the ESP plant. SER at 2-108, 2-109, 2-111.

The Staff independently estimated the likely thickness of surface ice that might form near the intake structures, using Assur's method (Chow, 1964) to estimate a maximum ice thickness of 31.4 in. SER at 2-115. The Staff determined that it is possible for an ice sheet to form for extended periods in Clinton Lake. SER at 2-115. Since the ESP facility intake structure is safety related and the potential for ice formation is a site-induced condition, the Staff noted that a COL applicant would need to demonstrate that the intake structure can withstand the effects of any ice sheet crushing, bending, buckling, splitting, or a combination of these modes. SER at 2-116. Based on email communication with the U.S. Army Corps of Engineers ("USACE") Cold Regions Research and Engineering Laboratory, the Staff determined that a 2002 USACE standard is the currently accepted standard for design ice engineering. SER at 2-118. Thus, the Staff determined that the 2002 USACE equation is acceptable for estimating the ice thickness in Clinton Lake and proposes to use a maximum ice thickness of 27 in as a site characteristic in any ESP that may be issued for the site. SER at 2-118, 2-122. The Staff noted that a COL applicant would have to design the ESP's facility UHS intake, should the facility design require a UHS, to maintain a minimum water temperature of 40° F at all times to preclude formation of frazil and anchor ice on the intake inlet. SER at 2-124. The Staff also noted that a COL applicant should ensure that the ice sheet formed on Clinton Lake will not constrain the intake, predicated on the ESP facility's UHS intake's being located at an elevation of 668 ft MSL. SER at 2-125.

The Staff concluded that by conforming to RS-002, Attachment 2, Section 2.4.7, the Applicant met the requirements to identify and evaluate ice effects at the site with respect to

10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c), except as noted in the applicable COL Action Items. SER at 2-127.

Cooling Water Canals and Reservoirs: The Applicant stated in SSAR Section 2.4.8.1 that it would use Clinton Lake as a source of raw water for the ESP facility. The Applicant would add a new intake structure near the existing CPS Unit 1 screenhouse to supply water to the ESP facility, which would use cooling towers for normal cooling and possibly also for safety-related cooling. The lake would supply makeup water for evaporation and blowdown losses from the tower(s). The Applicant stated in SSAR Section 2.4.8.1.5 that the existing submerged UHS pond would serve as the source of makeup water for the safety-related cooling tower(s) for the ESP facility when water from Clinton Lake was not available. SER at 2-127, 2-129.

The Staff visually inspected the site during the site safety analysis visit. SER at 2-136. The Staff determined that the SSAR accurately describes the intakes, discharge canals, outfalls, and reservoirs near the ESP site. SER at 2-136. The Staff determined that it is possible that the ESP facility may require a water-cooled UHS. SER at 2-137. The Staff noted that although the actual design of the NHS and UHS is beyond the scope of the ESP review, site characteristics that govern and may limit the design of the NHS and UHS must be established at the COL stage, so a COL or CP applicant should conclusively establish that any water-cooled UHS that may be required by a reactor selected for the ESP facility will be designed to a maximum 30-day makeup water requirement not exceeding 87 ac-ft, and also that the ESP facility's NHS is designed such that there is no over-reliance on the UHS for frequent plant shutdowns. SER at 2-137. The Staff also noted that a COL or CP applicant should ensure the monitoring and any required dredging of the submerged UHS pond. SER at 2-143. The Staff concluded that by conforming to SRP Section 2.4.8, the Applicant met the

requirements for cooling water canals and reservoirs at the site with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c)(3), except as noted in the applicable COL Action Items. SER at 2-143.

Channel Diversions: The Applicant stated in SSAR Section 2.4.9 that there is no existing historical evidence of channel diversion in Salt Creek or in the North Fork of Salt Creek upstream of the Clinton Dam. SER at 2-144. The Staff developed a basic understanding of the geomorphology of the region during its site visit of May 11, 2004. The Staff contacted the USGS Illinois Water Science Center to obtain references of channel diversion studies carried out on Salt Creek and the North Fork of Salt Creek; the Center stated in an email to the Staff that no channel diversion studies had been carried out on these streams. SER at 2-145.

The Staff concluded that by conforming to Section 2.4.9 of RS-002, Attachment 2, the Applicant met the requirement to identify and evaluate channel diversion at the site with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-146.

Flooding Protection Requirements: SSAR Section 2.4.3.6 estimated the design-basis flood elevation at the ESP site as 713.8 ft MSL. The Applicant stated that the flooding effects of local PMP are design related and would be considered at the COL stage. SER at 2-146, 2-147. The Staff noted that a COL or CP applicant would need to design the ESP facility's intake structures to withstand the combined effects of PMF, coincident wave activity, and wind setup. SER at 2-148. The Staff concluded that by conforming to SRP Section 2.4.10 the Applicant met the requirements of flooding protection at the site with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c)(3), except as noted in the applicable COL Action Item. SER at 2-148.

Low Water Considerations: The ESP site is adjacent to Clinton Lake, which provides cooling water for CPS Unit 1 and would provide cooling water for the proposed ESP facility. Clinton Lake would provide the normal cooling makeup water supply for the ESP facility. The

submerged UHS pond would provide 30-day emergency cooling makeup water for the ESP facility's UHS system. SER at 2-149. The Applicant used a design drought with a recurrence interval of 100 years to determine the minimum water surface elevation in Clinton Lake. This analysis considered factors that affect the water surface elevation in Clinton Lake, such as runoff, evaporation, and forced evaporation. SER at 2-149.

The Staff performed an analysis to assess the maximum rate at which the lake water surface elevation could be expected to drop, which resulted in a conservative estimate of a maximum drop of 4.85 ft/mo. SER at 2-155. The Staff determined that the drop would be gradual enough for the operators to react and safely shut down the EPS facility before the minimum operating threshold was reached. The Staff noted that if the reactor type selected for the ESP facility requires a UHS, a COL applicant would need to develop a plant shutdown protocol when the water surface elevation in Clinton Like falls to 677 ft MSL. SER at 2-156. The Staff concluded that, by conforming to Section 2.4.11 of RS-002, Attachment 2, the Applicant met the requirements for low-water conditions with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c) except with respect to the applicable COL Action Item. SER at 2-156.

Ground Water: In Section 2.4.133, the Applicant provided a description of regional and site hydrogeology and ground water conditions. The Applicant generally used the CPS USAR to derive the information presented in the SSAR, including the subsurface site characterization performed for the two previously proposed CPS units, as well as the ongoing monitoring for the constructed Unit 1. The Applicant reported that it obtained an additional four borings within the ESP footprint as part of its pre-ESP application activities: these borings further confirm the site geologic conceptual model presented previously in the USAR. SER at 2-157.

Based on its review of a USGS document (Lloyd and Lyke,1995), the Staff determined that the Applicant's description of regional hydrogeological conditions is accurate. SER

at 2-160. The Staff further determined that the SSAR accurately describes onsite and offsite ground water use. SER at 2-160. The Staff determined that the normal and safety-related requirements for the ESP facility for the ESP facility depend on the selected reactor type; therefore, it concluded that a COL Action Item is sufficient to ensure that ground water will not be used in normal or safety-related plant operations for the ESP facility. SER at 2-160.

The Applicant's description of the effluent-holding facility presumed (see SER Sections 2.4.13.1 and 2.4.13.3) that no scenario will exist in which liquid radioactive effluent could be released above the ambient ground water table, including the scenario in which the effluent-holding facility could be flooded, raising the release point above the ambient ground water table. SER at 2-162. The Staff agreed that under these assumptions, release of liquid effluent to ambient ground water could be precluded. SER at 2-162. Therefore, the Staff determined that it is necessary to ensure that the hydraulic gradient will always point inwards into the radwaste holding and storage facility from ambient ground water during construction and operation of the ESP facility including the time in which recovery of groundwater occurs to near its dewatering elevation; as a result, the Staff identified Permit Condition 3. SER at 2-162. In an open item from the DSER, the Staff determined that the Applicant needed to provide the potential impact of future construction for the ESP facility on the piezometric gradient for the ESP site; the Staff reviewed the Applicant's response to the open item and determined that the Applicant had not provided data to verify the conservatism of the ground water hydraulic or that of soil properties. SER at 2-161, 2-163. Consequently, the Staff noted that a COL or CP applicant would need to undertake additional characterization to establish conservative ground water flow velocities and conservative soil properties representative of the hydrogeologic conditions at the ESP site. SER at 2-161, 2-162, 2-163.

The Staff concluded that, except with respect to the applicable COL Action Items and Permit Condition 3, the Applicant, by conforming to Section 2.4.12 of RS-002, Attachment 2,

met the requirements to identify and evaluate ground water characteristics at the site with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-164.

Accidental Releases of Liquid Effluent: In the two paragraphs comprising SSAR Section 2.4.12, the Applicant stated that it is extremely unlikely that effluents can move out of facilities containing liquid radioactive wastes because of the high water table elevation. The Applicant's position is that the high water table results in an inward-directed hydraulic gradient that would allow ground water into the facility but not out of the facility. SER at 2-164.

The Staff determined that the Applicant's description of the effluent-holding facility presumed that no scenario would exist in which the liquid radioactive effluent could be released above the ambient ground water table, including the scenario in which the effluent-holding facility could be flooded, raising the release point above the ambient grand water table. SER at 2-167. The Staff agreed that, under these assumptions, release of liquid radioactive effluent to ambient ground water could be precluded. SER at 2-167. However, the Staff noted that a COL or CP applicant would need to demonstrate that there will be no likely scenario that could lead to liquid radioactive release to the ambient ground water, either above the ambient ground water table or below it. SER at 2-167. Further, as per Permit Condition 3, a COL or CP applicant would be required to put a ground water monitoring system in place to ensure that the hydraulic gradient would always point inwards into the radwaste holding and storage facility from ambient ground water during construction and operation of the ESP facility, including the time during which recovery of ground water occurs to near its predewatering condition. SER at 2-167. The Staff also determined that a permit condition requiring a radwaste facility design for a future reactor with features to preclude any and all accidental releases of radionuclides into any potential pathway is necessary; as a result, the Staff identified Permit Condition 4. SER at 2-167. The Staff also identified Permit Condition 5, which would provide that the

requirements of Condition 3 be kept in place and/or in operation for the life of the facility, including its decommissioning. SER at 2-168.

The Staff concluded that, by conforming to Section 2.4.13 of RS-002, Attachment 2, the Applicant met the requirements to identify and evaluate the accidental release of liquid effluents to ground water and surface water at the site with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c), except as noted in Section 2.4.13.3 of the SER. SER at 2-169.

Thermal Discharges: The ESP site is adjacent to Clinton Lake, which provides cooling water for CPS Unit 1. The Normal Plant Heat Sink ("NPHS") water supply for the ESP facility would be obtained from Clinton Lake, and normal operation of the ESP facility would use a cooling tower(s) operated with water drawn from a cooling tower basin(s). SER at 2-169. The NPHS has no safety function and is not required for shutdown or accident mitigation. However, in the event that the NPHS fails frequently and suddenly, there would be excessive reliance on the UHS. SER at 2-171. The Staff's analysis of the information provided by the Applicant led the Staff to conclude that the NPHS would be likely to perform its function consistent with the maximum thermal discharge assumed in the PPE and that the consequences of the NPHS operation on the UHS are acceptable and do not lead to frequent plant shutdown or frequent use of the UHS. SER at 2-172.

Ultimate Heat Sink: At the ESP stage, because a specific reactor type is not identified, it is not known whether a UHS will be required for the ESP facility. If the ESP facility does require a UHS, the Staff used the PPE evaporation rate for the UHS equal to 411 gpm for 30 days to establish excess capacity within the submerged UHS pond. SER at 2-174. As discussed in SER Section 2.4.8.3, the Staff determined that the submerged UHS pond has an excess capacity of approximately 318 ac-ft. SER at 2-174. The Staff found that the Applicant provided sufficient information pertaining to the NPHS to determine that the consequences of

NPHS operation on the UHS are acceptable. Therefore, the Staff concluded that the Applicant met the requirements of 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-175.

v. Geology, Seismology, and Geotechnical Engineering

The NRC Staff evaluated the Applicant's analysis of the geological, seismological, and geotechnical engineering properties of the ESP site. This analysis focused on a review of the basic geological and seismological site and regional data, the vibratory ground motion of the site, and the safe-shutdown earthquake ("SSE") ground motion. The Staff's analysis is summarized in Sections 2.5.1 through 2.5.6 of the SER. SER at 2-177.

Site and Regional Geology: SSAR Sections 2.5.1.1, "Regional Geology," and 2.5.1.2, "Site Geology," describe the geology of the site and the surrounding region. The Staff's evaluation of the Applicant's submission was based on four areas designated in RG 1.165, corresponding to areas 320km, 40km, 8km, and 1km from the site. SER at 2-195. In order to ensure a thorough review of the Applicant's submission, the Staff obtained the assistance of the U.S. Geological Survey ("USGS"). SER at 2-195. The interpretations, assumptions, and conclusions presented by the Applicant were confirmed by the Staff and USGS advisors through a visit to the ESP site. SER at 2-196. The Staff also conducted a review of Section 2.5.2 that focused on (1) the tectonic or seismic information, (2) the nontectonic deformation information, and (3) the conditions caused by human activities, with respect to both the regional geology and site geology. SER at 2-195, 2-196.

The Staff review of the regional geology evaluated the structural geology, seismology, paleoseismology, physiography, geomorphology, stratigraphy, and geologic history, within 200 miles of the site. SER at 2-196. The Applicant concluded that the ESP site is one of the most geologically stable areas in the United States, and that the geologic conditions at the ESP site are the same as those at the CPS site. SER at 2-196. The Staff, after reviewing SSAR

Section 2.5.1.1, concluded that the Applicant provided a thorough and accurate description of the geologic features and characteristics of the site. SER at 2-196.

The Staff review of the site geology, presented in Section 2.5.1.2, evaluated the site-related geologic features and structure, as well as conditions caused by human activities. SER at 2-199. In the application, the Applicant described the site physiography, stratigraphy, structural geology, ground water conditions, and other geologic conditions. SER at 2-199. The Applicant concluded that the site is located in a tectonically stable area of North America and that there is no evidence of surface faulting at the site. SER 2-200. The Staff found that the Applicant's analysis described readily observable local geologic features and provided an adequate description of the local site conditions, and the Staff concluded that the Applicant provided a thorough and accurate description of the local geology in support of the ESP application. SER at 2-199, 2-200.

After reviewing the geological and seismological information submitted by the Applicant in SSAR Section 2.5.1, the Staff concluded that the Applicant provided a thorough characterization of the geological and seismological characteristics of the site, as required by 10 C.F.R. § 100.23. SER 2-200. The Staff found that no capable tectonic sources that have the potential to cause near-surface fault displacement exist in the site area. SER at 2-200. In addition, the Staff concluded that the Applicant had identified and appropriately characterized the seismic sources significant to determining the SSE for the ESP site, in accordance with RG 1.165 and SRP Section 2.4.1. SER at 2-200. By identifying and classifying the seismic sources significant to determining the SSE for the ESP site, the Staff found that the Applicant satisfied 10 C.F.R. § 100.23(c) and GDC 2 in this respect. SER at 2-200. Based on the Applicant's geological investigations of the site vicinity and the site area, the Staff concluded that the Applicant had properly characterized the site lithology, stratigraphy, geologic history, and structural geology. SER at 2-200. The Staff also concluded that there is no potential for

the effects of human activities (i.e., ground water withdrawal or mining activity) to compromise the safety of the site. SER at 2-200. Therefore, the Staff concluded that the proposed ESP site is acceptable from a geological and seismological standpoint and meets the requirements of 10 C.F.R. § 100.23. SER at 2-200.

Vibratory Ground Motions: Rather than using the methodology described in RG 1.165 to determine the SSE ground motion, the Applicant chose to use a different approach, which is described in the American Society of Civil Engineers ("ASCE") / Structural Engineering Institute ("SEI") Standard 43-05, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities and Commentary." SER at 2-220. This new approach is referred to as a "performance-based" approach, which sets a goal or target of a mean annual frequency of $10^{-5}$ of unacceptable performance of nuclear SSCs as a result of seismically initiated events. SER at 2-220. Specifically, the performance-based approach is intended to achieve a mean $10^{-5}$ risk per year of core damage caused by seismic initiators. SER at 2-220. This safety performance goal is based on assuming a target $10^{-4}$ mean annual risk of core damage caused by all accident initiators and on the assumption that seismic initiators contribute about 10 percent of the risk of core damage posed by all accident initiators. SER at 2-220.

The Staff focused its review of SSAR Section 2.5.2.6 on the method used by the Applicant to determine the SSE ground motion spectra (horizontal and vertical ) for the ESP site. SER at 2-259. Rather than develop the SSE as recommended by RG 1.165, the Applicant again used the performance-based approach described in ASCE/SEI Standard 43-05, which sets a target of a mean annual frequency of $10^{-5}$ of unacceptable performance of Category I nuclear SSCs as a result of seismically initiated events. SER at 2-259. As noted previously, this safety performance target, $P_{FT}$, is based on assuming (1) a target $10^{-4}$ mean annual risk of core damage from all accident initiators and (2) that seismic initiators contribute about 10 percent of the risk of core damage posed by all accident initiators. SER at 2-259. In

order to determine the SSE that achieves the annual performance goal of $10^{-5}$, this approach scales the site-specific mean $10^{-4}$ uniform hazard response spectrum ("UHRS"), determined in the pervious section, by a design factor ("DF"). SER at 2-259.

After extensive review, the Staff found the performance-based approach to be an advancement over the solely hazard-based reference probability approach recommended in RG 1.165. SER at 2-268. The Staff noted that the performance-based approach uses not only the seismic hazard characterization of the site from the probabilistic seismic hazard analysis ("PSHA"), but also basic seismic fragility SSC modeling in order to obtain an SSE that directly targets a structural performance frequency value. SER at 2-268. The Staff concluded that the Applicant targeted a sufficiently low value ($10^{-5}$/yr), which it set to be equivalent to the frequency of onset of significant inelastic deformation ("FOSID"), smaller ($10^{-6}$/yr) than the median of the mean SCDF for the 25 nuclear power plants evaluated in NUREG-1742. SER at 2-268.

Consequently, after reviewing SSAR Section 2.5.2 and the Applicant's responses to the RAIs, the Staff found that the Applicant provided a thorough characterization of the seismic sources surrounding the site, as required by 10 C.F.R. § 100.23. SER at 2-273. The Staff found that the Applicant had adequately addressed the uncertainties inherent in the characterization of these seismic sources through a PSHA, and that this PSHA follows the guidance provided in RG 1.165. SER at 2-273. The Staff concluded that the controlling earthquakes and associated ground motion derived from the Applicant's PSHA are consistent with the seismogenic region surrounding the ESP site, and that the Applicant's SSE adequately represents the regional and local seismic hazards and accurately includes the effects of the local ESP subsurface properties. SER at 2-273. Therefore, based on its review, including approval of the performance-based approach used by the Applicant, the Staff concluded that the proposed ESP site is acceptable from a geologic and seismologic standpoint and meets the requirements of 10 C.F.R. § 100.23. SER at 2-273.

Surface Faulting: Section 2.5.3.3 of the SER provides the Staff's evaluation of the seismological, geological, and geophysical investigations carried out by the Applicant to address the potential for surface deformation that could affect the site. SER at 2-275. The technical information presented in the SSAR Section 2.5.3 reflected the Applicant's surface and subsurface investigations, performed in progressively greater detail as they moved closer to the ESP site. SER at 2-275.

In order to thoroughly evaluate the surface faulting investigations performed by the Applicant, the Staff sought the assistance of the USGS. SER at 2-275. The Staff and its USGS advisors visited the ESP site and met with the Applicant to assist in confirming the interpretations, assumptions, and conclusions presented by the Applicant concerning potential surface deformation. SER at 2-275. The Staff concluded that the Applicant performed extensive field investigations and concurred with the Applicant's conclusion that there are no capable faults within the site area. SER at 2-276. Based on its site visit and its review of SSAR Section 2.5.3, the Staff concurred with the Applicant that there are no capable tectonic sources within 25 miles of the site that would cause surface deformation in the site area. SER at 2-276. The Staff concluded that the Applicant performed its investigations in accordance with 10 C.F.R. § 100.23 and RG 1.165 and provided an adequate basis to establish that no capable tectonic sources exist in the site vicinity that would cause surface deformation in the site area. SER at 2-276. Therefore, the Staff concluded that the site is suitable from the perspective of tectonic surface deformation and meets the requirements of 10 C.F.R. § 100.23. SER at 2-276, 2-277.

Stability of Subsurface Materials and Foundations: SSAR Section 2.5.4 presents the Applicant's evaluation of the stability of subsurface materials and foundations at the ESP site. In SSAR Section 1.5, the Applicant stated that it developed the geological, geophysical, and geotechnical information used to evaluate the stability of the subsurface materials in

accordance with the requirements of 10 C.F.R. § 100.23. SER at 2-293. The Applicant applied the guidance of RS-002, RG 1.70, DG-1105,[8] RG 1.132, and RG 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants." SER at 2-293. The Staff reviewed SSAR Section 2.5.4 for conformance with the regulatory requirements and guidance applicable to the characterization of the stability of subsurface materials. SER at 2-293.

Based on its review of SSAR Section 2.5.4 and the Applicant's responses to the associated RAIs and an earlier open item, the Staff concluded that the Applicant adequately determined the engineering properties of the soil and rock underlying the ESP site through its field and laboratory investigators. SER at 2-306. The Staff concluded that the Applicant performed sufficient field investigations and laboratory testing to determine the overall subsurface profile, the properties of the soil and rock underlying the site, and the similarity between the CPS and ESP subsurface profiles and properties. SER at 2-306. Specifically, the Staff concluded that the Applicant adequately determined (1) the soil and rock dynamic properties through its field investigations and laboratory tests and (2) the liquefaction potential of the soils. (The Staff noted that the Applicant covered the response of the soil and rock to dynamic loading in SSAR Section 2.5.2. SER at 2-306.)

In SSAR Table 1.4-1, the Applicant identified three subsurface material properties as ESP site characteristic values, the first of which specifies that there is no liquefaction below 60 feet below the ground surface (bgs). SER at 2-307. The Staff found that the Applicant demonstrated, in SSAR Section 2.5.4.8, that any liquefaction at the ESP site would be limited to the upper 60 ft of soil. SER at 2-307. SSAR Table 1.4-1 states that "soils above 60 ft bgs to be replaced or improved. However, in SSAR Section 2.5.4.12 the Applicant stated, "decisions

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[8] This guidance has been superseded by RG 1.198 since the Applicant submitted the SSAR.

regarding the need for and type of ground improvement will be made during the COL stage." Therefore, the Staff identified Permit Condition 6, an unequivocal commitment by the Applicant to improve or replace and remove the soils above 60 ft below the ground surface. SER at 2-307.

Stability of Slopes: The Applicant did not carry out slope stability analyses for the ESP application. SER at 2-307. Therefore, the Staff was unable to reach any conclusions regarding the stability of slopes that have not been designed or constructed. SER at 2-308.

Embankments and Dams: SSAR Section 2.5.6 states that the ESP facility will use cooling towers for cooling, with Clinton Lake being used to provide makeup water to the cooling towers. Because the ESP facility will use the CPS UHS to supply makeup water to the cooling towers, the Applicant stated that it would perform evaluations (if appropriate) at the COL stage to assess the performance of the submerged dam forming the UHS under the ESP SSE ground motion. The Staff found the Applicant's decision to delay this evaluation until the COL stage to be acceptable. SER at 2-309.

c. SER, Chapter 3, "Site Safety Assessment"

In Chapter 3 of the SER, the Staff reviewed the Applicant's assessment of aircraft hazards to verify that the risks due to such hazards are sufficiently low for a new nuclear unit that might be constructed on the proposed site. The Staff noted that the 4 private airstrips in the site vicinity do not have commercial operations and are only available for public use in emergencies. SER at 3-1. Although the Applicant determined that none of the fields has enough flight operations to require a detailed analysis of the risk to a plant at the proposed ESP site based on a criterion in RG 1.70, the Staff conducted an independent evaluation of the hazards associated with the Martin RLA Airport because it is within 5 miles of the ESP site. SER at 3-1, 3-3. However, because the Staff estimated that an aircraft from the Martin RLA

Airport has a probability of about $6x10^{-8}$ per year of impacting the ESP facility, lower than the $10^{-7}$ threshold in the acceptance criteria in SRP Section 3.5.1.6, the Staff concluded that aircraft hazards associated with the Martin RLA Airport do not pose a significant risk to facilities at the proposed ESP site. SER at 3-3.

The Applicant found that a detailed evaluation of potential hazards of airport flight operations was not necessary because the number of flights per year associated with the area airports (including the closest public airports – the Central Illinois Regional Airport in Bloomington, about 23 miles north of the site; the Decatur Airport, about 23 miles south of the site; and the Rantoul National Aviation Center Airport (Frank Elliott Field), about 37 miles east of the site) does not exceed the threshold specified in Section 3.5.1.6 of RS-002. SER at 3-1. The Staff did an independent review of public airports in the vicinity of the proposed ESP site and identified 10 airports within 50 miles of the site, but on the basis of the airport distances from the airports to the site and the annual number of operations, it found that hazards of operations at these airports near the proposed ESP site do not pose a significant risk to safety-related structures that might be built at the site. SER at 3-4.

Four low-altitude airways pass near the ESP site and are sufficiently close to require detailed evaluations of the potential hazards; the CPS USAR analysis concluded that the probability of an aircraft crash on the CPS site from flights along the four airways is $5.42x10^{-8}$ per year. The Staff performed an independent assessment of the risks associated with the airways and concluded that the probability of an aircraft crash on the ESP site having radiological consequences greater than the 10 C.F.R. § 50.34(a)(1) criteria is less than $5.0x10^{-8}$. Therefore, the Staff concluded that, from the perspective of aircraft hazards, the proposed site is acceptable for siting a plant or plants of the types specified by the Applicant. SER at 3-4.

d. SER, Chapter 11, "Radioactive Effluent Dose Consequences from Normal Operations"

In Chapter 11 of the SER, the Staff reviewed the information in the Application concerning radiological effluents and solid radioactive waste, to determine whether site characteristics are such that the radiation dose to members of the public would be within regulatory requirements. SER at 11-1. The licensee submitted that the proposed facility will have the ability to handle these radiological effluents and solid waste materials in a manner that minimizes radioactive releases to the environment and maintains exposure to the public and plant personnel during normal plant operation and maintenance at levels that are as low as reasonably achievable ("ALARA"). SER at 11-1.

From bounding effluent, solid waste, and dose estimates provided by the Applicant, the Staff concluded that the Applicant provided adequate information to give reasonable assurance that it will control, monitor, and maintain radioactive gaseous and liquid effluents from the ESP facility within the regulatory limits specified in 10 C.F.R. Part 20, 10 C.F.R. Part 71, and 49 C.F.R. Part 173, as well as maintain them at ALARA levels, in accordance with the effluent design objectives contained in Appendix I to 10 C.F.R. Part 50. SER at 11-3. However, the Staff noted that any COL applicant that references an ESP for the site should verify that the calculated radiological doses to members of the public from radioactive gaseous and liquid effluents for any facility to be built on the site are bounded by the radiological doses included in the SSAR for the ESP application and reviewed by the NRC Staff. SER at 11-3.

e. SER, Chapter 13, "Conduct of Operations"

As set forth below, the Application states that no physical characteristics unique to the existing Clinton site would pose a significant impediment to the development of emergency plans for the proposed reactor(s) pursuant to 10 C.F.R. § 52.17(b)(1), describes the major features of Exelon's proposed emergency plan pursuant to 10 C.F.R. § 52.17(b)(2)(I), and

addresses whether site characteristics are such that the Applicant can develop adequate security plans and measures. SER at 13-2, 13-80.

i. Emergency Planning

The Staff evaluates emergency plans to determine whether there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. SER at 13-1. An early site permit application, pursuant to 10 C.F.R. § 52.17(b), must identify any physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans. SER at 13-1. The application must also describe the contacts and arrangements that the applicant has made with Federal, State, and local government agencies with emergency response planning responsibilities. SER at 13-1. In addition, the application may propose major features of the emergency plans, as described in Supplement 2 to NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants—Criteria for Emergency Planning in an Early Site Permit Application—Draft Report for Comment" (hereafter referred to as Supplement 2), issued April 1996, or may propose complete and integrated emergency plans. SER at 13-1.

Because the Applicant elected to present and seek NRC acceptance of the major features of the emergency plans, the Staff's evaluation addressed the three aspects of such a submission, in the following order: (1) identify physical characteristics that could pose a significant impediment to the development of emergency plans; (2) describe contacts and arrangements made with Federal, State, and local governmental agencies with emergency planning responsibilities; and (3) propose major features of the emergency plans. SER at 13-1, 13-2. Although the Applicant identified Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 C.F.R. Part 50, "Domestic Licensing of Production and Utilization Facilities," as applicable to the major features it proposed, the Staff

noted that its findings are limited to those particular portions of Appendix E that the Staff considered during its review of a particular major feature. SER at 13-2.

Also, notwithstanding any Staff approval of a proposed major feature, the Staff stated its intent to review all features of the emergency plan requiring description pursuant to Appendix E, but which are not described in the ESP application, in the context of a COL or operating license ("OL") application. SER at 13-2. The Staff indicated it would review the complete and integrated emergency plans submitted in the COL or OL application to determine whether they comply with such requirements, as well as with the requirements of 10 C.F.R. § 50.47, "Emergency Plans." SER at 13-2.

The Applicant stated that the evacuation time estimate ("ETE") performed in 1993 for the CPS plume exposure pathway served as the basis for the ETE analysis supporting its ESP application. SER at 13-2. The Applicant further stated that the 1993 ETE assesses the relative feasibility of an evacuation for the 10-mile (mi) EPZ plume exposure pathway; the Applicant evaluated the assumptions that served as the basis for the 1993 ETE and found that these assumptions remain valid for the area surrounding the ESP site. SER at 13-2, 13-3. The Applicant's methodology included use of the NETVAC computer simulation model, which facilitates a reasonably sophisticated modeling of the road network, the use of evacuation preparation and departure time distributions, and the use of population and vehicle demand distribution data to simulate a variety of evacuation scenarios. SER at 13-3.

The Staff found that because the proposed ESP site is adjacent to CPS, which is an operating nuclear power plant with integrated onsite and offsite radiological emergency plans, no significant impediments exist to the development of an emergency plan for the proposed ESP site. SER at 13-13. The Staff also found that the Applicant adequately identified physical characteristics unique to the proposed site by performing a preliminary analysis of the time required to evacuate various sectors and distances within the plume exposure pathway EPZ for

transient and permanent populations and did not note any major impediments for an evacuation or other protective actions. SER at 13-13. The Staff determined that the Application's ETE analysis includes an estimate of the number of people to be evacuated, using the latest population census numbers and the most recent local conditions. SER at 13-13. Therefore, with respect to impediments to emergency plan development, the Staff concluded that the information the Applicant provided is consistent with the guidance in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(1) and 10 C.F.R. § 52.18. SER at 13-14.

The Staff found that the Applicant provided an acceptable description of contacts and arrangements made with Federal, State, and local governmental agencies with emergency planning responsibilities, including the name and location of the organizations contacted, the title of the persons contacted, and the role of the organization in emergency planning. Therefore, the Staff concluded that the Application is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(3). SER at 13-17.

With respect to emergency planning zones, the Application stated that the EPZ boundary of the Clinton ESP site is identical to the CPS EPZ boundary, which was defined in 1985 following a detailed review of the demography, topography, characteristics of the land, access routes, and jurisdictional boundaries in the area surrounding the power facility. SER at 13-17. The Staff thus found that the Applicant proposed a plume exposure pathway EPZ of approximately a 10-mile radius and an ingestion pathway EPZ of approximately a 50-mile radius, both of which reflect local emergency response needs and capabilities. SER at 13-18. The Staff concluded that the size and configuration of the EPZs is consistent with the guidance in RS-002 and Supplement 2, meeting the requirements of 10 C.F.R. § 50.33(g), 10 C.F.R. § 50.47(c)(2), 10 C.F.R. § 52.17(b)(2)(I), 10 C.F.R. § 52.18, and Sections I, III, and IV of Appendix E to 10 C.F.R. Part 50. SER at 13-18.

The Applicant also sought NRC acceptance of 14 major features of its emergency plan. The Staff evaluated the Application with respect to each of these major features, and concluded that 13 of the proposed features (Major Features A-G, I-L, O & P) were consistent with the guidance in RS-002 and Supplement 2, meeting the requirements of 10 C.F.R. § 52.17(b)(2)(I), 10 C.F.R. § 52.18, and the appropriate sections of Appendix E to 10 C.F.R. Part 50, insofar as those requirements apply to the proposed features. SER at 13-22, 13-25, 13-27 to 13-28, 13-29, 13-31, 13-35, 13-38, 13-45, 13-63 to 13-64, 13-70, 13-72, 13-75, 13-79 to 13-80. These features, which the Staff thus found acceptable, included assignment of responsibility (organization control); onsite emergency organizations; emergency response support and resources; emergency classification system; notification measures and procedures; emergency communications; public education and information; accident assessment; protective response; radiological exposure control; medical and public health support; radiological emergency response training; and responsibility for the planning effort (development, periodic review, and distribution of emergency plans). *Id.*

With respect to Major Feature H (emergency facilities and equipment), the Staff found that the Applicant did not describe in sufficient detail the emergency facilities and related equipment for the operational support center ("OSC") and technical support center ("TSC") as specified in RS-002 and Supplement 2. Therefore, the Staff concluded that proposed major feature H is unacceptable. SER at 13-43. Because the emergency response facility guidance in NUREG-0696 will be applied during the emergency plan review at the COL stage, the Staff will determine the adequacy of such incorporation in this area during a COL or OL review.

ii. Site Characteristics–Physical Security

The Staff also reviewed the physical security aspects of the ESP application to determine whether the site characteristics are such that adequate security plans and measures can be developed. SER at 13-80. The Staff reviewed the application and RAI responses and

conducted a site visit, and using the criteria set forth in 10 C.F.R. 100.21 (f), the Staff identified and considered various characteristics of the site that could affect the establishment of adequate security plans and measures. SER at 13-81. Specifically, the Staff considered pedestrian land approaches, vehicular land approaches, railroad approaches, water approaches, potential high-ground adversary advantage areas, nearby road transportation routes, nearby hazardous materials facilities, nearby pipelines, and culverts that could provide a pathway into the PA. SER at 13-81. With respect to pedestrian and water approaches, the Staff concluded that the distance from possible locations of vital equipment and structures (which might be located anywhere in the identified site footprint because the ESP application does not describe a specific design) to the OCA boundary is sufficiently large to locate barriers, detection equipment, and isolation zones consistent with RG 4.7. SER at 13-81.

Likewise, finding that the OCA is sufficiently large to establish a vehicle checkpoint with adequate standoff distance from the possible location of vital equipment to mitigate vehicle bomb overpressure effects, the Staff concluded that the location of existing roads and site terrain features does not preclude the establishment of adequate vehicle control measures, and that no railroad line or spur features would preclude the development of adequate security plans or measures. SER at 13-81, 13-82. The Staff also found that the distances to nearby hazardous materials facilities and nearby pipelines and the associated hazardous materials did not pose an impediment to the development of adequate security plans or measures. SER at 13-82. Based on its evaluation, the Staff concluded that the Clinton ESP site characteristics would allow a COL or CP applicant to develop adequate security plans and measures for a new unit on the ESP site. SER at 13-82.

f. SER, Chapter 15, "Postulated Accidents and Accident Dose Consequences"

In Chapter 15 of the SER, the Staff evaluated the radiological consequences of design-basis accidents ("DBAs") to determine whether a new nuclear unit could be sited at the ESP site without undue risk to the health and safety of the public, in compliance with 10 C.F.R. § 52.17, "Contents of Applications," and 10 C.F.R. Part 100, "Reactor Site Criteria." SER at 15-1. The Applicant did not identify a particular reactor design to be considered for the proposed ESP site, but instead developed a set of reactor DBA source term parameters using surrogate reactor characteristics. SER at 15-1. The Applicant used these source term parameters, in conjunction with specific site characteristics for accident analysis purposes, to assess the suitability of the proposed ESP site as part of its PPE. SER at 15-1. The PPE was developed using seven reactor designs—five water-cooled reactors and two gas-cooled reactors[9] – though the Applicant used source terms for only two of these designs as inputs to its DBA analyses. SER at 15-1.

Using source terms developed predominantly from two light-water reactors designs, the certified Advanced Boiling Water Reactor ("ABWR") and a version of the Advanced Pressurized Water Reactor ("AP1000"), the Applicant performed and provided radiological consequence analyses for a number of DBAs. SER at 15-1. These included main steamline breaks, reactor coolant pump locked rotor, control rod ejection, control rod drop, small line break outside containment, steam generator tube rupture, loss-of-coolant accidents ("LOCAs"), and a fuel handling accident. SER at 15-1, 15-2.

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[9] The five light water reactor ("LWR") designs Exelon considered are a version of the Advanced Pressurized Water Reactor ("AP1000"); the Advanced Boiling Water Reactor ("ABWR"); the Advanced Canada Deuterium Uranium Reactor ("ACR-700"); the Economic Simplified Boiling Water Reactor ("ESBWR"), and the International Reactor Innovative and Secure ("IRIS") Reactor. The two gas-cooled designs Exelon considered are the Gas Turbine Modular Helium Reactor ("GT-MHR") and the Pebble Bed Modular Reactor ("PBMR").

As discussed in RS-002, the Staff considers the PPE approach to be an acceptable method for assessing site suitability. For the purposes of this analysis, the Applicant proposed a fission product release from the ESP footprint to the environment; the Staff reviewed the Applicant's dose evaluation based on this release. SER at 15-4.

Selection of DBAs: First, the Staff found that the Applicant selected DBAs that are consistent with the DBAs listed and analyzed in the SRP and in RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Plants," issued July 2000. SER at 15-5. The Staff also indicated that conclusions drawn regarding the site's acceptability based on the AP1000 and ABWR designs are likely to be valid for the other reactor designs the Applicant is considering, although whether those designs are bounded will be evaluated at the time of a CP or COL application. SER at 15-5. Therefore, the Staff found that the Applicant provided an acceptable DBA selection for evaluating the compliance of the proposed ESP site with the dose consequence evaluation factors specified in 10 C.F.R. § 50.34(a)(1). SER at 15-5.

Design-Specific (Postulated) χ/Q Values: Second, because Westinghouse revised the χ/Q (atmospheric dispersion factor) values in the AP1000 design certification document ("DCD") subsequent to the Applicant's use of the χ/Q values in the proposed AP1000 DCD that were under Staff review at the time the ESP application was submitted, the Applicant elected to update the ESP application to apply the latest χ/Q values in the AP1000 DCD, Revision 14, which is the basis for the AP1000 design certification, to all DBAs. The Staff verified that these χ/Q values used by the Applicant are the same as those in the AP1000 design certification document. SER at 15-5. In evaluating the ABWR, the Applicant did not use the postulated χ/Q values in the ABWR certified DCD, but instead calculated the radiological consequence doses using the postulated activity releases in the ABWR DCD, the EGC ESP site-specific χ/Q values, and the dose conversion factors in Federal Guidance Reports 11 and 12. SER at 15-6.

Site-Specific χ/Qs: Third, the Staff reviewed the Applicant's site-specific χ/Q values and performed an independent evaluation of atmospheric dispersion per the guidance provided in Section 2.3.4 of RS-002. Based on the Applicant's recalculation of the short-term accident χ/Q values using three complete years of meteorological data from January 2000 to December 2002 (instead of January 2000 to August 2002 data it initially used) and using a minimum distance of 805 meters to the EAB (instead of the 1025 meters initially used), the Staff found the χ/Q values acceptable. SER at 15-6.

Source Terms and Radiological Consequence Evaluations: Based on the AP1000 DCD and the design certification rule for the ABWR, the Staff found that the certified ABWR and the proposed AP1000 designs met the radiological consequence evaluation factors identified in 10 C.F.R. § 50.34(a)(1) with their postulated χ/Q values. SER at 15-7.

The Staff further commented that the radiological consequences of the DBAs at the proposed site based on the AP1000 and ABWR designs are likely to be valid for the other reactor designs the Applicant is considering, though whether or not the final reactor design the Applicant selects for use at the Clinton ESP site is in fact bounded by the ESP evaluation would be subject to review during the Staff's consideration of any COL or CP application. SER at 15-8. The Staff subsequently found the source terms from the PPE (i.e., the ESP footprint) themselves to be reasonable and acceptable, and stated that the Applicant correctly concluded that the dose consequences for the chosen surrogate designs comply with the dose consequence evaluation factors of 10 C.F.R. § 50.34(a)(1). SER at 15-8.

In sum, the Staff concluded that the proposed distances to the EAB and the LPZ outer boundary of the proposed ESP site, in conjunction with the fission product release rates to the environment provided by the Applicant as PPE values, are adequate to provide reasonable assurance that the radiological consequences of the DBAs will be within the dose consequence evaluation factors set forth in 10 C.F.R. § 50.34(a)(1) for the proposed ESP site. SER at 15-9.

The Staff further concluded that (1) the Applicant demonstrated that the proposed ESP site is suitable for power reactors with source term characteristics bounded by those of the ABWR and AP1000 without undue risk to the health and safety of the public, and (2) the Applicant complied with the requirements of 10 C.F.R. § 52.17 and 10 C.F.R. Part 100. SER at 15-10.

g. SER, Chapter 17, "Early Site Permit Quality Assurance Measures"

In Chapter 17 of the SER, the Staff evaluated the quality assurance ("QA") measures employed by the Applicant and its contractors[10] in preparing its ESP application. Current NRC regulations do not require ESP holders or applicants to implement a QA program compliant with the requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 C.F.R. Part 50. SER at 17-1. However, applicants are expected to implement QA measures equivalent in substance to the measures described in Appendix B to 10 C.F.R. Part 50, in order to provide reasonable assurance that any information derived from ESP activities which could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-1.

Thus, although the Applicant chose not to supply information on the QA measures it employed for ESP activities in its application, the Staff evaluated quality measures for those activities associated with the Applicant's generation of site-related information that could be used as input to the design of future SSCs to ensure that these measures can provide reasonable assurance of the integrity and reliability of the information, assuming that the Applicant's QA measures are equivalent in substance to the criteria of Appendix B to 10 C.F.R. Part 50. SER at 17-1. Because conformance with the QA measures described in

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[10] Contractors identified with respect to the QA review included CH2M HILL, Parsons Energy & Chemicals Group, Testing Services Corporation, Geomatrix, GRL Engineers, Inc., Stratigraphics, and the University of Texas.

Section 17.1.1 of RS-002, Attachment 2, provides reasonable assurance that an applicant used adequate QA measures to support its ESP application, the Staff focused its review on whether the Applicant's QA measures adequately addressed that guidance for each applicable element. SER at 17-1. The Staff performed much of its evaluation in an inspection conducted in January 2004 and documented in a February 2004 Inspection Report. SER at 17-1, 17-2.

The Staff reviewed 18 elements associated with QA measures, and found that each element was either acceptably implemented with respect to ESP application activities, or was not required based on the scope of work for the ESP project. SER 17-2 to 17-40. The elements examined by the Staff included QA organization; the quality assurance program; design control; procurement document control; instructions, procedures, and drawings; document control; control of purchased material, equipment, and services; identification and control of materials, parts, and components; control of special processes; inspection; test control; control of measuring and test equipment; handling, storage, and shipping; inspection, test, and operating status; nonconforming materials, parts, or components; corrective action; quality assurance records; and audits.[11] SER 17-2 to 17-40.

Based on its review and evaluation of the QA measures contained in the Applicant's ESP program, the Staff concluded that the Applicant's QA measures conform to the guidance in RS-002, Attachment 2, as well as to appropriate industry standards, and that the Applicant and its contractors implemented them for the ESP application activities. SER at 17-40.

h. Review by the Advisory Committee on Reactor Safeguards

The Advisory Committee on Reactor Safeguards ("ACRS") completed its review of the Application and of the Staff's draft safety evaluation report ("DSER"). SER at 18-1. The ACRS

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[11] The elements the Staff found not to be required based on the scope of work for the ESP project were identification and control of materials, parts, and components; control of special processes; inspection; inspection, test, and operating status; and nonconforming materials, parts, or components. SER at 17-21, 17-23, 17-24, 17-31, and 17-32.

ESP subcommittee began a detailed review of the application and DSER in February 2005, and the ACRS ESP subcommittee met with representatives from Exelon and the NRC Staff on September 7, 2005. SER at 18-1. The ACRS issued an interim letter report in September 2005, and also met with the Staff in March 2006 to discuss resolution of open items and the responses to ACRS comments on the major elements of the ESP review. SER at 18-1. In its final letter report dated March 24, 2006, the ACRS concurred with the Staff's conclusions and concluded that the proposed site, subject to the permit conditions recommended by the Staff, can be used for nuclear power plants or modules having a total power generation rate of 2400 to 6800 MW thermal without undue risk to public health and safety. SER at 18-1.

Based upon its review of the SER and the record of this proceeding, the Board should be satisfied that by either (1) adhering to the relevant guidance and acceptance criteria of RS-002, the SRP, and other identified regulatory guidance documents or (2) where deviations from or alternatives to that guidance proved necessary, ensuring that those deviations or alternatives were adequately justified, the Staff utilized a reasonable and logical approach to reviewing the application and reaching its conclusions. With respect to the two safety findings to be reached by the Board – (a) that the issuance of an ESP will not be inimical to the common defense and security or to the health and safety of the public; and (b) taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having characteristics that fall within the parameters for the site, can be constructed and operated without undue risk to the health and safety of the public – the Board should conclude that the Staff had a reasonable basis for its findings and, accordingly, concur with those determinations.

B. NEPA-Related Matters

1. Applicable Regulatory Guidance

The NRC standards for review of an ESP application are outlined in 10 C.F.R. § 52.18. The NRC Staff conducts its reviews of ESP applications in accordance with guidance set forth

in review standard RS-002. That review standard draws from the previously published NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*, as well as from NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants* (hereafter "ESRP"). FEIS at xxviii.

The Staff's FEIS focused on the environmental effects of construction and operation of reactors with characteristics that fall within the plant parameter envelope ("PPE") developed by Exelon and included an evaluation of alternative sites to determine whether there is an obviously superior alternative to the proposed Clinton ESP site. FEIS at 1-3. An ESP environmental report is not required to include an assessment of the benefits (for example, the need for power) (10 C.F.R. § 52.17) or a discussion of energy alternatives; these may be deferred to the CP or COL application. FEIS at 1-3. However, the Exelon environmental report did address energy alternatives; therefore, the FEIS included an assessment of energy alternatives, but did not evaluate the need for power. FEIS at 1-3.

2. Overall Environmental Review Findings

In response to items (c), (d), and (e) from the Board's August 2 Order, this section of the brief collectively addresses the environmental findings identified by the Board. In reaching its ultimate findings and recommendation concerning the ESP application, the Staff provided its conclusions on a number of determinations required by NEPA. These determinations included analysis of any unavoidable adverse environmental impacts, any irreversible and irretrievable commitments of resources, the relationship between short-term uses and long-term productivity of the human environment, and the cumulative impacts of the proposed action.

With respect to unavoidable adverse environmental impacts (NEPA section 102(2)(C)(ii)), the Staff concluded that there will be no unavoidable adverse environmental impacts associated with the granting of the ESP, with the exception of impacts associated with the limited site-preparation and preliminary construction activities (defined in

10 C.F.R. § 50.10(e)(1); *see also* FEIS at 10-4) and identified in the site redress plan (as provided by 10 C.F.R. § 52.17(c) and 10 C.F.R. § 52.25). FEIS at 10-4. The Staff further found reasonable assurance that redress carried out under the Applicant's plan will achieve an environmentally stable and aesthetically acceptable site suitable for whatever non-nuclear use may conform with local zoning laws; therefore, it concluded that the potential site preparation and preliminary construction activities described in Exelon's site redress plan would not result in any significant adverse impacts that could not be redressed. FEIS at 10-5.

The Staff found that although impacts associated with the site preparation and preliminary construction activities are bounded by the construction activities, there are unavoidable adverse environmental impacts associated with the construction and operation of a new nuclear unit at the Clinton ESP site. FEIS at 10-4. Therefore, although final assessment of adverse environmental impacts from construction and operation at the Clinton ESP site would be performed at the CP or COL stage for issues that were not resolved in the ESP review,[12] the Staff summarized the impacts described in Chapters 4 and 5 of its ESP FEIS analysis. FEIS at 10-5 to 10-7.

With respect to construction activities, such unavoidable impacts were primarily related to land use (involving ground disturbance for permanent facilities and removal of some forested habitat), but also included some potential socioeconomic impacts resulting from increased traffic. FEIS at 10-5 to 10-6. The Staff reiterated from its earlier analysis the ways in which most impacts would be mitigated, such as actions to reduce equipment emissions and fugitive dust. FEIS at 10-5 to 10-6, Tbl. 10-1.

Likewise, with respect to operations, the Staff reiterated that unavoidable impacts would be small, and it summarized mitigation activities, such as State regulation of water use and

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[12] *See* FEIS at tables in chapters 4, 5, 9, and 10.

water quality to mitigate cooling system impacts, and the use of tax revenues and local land management plans to mitigate increased growth and use of public services. FEIS at 10-6, 10-7, Tbl. 10-2.

With respect to irreversible and irretrievable commitments of resources (NEPA section 102(2)(C)(v)), the Staff found that the only such commitments would be resources used by Exelon for site-preparation activities, and that such resources not used during the ESP stage would be used at the CP or COL stage or could be used for other activities even if Exelon does not eventually seek a CP or a COL for the ESP location. FEIS at 10-8. The Staff noted, however, that irretrievable commitments of resources during construction generally would be similar to those of any major construction project and would depend on the specific design. The Staff also determined that the materials required for construction and uranium required for operations would be of small consequence with respect to the availability of such resources. FEIS at 10-8.

With respect to the relationship between short-term uses and long-term productivity of the human environment (NEPA section 102(2)(C)(iv)), the Staff found that the only short-term use of the environment that could occur if the proposed action is implemented would be site preparation activities authorized in an ESP, and any such activities are unlikely to adversely affect the long-term productivity of the environment. FEIS at 10-8. The assessment of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity would be performed at the CP or COL stage. FEIS at 10-8, 10-9.

With respect to cumulative impacts, the Staff repeated its conclusions from FEIS Chapter 7 that potential cumulative impacts were determined to be small. FEIS at 10-9. The Staff noted that some impact issues had the potential for MODERATE adverse impacts, most of

which would occur under temporary circumstances or as the result of a larger-than-expected concentration of construction workers settling near the Clinton ESP site. FEIS at 10-9.

In light of its findings and conclusions, the Staff's recommendation to the Commission related to the environmental impacts of the proposed action was that the ESP should be issued.[13] FEIS at 10-9 to 10-11. As summarized below, these Staff conclusions and recommendations flowed from the analyses documented in each chapter of the FEIS.

a. Introduction and Background

On November 25, 2003, the NRC Staff published a notice in the *Federal Register* (68 FR 66130) stating its intent to prepare an EIS, conduct scoping, and publish a draft EIS ("DEIS") for public comment as required by 10 C.F.R. § 51.26. FEIS at 1-1. A public scoping meeting was held on December 18, 2003, to obtain public input on the scope of the environmental review. FEIS at 1-5. The U.S. Environmental Protection Agency issued a notice on March 11, 2005 (70 FR 12211) announcing the availability of the DEIS, and a public meeting was held on April 19, 2005, to receive comments on the DEIS. FEIS at 1-5. The Staff considered these comments while developing its FEIS. FEIS at 1-5, App. E.

Following requirements set forth in 10 C.F.R. Part 51 and the guidance in RS-002, the NRC environmental staff (and its technical experts from the Pacific Northwest National Laboratory retained to assist the Staff) visited the Clinton ESP site and alternative sites in March 2004 to gather information and to become familiar with the sites and their environs. FEIS at 1-5. During these site visits, the Staff and its contractor personnel met with the Applicant's staff, public officials, and the public. FEIS at 1-5. To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC established a

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[13] As noted in the discussion of FEIS chapter 4, *infra*, the Staff recommended that the permit be issued with a permit condition related to compliance with the Federal Water Pollution Control Act ("FWPCA"), Section 401, certification process managed by the Illinois Environmental Protection Agency ("IEPA"). FEIS at 4-8, 10-9.

standard for quantifying environmental impacts using the Council on Environmental Quality guidance (40 C.F.R. § 1508.27). FEIS at 1-6. Using this approach, the NRC established three significance levels -- SMALL, MODERATE, or LARGE[14] – that the Staff applied to its findings throughout the FEIS. FEIS at 1-6.

In conducting its review, the Staff evaluated environmental impacts based on the bounding parameter values Exelon submitted as part of its application; as discussed above with respect to the safety review, these values constitute the PPE for the Clinton ESP site and represent the "footprint" for a future facility. A list of these values is reproduced in Appendix J to the FEIS. In any COL or CP application referencing a Clinton ESP, the Staff would review the actual design selected to determine whether the design fits within these bounding parameter values.

b. FEIS Chapter 2, "Affected Environment"

The proposed ESP site is located in DeWitt County, Illinois, within the existing boundaries of the current Clinton Power Station (CPS). FEIS at 2-1. The CPS property is owned by AmerGen Energy Company, LLC (AmerGen), and the site is located on the shore of Clinton Lake approximately 10 km (6 mi) east of the City of Clinton (which is located more than 10 km (6 mi) west of the site, with a population of 7485). FEIS at 2-1, 2-6.

The ESP site is located in rural DeWitt County (approximate population in 2000 of 17,000), and is located between Bloomington and Decatur, which are 35 km (22 mi) to the north and 35 km (22 mi) to the south, respectively. FEIS at 2-1. In addition, the site is located

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[14] The NRC Staff's definitions of these significance levels are as follows:
SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

between Lincoln and Champaign-Urbana, 45 km (28 mi) to the west and 48 km (30 mi) to the east, respectively. FEIS at 2-1. The ESP site vicinity is 84 percent agricultural land (24,622 ha [60,842 ac]); industrial land use within the vicinity is less than 1 percent and is limited to areas near Clinton and Weldon (located more than 8 km (5 mi) southeast of the site, with a population of 440). FEIS at 2-6. Illinois State Route (SR) 54 passes approximately 1.6 km (1 mi) north of the ESP site; Illinois SR 10 passes approximately 5 km (3 mi) south; and Illinois SR 48 is approximately 8 km (5 mi) east of the ESP site (see Figure 2-3). FEIS at 2-1. There is one active railroad line within the vicinity: the Canadian National Railroad runs parallel to Illinois SR 54 and traverses the vicinity approximately 1.6 km (1 mi) north of the site. FEIS at 2-1. There are three active private airports nearby: the Martin Airport, approximately 6 km (4 mi) south of the site; the Thorp Airport, approximately 8 km (5 mi) northwest of the site; and the Baker Strip, approximately 8 km (5 mi) southeast of the site. FEIS at 2-1.

The ESP site is situated on Clinton Lake, which was formed by the construction of an earthen dam across Salt Creek, 366 m (1200 ft) downstream from the confluence of Salt Creek with the North Fork of Salt Creek. FEIS at 2-1. The ESP site is approximately 5 km (3 mi) northeast of the dam, located on a peninsula between the two arms of the lake, at an approximate grade elevation of 224 m (736 ft). FEIS at 2-1. The normal lake pool elevation is 210 m (690 ft), with a surface area of 1981 ha (4895 ac). FEIS at 2-1. The station occupies approximately 187 ha (461 ac) of land, and all site land, subsurface lands, and mineral rights are owned by AmerGen, an Exelon subsidiary, with whom agreements are in place to ensure that Exelon has the necessary authority, control, and rights related to the proposed ESP site. FEIS at 2-1, 2-5.

The Clinton ESP site has a typical continental climate with moderately cold winters and warm summers. FEIS at 2-14. The site is relatively flat, with no topographic features that would cause the local climate to deviate significantly from the regional climate. FEIS at 2-14.

With respect to atmospheric stability, temperature difference measurements made on the CPS meteorological tower indicate that unstable atmospheric conditions exist at the site approximately 18 percent of the time, and stable conditions exist about 44 percent of the time (Exelon 2006a). During the remaining 38 percent of the time, the atmospheric stability is neutral, and atmospheric dispersion is moderate. FEIS at 2-15.

The Staff viewed the meteorological site and instrumentation, reviewed the available information on the meteorological measurement program, and evaluated data collected by the program (which has existed at the Clinton ESP site since April 1972). FEIS at 2-18, 2-19. Based on this information, the Staff concluded that the program provides data that represent the onsite meteorological conditions as required by 10 C.F.R. § 100.20. FEIS at 2-18, 2-19. The Staff found that the data also provide an acceptable basis for making estimates of atmospheric dispersion for the evaluation of the consequences of routine and accidental releases required by 10 C.F.R. § 50.34 and 10 C.F.R. Part 50, Appendix I. FEIS at 2-18, 2-19.

With respect to the radiological environment, the Staff reviewed annual radioactive effluent release reports for calendar years 1999, 2000, and 2001, and found that doses to the maximally exposed individuals around CPS were a small fraction of the limits specified in Federal environmental radiation standards, 10 C.F.R. Part 20; 10 C.F.R. Part 50, Appendix I; and 40 C.F.R. Part 190. FEIS at 2-20.

c. FEIS Chapter 3, "Site Layout and Plant Parameter Envelope"

In Chapter 3 of the FEIS, the Staff reviewed the Application's description of the site layout and provided the Staff's characterization of the plant parameter envelope. A list of the applicable PPE parameters and values is reproduced in Appendix J to the FEIS.

The Staff noted that because PPE values were to be used as a surrogate for design-specific values,[15] the Staff expected Exelon to provide sufficient information for the Staff to develop a reasonable independent assessment of potential impacts to specific environmental resources. FEIS at 3-5. In some cases, the Staff found that the design-specific information called for in the ESRP was not provided in the Clinton ESP application because it did not exist or was not available; as a result, the NRC Staff could not fully apply the ESRP guidance in those review areas. FEIS at 3-5. In accordance with RS-002, in those cases, the Staff used its experience and judgment to adapt the review guidance in the ESRP and to develop assumptions necessary to evaluate impacts to certain environmental resources to account for missing information. FEIS at 3-5. The Staff identified these assumptions in the appropriate sections of the FEIS, as well as in Appendix K. FEIS at 3-5, Appx K.

The Staff noted that, pursuant to RS-002, it did not review the PPE values for correctness. However, the Staff determined that Exelon's application was sufficient to enable the Staff to conduct its required environmental review and that the PPE values are not unreasonable for consideration by the Staff when making its finding on the application in accordance with 10 C.F.R. § 52.18. FEIS at 3-5. During its environmental review, the Staff used its judgment to determine whether Exelon provided sufficient information for the Staff to perform its independent assessment of the environmental impacts of construction and operation of a new nuclear unit or units. FEIS at 3-5. The Staff considered the PPE values to be bounding parameters. FEIS at 3-5. Therefore, for environmental issues that could be

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[15] Exelon used 7 reactor designs to develop the PPE, including five light water reactors (LWRs) and two gas-cooled reactors. The 5 LWRs were the Advanced Canada Deuterium Uranium Reactor (ACR-700); the Advanced Boiling Water Reactor (ABWR), an earlier version of the Advanced Pressurized Water Reactor approved by the NRC (AP1000); the Economic Simplified Boiling Water Reactor (ESBWR); and the International Reactor Innovative and Secure (IRIS) next-generation pressurized water reactor (PWR). The two gas-cooled reactor designs used were the Gas Turbine Modular Helium Reactor (GT-MHR) and the Pebble Bed Modular Reactor (PBMR). FEIS at 3-2 to 3-4.

resolved, the Staff's evaluation serves as a bounding estimate of the potential environmental impacts resulting from constructing and operating the new nuclear unit at the ESP site. FEIS at 3-5. However, the Staff reiterated that environmental impacts not considered or not bounded at the ESP stage would be assessed at the CP or COL stage. FEIS at 3-7.

d. FEIS Chapter 4, "Construction Impacts at the Proposed Site"

In Chapter 4 of the FEIS, the Staff analyzed the potential impacts of construction on land use, air quality, water, ecosystems, socioeconomics, historic and cultural resources, environmental justice, nonradiological and radiological health effects, and applicable measures and controls that would limit the adverse impacts of station construction. FEIS at 4-1. Where possible, the Staff assigned a single significance level of potential impact – SMALL, MODERATE, or LARGE – to each issue, in accordance with 10 C.F.R. Part 51. FEIS at 4-1.

Land Use: First, with respect to land use, the Staff noted that the area that would be affected on a long-term basis as a result of permanent facilities is approximately 39 ha (96 ac). The Staff found that because preconstruction and construction activities would be accomplished using best construction practices and would follow all applicable laws and regulations, because no new or modified highways or railroad lines are planned to support a new nuclear unit, and because offsite land-use changes as a result of construction activities are expected to be minimal (including little impact in terms of new housing construction), there are no land-use impacts that would render the site unsuitable for a new nuclear unit. The Staff concluded that the environmental impact resulting from land use would be SMALL. FEIS at 4-3 to 4-4.

Similarly, because the likely pathway of any new transmission lines required to deliver power from a new unit at the ESP site almost exclusively would cross land currently in seasonal agricultural production, and because the principal impacts from construction activities would be minimal and mostly temporary and would alter the land use on a relatively minimal amount of land, the Staff concluded that construction-related impacts on land use in the transmission line

rights-of-way that require upgrading and offsite areas would be SMALL, regardless of whether the existing rights-of-way are doubled or new rights-of-way are used. FEIS at 4-5.

Air Quality: With respect to meteorological and air quality impacts, the Staff noted that construction activities take place for a limited duration and can be controlled using standard measures (like wetting for fugitive dust and obtaining relevant State permits), so that impacts would be temporary and limited in magnitude. FEIS at 4-5. The Staff found that increased automobile traffic (and associated exhaust) was unlikely to have noticeable effects on air quality beyond the immediate vicinity of local highways, particularly given that air quality in DeWitt County and the surrounding counties is in compliance with all standards. FEIS at 4-6.

Water: Concerning water-related impacts, the Staff determined that impacts from hydrologic alterations due to construction activities would be localized and temporary, and that the Illinois Environmental Protection Agency ("IEPA") FWPCA Section 401 and U.S. Army Corps of Engineers ("ACE") Clean Water Act Section 404 permit processes would be adequate to ensure that impacts of hydrologic alterations are SMALL.[16] FEIS at 4-6 to 4-8. The Staff found that water-use requirements and water quality impacts from ESP construction activities would be similar to other large industrial construction projects and thus would be SMALL, localized, and temporary.[17] FEIS at 4-9.

Ecology: With respect to impacts on ecological resources, the Staff evaluated terrestrial impacts, aquatic impacts, and impacts to threatened and endangered species. FEIS at 4-9.

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[16] As a result of Exelon's discussions with IEPA concerning FWPCA Section 401, Exelon proposed a permit condition under which the ESP holder could not conduct permit activities without first submitting to the NRC either a 401 certification issued by the IEPA or its determination that no 401 certification is required; the condition would also entail annual advisory letters to the IEPA (and copies to the NRC) identifying permit-related activities and stating whether those activities would require 401 certification. FEIS at 4-8. The Staff stated that if the IEPA found the proposed condition to be an appropriate approach to FWPCA compliance, the Staff would recommend including the condition in any ESP issued. FEIS at 4-8, 10-9.

[17] As noted in Appendix K to the FEIS, the Applicant does not intend to implement a permanent groundwater dewatering system. FEIS at K-14, K-18, K-27.

For terrestrial impacts, the Staff found that the impacts of construction (including land-clearing, construction noise, fugitive dust, equipment emissions, avian collisions with structures, and traffic mortality) on wildlife, including State-listed species, and on wildlife habitat, including loss of forest, would be minimal, and that no construction impacts to wetlands onsite are anticipated. FEIS at 4-16. It concluded that impacts on wildlife habitat and wildlife populations associated with the transmission system could be SMALL if additional transmission capacity were to be accommodated within the existing right-of-way, and SMALL if the existing right-of-way required expansion, but could range from SMALL to LARGE if new rights-of-way were to be required. FEIS at 4-16. Therefore, the Staff considered the issue unresolved. FEIS at 4-16.

With respect to impacts on aquatic ecological resources, the Staff found that best management practices to minimize sedimentation (and timing construction activities to minimize impacts on fish during critical spawning or rearing periods) would mitigate potential aquatic impacts, which would mainly be associated with construction of a new cooling water intake structure. FEIS at 4-16. The Staff found that adverse impacts were not anticipated for either of two State-listed mussel species potentially found in DeWitt County, and it stated that no impacts to any other State-listed aquatic animal or plant species is anticipated because none is known to occur in the vicinity of the ESP site. FEIS at 4-17. Exelon has committed to contact the Illinois Department of Natural Resources before commencement of construction activities to ensure that these assumptions remain valid. FEIS at 4-17. The Staff thus concluded that impacts to aquatic species and habitat from construction of a new nuclear unit at the Clinton ESP site are expected to be SMALL. FEIS at 4-17.

Furthermore, the Staff found that construction impacts to Federally listed terrestrial animal species, the bald eagle and Indiana bat, are expected to be negligible; that no Federally listed aquatic species are known to occur; and that there would be no construction impacts to other Federally listed or proposed terrestrial or aquatic plant and animal species or to

designated or proposed critical habitat. FEIS at 4-20. Therefore, the Staff determined that construction impacts on Federally listed or proposed threatened or endangered aquatic or terrestrial species would be SMALL, predicated on certain Staff assumptions, including the current occurrence of Federally listed threatened and endangered species and critical status of such species, and the current designation of critical habitat. FEIS at 4-20.

Socioeconomics: With respect to socioeconomic impacts, the Staff assessed physical impacts, demographics, and impacts to the community. The Staff found that physical impacts to workers and the local public would be SMALL because of dust and noise control measures and regulations, the relative isolation of the ESP site from neighboring residences and other sensitive receptors, and timing restrictions on particularly noisy activities. FEIS at 4-21, 4-22. The Staff found no impacts to offsite buildings, although it found that construction impacts on roads would be SMALL to MODERATE, depending on hauling weights. FEIS at 4-23. The Staff also found only SMALL aesthetic impacts, as most such impacts would be temporary or mitigated by the Applicant's measures to restrict construction laydown and timely remove construction debris from the site. FEIS at 4-24.

The Staff concluded that demographic impacts of construction would be SMALL, based on the expectation that most of the 3150 construction workers Exelon anticipates employing to build a new unit will come from within the region; even if a larger than expected percentage choose to relocate from outside the region, this number represents a small percentage of the larger population base. FEIS at 4-24, 4-25.

Concerning community impacts, the Staff determined that the magnitude of the positive economic impacts of construction would be diffused in the larger economic bases of Macon, McLean, and Champaign Counties, such that impacts on the economy of the region would be beneficial and SMALL everywhere in the region except in DeWitt County, where the impacts could be beneficially MODERATE. FEIS at 4-27. Similarly, the Staff concluded that the

potential beneficial impacts of taxes collected during construction would be SMALL and beneficial, except in DeWitt County where they would be MODERATE and beneficial. FEIS at 4-29.

The Staff found only SMALL impacts on transportation because of Exelon's traffic control measures and because the roads are currently lightly traveled and, except at shift changes, would not be overly congested by increased construction traffic. FEIS at 4-31. The Staff determined recreational and aesthetic impacts to be SMALL as well, given the distance of recreational access points to the plant site, and Exelon's commitment to mitigation activities during construction. FEIS at 4-31, 4-32. The Staff found that impacts on housing would be SMALL, if all the workers generally come from within the region and chose not to locate closer to work in DeWitt, Piatt, or Logan counties, but could also be MODERATE in those counties, if the assumption that all the workers would come from within the region proves invalid, or if a number of construction workers decide to relocate to be closer to work. FEIS at 4-33.

In terms of construction impacts on public services, the Staff found that public water supply and waste water treatment are not a constraint to growth in the vicinity and region of the ESP site, assuming that growth increases hold to the historical norm, and that, because the construction workforce is expected to come predominantly from within the region, the demand for police, fire, and medical services would impact established entities, which could provide adequate services. FEIS at 4-35. The Staff further determined that construction would have a beneficial economic impact to the economically disadvantaged population, lessening the demand for social services, and that a possible initial increase in demand for social services at the beginning of the construction period would be considered manageable. FEIS at 4-35. The Staff also found that impacts on education would be SMALL, based on the expectation that, as the majority of the construction workers would be expected to come from the region, and most

of those from outside would likely commute, there would be minimal impact of additional children being placed in the educational systems within the region. FEIS at 4-35, 4-36.

Historic and Cultural Resources: After its evaluation pursuant to NEPA and the National Historic Preservation Act of 1966, as amended through 2000 (NHPA), the Staff concluded that the potential construction impacts on historic and cultural resources would be SMALL, but that mitigation might be warranted in the event of an inadvertent discovery. FEIS at 4-36, 4-37. This conclusion was based on (1) the pre-construction and construction measures that Exelon would take to avoid adverse impacts to significant cultural resources, including methods such as tilling, surveying, and shovel testing, as well as consultation by the Applicant with the Illinois Historic Preservation Agency and (2) the Staff's cultural resource analysis and consultation, including with State and Native American tribal officials and via public scoping. FEIS at 4-37, 2-66 to 2-70.

Environmental Justice: Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations; on August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions. FEIS at 4-38; *see* 69 Fed. Reg. 52040. Based on the Applicant's identification of the locations of minority and low-income populations within an 80-km (50-mi) radius of the Clinton ESP site, and on the Staff's analysis, including interviews during its site audit, the Staff found neither unusual resource dependencies or practices through which these minority and low-income populations could be disproportionately impacted by construction of a new nuclear unit and that would result in those populations being adversely affected, nor any location-dependent disproportionately high and adverse impacts. FEIS at 4-38.

Nonradiological Health Impacts: Based on the mitigation measures identified by Exelon in its ER (related to dust, smoke, engine exhaust, and concrete operations), the permits and authorizations required by State and local agencies, the distance from the construction site to the public, and the Staff's independent review, the Staff concluded that the nonradiological health impacts to the public from construction activities would be SMALL. FEIS at 4-39. Likewise, based on similar factors; on NRC and OSHA safety standards, practices, and procedures; on the use of training and protective equipment; and on the fact that historically, injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates, the Staff concluded that the nonradiological health impacts to workers from construction activities would be SMALL. FEIS at 4-39, 4-40. Furthermore, with respect to noise, in light of the temporary nature of construction activities, Exelon's noise mitigation plans, and the distance from the Clinton ESP site to residences and public buildings, the Staff concluded that the noise impacts from construction would be SMALL. FEIS at 4-40, 4-41.

Radiological Health Impacts: After reviewing Exelon's estimate of dose to site preparation workers during construction activities (from direct radiation as well as from gaseous and liquid effluents), the Staff found the doses to be well within NRC exposure limits designed to protect the public health, even if workers exceeded the 2080 hr/yr occupancy factor. FEIS at 4-44. (The Applicant's evaluation included an annual dose estimate for the site preparation workers of approximately 0.25 mSv (25 mrem), less than the 1 mSv (100 mrem) annual dose limit to an individual member of the public found in 10 C.F.R. § 20.1301.) Therefore, assuming the location of the proposed new nuclear unit does not change, the Staff concluded that the impacts of radiological exposures to site preparation workers would be SMALL. FEIS at 4-44.

Measures and Controls: The Staff identified a variety of measures and controls to limit adverse impacts during site-preparation activities, including the Applicant's compliance with state, federal, and local laws and regulations, as well as with applicable permits and licenses;

compliance with the Applicant's own processes and procedures; incorporation of environmental requirements into construction contracts; and continued identification of environmental resources and potential impacts during the development of the ER and the ESP process. FEIS at 4-45.

e. FEIS Chapter 5, "Operation Impacts at the Proposed Site"

In Chapter 5 of the FEIS, the Staff analyzed the potential impacts of operation on land use, air quality, water, ecosystems, socioeconomics, historic and cultural resources, and environmental justice, as well as nonradiological and radiological health effects and the environmental impacts of postulated accidents. Where possible, the Staff assigned a single significance level of potential impact – SMALL, MODERATE, or LARGE – to each issue, in accordance with 10 C.F.R. Part 51. FEIS at 5-1.

Land Use: The Staff concluded that impacts to land use in the vicinity of the ESP unit due to operations, including potential minor land cover alterations (depending on the need for new housing for workers) and the impact of salt drift (found in NUREG-1437, the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* ("GEIS") to be of only minor significance) would be SMALL. FEIS at 5-1, 5-2. Similarly, the Staff found that, in the event that upgraded transmission lines are constructed in the existing transmission line rights-of-way, only SMALL impacts to land use would occur as a result of normal transmission maintenance activities such as right-of-way vegetation clearing, line maintenance, and other normal access needs. FEIS at 5-3.

Air Quality: In evaluating meteorological and air quality impacts, the Staff reviewed impacts from cooling towers as well as from transmission lines. Based on the lack of major air pollution sources near the Clinton ESP site, and the assumption that the impacts (such as salt drift and deposition) of cooling towers associated with a new nuclear unit would be similar to

those of cooling towers at existing nuclear facilities, the Staff concluded that cooling tower impacts on air quality would be SMALL. FEIS at 5-3, 5-4.

Likewise, because at a new nuclear unit additional standby diesel generators and auxiliary power systems for emergency power and auxiliary steam purposes would be used on an infrequent basis, because pollutants discharged (e.g., particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides) would be in accordance with State and Federal regulatory requirements, and because there would be no significant industrial activities within 16 km (10 mi) of the Clinton ESP site, the Staff concluded that the environmental impact of pollutants from these sources would be SMALL. FEIS at 5-4. The Staff also estimated that uranium fuel cycle carbon dioxide emissions for the postulated plant would be less than 0.8 million metric tons (0.9 million tons). FEIS at 5-4. Finally, because the largest lines currently used by the transmission system to which the new unit would connect are well within the range of lines considered in the GEIS, the Staff concluded that the potential operational impacts of transmission lines on air quality are SMALL. FEIS at 5-5.

Water: With respect to water-use impacts, the Staff found that the frequency and duration of low water conditions would increase if the ESP unit were constructed, both directly because of the consumptive use of water and indirectly because reducing the lake volume would increase the induced evaporation in Clinton Lake. FEIS at 5-6. The Staff noted that impacts could be minor during periods with average or above average precipitation. FEIS at 5-8. Therefore, the Staff concluded that during normal water years, the water use impacts would be SMALL, but during years of below-average precipitation, impacts could be MODERATE until normal water conditions return.[18] FEIS at 5-8. The Staff noted that in such

[18] As noted in Appendix K to the FEIS, the Applicant does not intend to use groundwater as a water source or implement a permanent groundwater dewatering system. FEIS at K-14, K-18, K-27.

cases, Exelon would need to coordinate with IEPA on appropriate measures, such as derating or even temporary shutdown of the unit. FEIS at 5-8.

With respect to water quality impacts, the Staff concluded that because Exelon has committed to keeping the combined discharge of the CPS and ESP unit effluent within the bounds of the CPS's existing NPDES permit, which IEPA has determined provides adequate protection to the environment, impacts of a new nuclear unit on lake water quality would be SMALL.[19] FEIS at 5-9.

Ecology: With respect to impacts on ecological resources, the Staff evaluated terrestrial impacts, aquatic impacts, and impacts to threatened and endangered species. FEIS at 5-9. For terrestrial impacts, the Staff found that based on the prior GEIS analysis (finding salt drift to have insignificant impacts at existing plants with cooling towers), a lack of important terrestrial plant species and habitats, as well as extensive agricultural land use onsite and in the immediate vicinity of the ESP site, the Staff concluded that the potential impacts on crops, ornamental vegetation, and native plants from addition of one or more cooling towers for a new nuclear unit at the Clinton ESP site would be minimal. FEIS at 5-10. The Staff also relied on the GEIS analysis in concluding that the impacts of bird collisions with cooling towers would be negligible. FEIS at 5-10, 5-11. The Staff found that noise from operating cooling towers would not be likely to disturb wildlife beyond the ESP site and that, based on water budget analyses, changes in shoreline vegetation and wildlife use due to the addition of a new nuclear unit would be negligible. FEIS at 5-11, 5-12. Concerning transmission line impacts, the Staff concluded, based on analyses in the GEIS, that impacts from right-of-way maintenance (including on floodplains and wetlands), bird collisions, and electromagnetic fields ("EMFs") would be of small significance. FEIS at 5-12 to 5-14.

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[19] See previous footnote.

For aquatic impacts, the Staff found that impacts on aquatic ecosystems from operation of the intake system would likely be SMALL during normal water years, provided the velocity through the intake screens is less than 0.5 ft/sec and the Applicant uses a closed cycle or a hybrid cooling system. FEIS at 5-23. Because the intake structure design and permit requirements that would be set by the IEPA are presently unknown, the Staff found that cooling water intake system impacts could be MODERATE if best available technology is not utilized at the CPS and localized reduction or "cropping" of fish occurs beyond what natural spawning or "recruitment" can replace, as a result of joint operation of the CPS and ESP units. FEIS at 5-23, 5-24. The Staff also concluded that during normal water years, operational impacts of the plant cooling water system other than impingement and entrainment would be SMALL, but that during low water years, the impact to the water level (and thus to the water temperature and available habitat) could be MODERATE until normal water conditions and lake level return. FEIS at 5-24. The Staff determined that an applicant for a CP or COL referencing any ESP that may be issued for the Clinton ESP site would need to provide additional information on the intake structure design and expected NPDES permit requirements regarding impingement, entrainment, and thermal effects on aquatic organisms in order for the Staff to make a significance determination with respect to this resource. FEIS at 5-24. Therefore, the Staff concluded that the aquatic ecology issues associated with operation of a proposed ESP unit are unresolved. FEIS at 5-24.

The Staff found that there would be no operational impacts to Federally listed or proposed terrestrial or aquatic plant species and no operational impacts to Federally listed or proposed aquatic animal species, and that operational impacts to Federally listed terrestrial animal species, the bald eagle and Indiana bat, are expected to be negligible given the expected insignificant impacts from transmission line right-of-way maintenance and from bird collisions with cooling towers and transmission lines. FEIS at 5-25, 5-26. The Staff also

determined that there would be no operational impacts to designated or proposed critical habitat for Federally listed or proposed terrestrial or aquatic animal species. FEIS at 5-26. Therefore, the Staff concluded that the impacts of operation on Federally listed or proposed threatened or endangered aquatic or terrestrial species would be SMALL, predicated on certain Staff assumptions, including the current occurrence of Federally listed threatened and endangered species and critical habitat in the project area, and the current designation of critical habitat. FEIS at 5-26.

Socioeconomics: With respect to socioeconomic impacts, the Staff assessed physical impacts, demographics, and impacts to the community. In terms of physical impacts, the Staff found that offsite noise impacts likely would be minor because of noise control devices on vehicles, the adherence to applicable State and Federal criteria, the distance of nearby residences to the site, and the fact that operations activities entailing significant noise would be limited to normal weekday business hours. FEIS at 5-29. The Staff also noted Exelon's stated intention to adhere to applicable air-pollution control regulations as they relate to the operation of fuel-burning equipment, and the fact that central Illinois is not classified as in violation of applicable air-pollution standards. FEIS at 5-29. Therefore, the Staff concluded that the physical impacts of station operation on the workers and the local public would be SMALL. FEIS at 5-29.

The Staff found no significant physical impacts of station operation on offsite buildings or on nearby roads (particularly compared to road loads during construction). FEIS at 5-29, 5-30. The Staff determined that a new nuclear unit at the Clinton ESP site would have visual impacts similar to those of the existing CPS and that, because the area is sparsely populated, the facility would have a small impact on aesthetic quality for nearby residences and on recreational users of Clinton Lake. FEIS at 5-31. The Staff found that the aesthetic impacts could also be MODERATE due to the consumptive use of water for cooling and impacts on

Clinton Lake during times of severe drought; however, the Staff stated that mitigation would not be generally warranted due to the temporary nature of this impact. FEIS at 5-31.

The Staff determined that the expected number of new employees and their families - approximately 580 additional permanent employees, translating into an estimated increase in population of about 2320 (assuming each new employee represents a family of four) – would represent a very small increase to the relevant counties' total population, even if the new workers were to come from outside the region or if new area jobs emerged as part of a "multiplier effect." FEIS at 5-31, 5-32. Therefore, the Staff concluded that the demographic impacts of station operation would be SMALL. FEIS at 5-32.

The Staff found that the magnitude of the economic impacts (taking into account possible multiplier effects) would be diffused in the larger economic bases of Macon, McLean, and Champaign Counties, and that DeWitt County as the site county consequently would benefit more than Piatt and Logan Counties. FEIS at 5-33. The Staff concluded that the impacts of station operation on the economy would be beneficial and SMALL everywhere in the region except DeWitt County, where the impacts could be MODERATE. FEIS at 5-33. Likewise, the Staff evaluated the effect of income, sales, use, and property taxes of additional Exelon employees, as well as taxes on Exelon's corporate profits, finding that tax paid by Exelon would directly benefit DeWitt County (and other jurisdictions that would receive property tax from the proposed nuclear unit), as would property taxes from employees living in the county. FEIS at 5-35. The Staff found that sales and use taxes could beneficially impact DeWitt County and the City of Clinton, due to its proximity to a new nuclear unit, while personal and corporate income taxes would be paid to the State of Illinois. FEIS at 5-33 to 5-35. The Staff concluded that, although the amount of taxes collected over the potential lifetime of the project could be large in absolute amounts, it is small when compared to the total amount of taxes Illinois collects in any given year or would collect over the 60-year life of operation of a

new facility, and thus the overall beneficial impacts would likely range from SMALL in most areas of the region to LARGE in DeWitt County. FEIS at 5-35, 5-36.

In terms of community impacts, the Staff found that as the rural roads are well maintained and lightly traveled, and congestion is expected only at shift changes, impacts of station operation on the transportation system would be SMALL. FEIS at 5-36. The Staff also found that impacts on recreation would be SMALL to MODERATE, depending on whether a larger-than-expected proportion of the workforce would relocate from outside the region and increase recreational use of Clinton Lake, and on whether severe drought conditions in conjunction with the consumptive use of water for cooling at both the CPS and a new nuclear unit could impact lake pool elevations and temperature (which could be mitigated by plant operations). FEIS at 5-37, 5-38.

The Staff concluded that potential impacts on housing would be SMALL in the region and potentially MODERATE in DeWitt, Piatt, and Logan Counties, depending on whether the operations workforce comes from outside the region and/or locates in DeWitt, Piatt, or Logan counties to be nearer the work site. FEIS at 5-39.

In terms of impacts of operation on public services, the Staff found that public water supply and waste water treatment have excess capacity to accommodate potential population increases, and that the projected capacity of police, fire, and medical services is currently adequate and is expected to expand modestly to meet the demands of a slight population growth. FEIS at 5-41. The Staff further determined that increases in tax revenue could help with the infrastructure and resource requirements for any potential increase in demand for services, and that operations would have a beneficial economic impact to the economically disadvantaged population by lessening the demand for social services. FEIS at 5-41. The Staff also found that impacts on education would be SMALL, noting that even if a higher than expected proportion of new employees relocate to Clinton and DeWitt County to be closer to

the site, the local school district appears to have the capacity to accommodate an associated increase in the student population and, if not, increased tax revenues could be used to expand school infrastructure. FEIS at 5-42.

Historic and Cultural Resources: The Staff stated that it did not expect any significant impacts on cultural and historic resources during ESP unit operation (most would have been identified as part of construction), and it noted that any new ground-disturbing activities that might occur during operation would follow Exelon procedures, which would require further evaluation to determine if additional archaeological review is necessary. FEIS at 5-43. The Staff concluded that the impacts from operations would be SMALL, although mitigation might be warranted in the event of an inadvertent discovery. FEIS at 5-43.

Environmental Justice: As discussed with respect to construction, the Staff did not find any disproportionately high or adverse health or environmental effects from operation of a new nuclear unit at the ESP site that would impact minority or low-income populations, and it thus concluded that impacts related to environmental justice considerations would be SMALL. FEIS at 5-43.

Nonradiological Health Impacts: The Staff determined that the small temperature increase in Clinton Lake expected as a result of operating the new nuclear unit would not significantly increase the abundance of thermophilic microorganisms, making any associated human health effects SMALL. FEIS at 5-44. Also, in light of the postulated noise levels for cooling towers, the distance from plant facilities to the site boundary, and the evaluation of noise impacts reflected in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*, NUREG-0586 ("Decommissioning GEIS"), the Staff concluded that the noise impacts to the public from operation would be SMALL. FEIS at 5-44, 5-45. Based on Exelon's assertion that the transmission lines that would connect new units to the grid would be constructed to NESC

and other industry standards, the Staff concluded that impacts associated with acute effects of EMFs would be SMALL, but it determined (with reference to NUREG-1437, the GEIS for License Renewal) that the issue of chronic EMF effects is not resolved because conclusive information is not available. FEIS at 5-46. The Staff noted that health impacts to workers from noise and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations and would be SMALL, and that worker health risks are expected to be dominated by occupational injuries, for which nuclear industry rates are, historically, lower than the average U.S. industrial rates. FEIS at 5-47.

Radiological Effects of Normal Operation: The Staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from a new nuclear unit at the Clinton ESP site. After independently evaluating Exelon's assessment of likely exposure pathways and its use of the LADTAP II and GASPAR II modeling programs to calculate the dose to a maximally exposed individual and a collective whole body dose for the population within 80 km (50 mi) of the Clinton ESP site, and comparing the calculated doses to regulatory design objectives, the Staff concluded that there would be no observable health impacts to the public from normal operation of a new nuclear unit, and the health impacts would be SMALL. FEIS at 5-47 to 5-56. Furthermore, based on a determination that occupational exposures for the new nuclear unit would likely be bounded by occupational exposures from currently operating LWRs and that the licensee of a new plant will need to maintain individual doses to workers within 0.05 Sv (5 rem) annually as specified in 10 C.F.R. § 20.1201 and apply the ALARA process to maintain doses below this limit, the Staff concluded that the health impacts from occupational radiation exposure would be SMALL. FEIS at 5-56, 5-57.

The Staff examined the Applicant's estimated doses to surrogate biota species for both liquid and gaseous effluent pathways. FEIS at 5-57, 5-58. The Staff's independent evaluation of biota doses produced similar results. FEIS at 5-59. The Staff concluded there was sufficient

protection because the cumulative effects of the CPS and the new nuclear unit would result in dose rates significantly less than those noted in studies by the National Council on Radiation Protection and Measurements ("NCRP") and International Atomic Energy Agency ("IAEA") that found adequate protection for biota. FEIS at 5-59. Therefore, the Staff concluded that the radiological impact on biota other than members of the public from routine operation would be SMALL. FEIS at 5-59.

Finally, the Staff reviewed the documentation for Exelon's proposed radiological environmental monitoring program ("REMP"). The Staff found the proposed REMP to be adequate, noting that Exelon will provide an annual Radiological Environmental Operating Report for the entire site (including both the CPS and a new nuclear unit) to compare data with those for previous years; that the REMP would utilize the sampling locations used by the CPS to the greatest extent practical; that an inter-laboratory comparison program currently exists; that an independent laboratory will continue to verify the program results; and that Exelon will implement a quality assurance program for the REMP. FEIS at 5-59 to 5-61.

Postulated Accidents: In Section 5.10 of the FEIS, the Staff considered the radiological consequences on the human environment of potential accidents at a new nuclear units at the Clinton ESP site. In its application, Exelon evaluated the potential consequences of postulated accidents, using a set of surrogate design basis accidents ("DBAs") intended to be representative of the range of reactor designs[20] being considered for the ESP site and site-specific meteorological data. FEIS at 5-62. Exelon evaluated the potential consequences of DBAs using procedures outlined in regulatory guides and standard review plans, including TID-14844, NUREG-0800, Regulatory Guide 1.3, Regulatory Guide 1.25, and Regulatory

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[20] Exelon's review focused on two LWR designs, the ABWR and the pre-certification surrogate AP1000 design, which are expected to bound the consequence analyses for the other possible reactor designs Exelon considered. FEIS at 5-62.

Guide 1.183. FEIS at 5-63. The Staff reviewed the atmospheric dispersion characteristics (including atmospheric dispersion factors, or χ/Q) used by Exelon and found them acceptable with respect to the potential environmental consequences of postulated DBAs for reactor designs with design χ/Q values falling within the bounds set by the site χ/Q values. FEIS at 5-64. (At the CP or COL stage, the applicant would need to demonstrate that the χ/Q values used in analyzing the reactor design proposed at the CP or COL stage are equal to or greater than the site χ/Q values specified in the ESP. FEIS at 5-64.)

The Staff then independently evaluated Exelon's estimates of the environmental consequences of each DBA in terms of total effective dose equivalent ("TEDE"). FEIS at 5-66. Because in all cases, the calculated TEDE values were considerably smaller than the TEDE doses used as safety review criteria, the Staff concluded that the consequences of DBAs at the Clinton ESP site are of SMALL significance for advanced LWRs and that the Clinton ESP site is suitable for operation of new advanced LWRs. FEIS at 5-67.

With respect to severe accidents, the Staff reviewed Exelon's analysis in the ER and then requested that Exelon perform a site-specific analysis using the MACCS2 computer code, which was developed to evaluate the potential consequences of severe accidents for NUREG-1150. FEIS at 5-67. The results of that analysis were submitted by Exelon in a letter dated July 23, 2004. FEIS at 5-67. The Staff conducted a confirmatory site-specific analysis using the MACCS2 code to evaluate potential impacts for the atmospheric, surface water, and groundwater pathways. FEIS at 5-75 to 5-77. The Applicant and Staff analyses examined consequences in terms of human health, economic costs, and land contamination. FEIS at 5-68. The Staff found that the environmental risks associated with severe accidents if an advanced LWR were to be located at the Clinton ESP site would be small compared to risks associated with operation of current-generation reactors at the Clinton ESP site and other sites

(as identified in the analyses in the GEIS and its Supplements), and that these risks are well below the NRC safety goals. FEIS at 5-77. Therefore, the Staff concluded that the probability-weighted consequences of severe accidents at the Clinton ESP site are of SMALL significance for an advanced LWR and that the Clinton ESP site is suitable for operation of an advanced LWR. FEIS at 5-77.

The Staff noted that the environmental impacts of both DBAs and severe accidents of designs not evaluated in the FEIS, including gas-cooled designs, are unresolved because information is lacking; these impacts would need to be evaluated at the CP or COL stage. FEIS at 5-67, 5-77.

Measures and Controls: The Staff identified a variety of measures and controls to limit adverse impacts during operations, including the Applicant's compliance with state, federal, and local laws and regulations, as well as with applicable permits and licenses; compliance with the Applicant's own processes and procedures; and various mitigative actions with respect to factors such as noise levels, dust and exhaust, erosion and sedimentation, traffic, transmission line right-of-way maintenance, chemical discharge, and health-related monitoring. FEIS at 5-78 to 5-80.

f. FEIS Chapter 6, "Fuel Cycle, Transportation, and Decommissioning"

In Chapter 6 of the FEIS, the Staff evaluated the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) transportation of radioactive material, and (3) decommissioning for the proposed Clinton ESP site. FEIS at 6-1.

i. Uranium Fuel Cycle Impacts and Solid Waste Management

The Staff first examined the Applicant's assessment of the environmental impacts from the uranium fuel cycle and solid waste management, for both the advanced light water reactor[21] and gas-cooled reactor designs.[22]

Light-Water Reactors: In the Applicant's analysis of LWR designs, the PPE for the new unit at the Clinton ESP site uses the bounding input parameters from several LWR designs, all of which use uranium dioxide fuel. FEIS at 6-2. As a result, the Staff determined that Table S–3 found at 10 C.F.R. § 51.51(b), which states key uranium fuel cycle environmental data calculated by the NRC, can be used to assess environmental impacts. FEIS at 6-2. The Staff is confident that the contemporary fuel cycle impacts weighed in its analysis are below those identified in Table S–3. FEIS at 6-8.

Because the fuel cycle impacts in Table S–3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e), the Staff used the stated capacity factor in the Exelon PPE of 95 percent with a total net electric output of 6800 MW(t) [equivalent to 2200 MW(e)] for the ESP site (referred to by the Staff in its review as "the 1000-MW(e) LWR scaled model"), resulting in approximately three times the impact values in Table S–3. FEIS at 6-7, 6-8.

The Staff then examined the fuel cycle environmental impacts associated with three times the values in Table S-3 to assess the impacts of the proposed ESP site. The Staff determined these impacts to be SMALL for each primary impact area, including land use, water

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[21] As noted earlier, the five LWR designs Exelon considered are the Advanced Canada Deuterium Uranium Reactor ("ACR-700"); the Advanced Boiling Water Reactor ("ABWR"); the Advanced Pressurized Water Reactor ("AP1000"); the Economic Simplified Boiling Water Reactor ("ESBWR"), and the International Reactor Innovative and Secure ("IRIS") next-generation pressurized water reactor ("PWR").

[22] As noted earlier, the two gas-cooled designs Exelon considered are the Gas Turbine Modular Helium Reactor ("GT-MHR") and the Pebble Bed Modular Reactor ("PBMR").

use, fossil fuel impacts, chemical and radioactive effluents, radioactive wastes, occupational dose, and transportation. FEIS at 6-9 to 6-15.

Gas-Cooled Reactors: The Staff considered issues related to reactors based on non-LWR designs, such as gas-cooled reactors, not to be resolved because there is insufficient design information at this time to validate values and impacts. FEIS at 6-15. However, the Staff attempted to estimate the impacts using data provided by the Applicant, with respect to the two potential gas-cooled designs, the GT-MHR and the PBMR. FEIS at 6-15, 6-16.

Exelon sought to demonstrate in its ER that the impacts for the gas-cooled reactor designs were comparable to the environmental impacts identified in the technical basis document, WASH-1248, *Environmental Summary of the Uranium Fuel Cycle*, and its Supplement 1 (NUREG-0116) for Table S–3. FEIS at 6-16. Both Exelon and the Staff performed this assessment by comparing key parameters – including energy usage, material involved, and number of shipments for each major fuel cycle activity – for the gas-cooled reactor designs to those used to generate the impacts in Table S–3. FEIS at 6-16. As with its evaluation of the LWR designs, the Staff used the 1000-MW(e) LWR scaled model to compare impacts, and it determined that the Applicant could site 2 GT-MHR units or 1 PBMR unit to remain below the site PPE of 2200 MW(e) total net electric output. FEIS at 6-16.

With respect to fuel fabrication, the Staff concluded it could not directly compare environmental impacts for uranium dioxide, because there are no currently operating large-scale fuel fabrication facilities producing gas-cooled reactor fuels in the United States. FEIS at 6-18. Although the Staff found, based on some small-scale facilities, that the environmental impacts from producing gas-cooled reactor fuel likely would be small in comparison with the fuel fabrication impacts for LWR technologies, it concluded that these impacts would need to be assessed at the CP or COL stage. FEIS at 6-18. Similarly, with respect to enrichment, after evaluating the slightly higher amount of energy required to enrich

gas-cooled fuel and the smaller amount of uranium hexafluoride needed, the Staff concluded that, on balance, the environmental impacts of enriching gas-cooled fuels by comparison with the impacts of enriching LWR fuel would likely be small, but that the impacts still would need to be assessed at the CP or COL stage. FEIS at 6-19.

In terms of uranium hexafluoride production, yellowcake milling, and uranium ore mining, because the scaled gas-cooled reactor $UF_6$, yellowcake, and ore needs are less than or comparable to those for the scaled LWR model, the Staff concluded that the associated environmental impacts are expected to be less for gas-cooled reactors and therefore would be small. FEIS at 6-19 to 6-20. Similarly, because gas-cooled reactor technologies are projected to generate far smaller amounts of low-level waste scaled annually compared to the amounts for the reference LWR, and because less waste and less heavy metal radioactive waste (because of gas-cooled reactors' higher thermal efficiency and higher fuel burnup) are expected to result in less decontamination and decommissioning waste than for the scaled LWR model, the Staff concluded that the environmental impacts of waste operations, decontamination, and decommissioning would also be small. FEIS at 6-20 to 6-21. However, the Staff noted that the impacts for decontamination and decommissioning would need to be assessed at the COL stage if a gas-cooled design is chosen. FEIS at 6-21.

ii. Transportation of Radioactive Materials

The Staff also evaluated the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to new nuclear units at the Clinton ESP site, (2) shipment of spent fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of low-level radioactive waste and mixed waste to offsite disposal facilities, as well as the transportation impacts of advanced LWR designs and gas-cooled reactor designs. FEIS at 6-21.

Previously in WASH-1238 and NUREG-75/038, the NRC evaluated the environmental effects of transportation of fuel and waste for LWRs and found the impact to be small. FEIS at 6-21. These documents provided the basis for Table S–4 in 10 C.F.R. § 51.52, which summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 megawatts thermal (MW(t))(1000 to 1500 MW(e)) and provides impacts for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR. FEIS at 6-21. Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 0.04 person-Sv (4 person-rem) per reference reactor year, while combined dose to the public along the route and dose to onlookers were estimated to result in a collective dose of 0.03 person-Sv (3 person-rem) per reference reactor year. FEIS at 6-21. Environmental risks (radiological) during accident conditions were determined to be small, while nonradiological impacts during accident conditions were estimated as one fatal injury in 100 reference reactor years and one nonfatal injury in 10 reference reactor years. FEIS at 6-21. At least one subsequent Staff review of transportation impacts concluded that those impacts were bounded by Table S–4. FEIS at 6-21, 6-22.

Although, pursuant to 10 C.F.R. § 51.52(a), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (and impacts are assumed to be bounded by Table S–4) if an LWR meets certain criteria, the Staff determined that none of Exelon's proposed designs met all the relevant criteria. FEIS at 6-22, 6-23. Therefore, Exelon was required to provide a full transportation description and detailed analysis for each LWR design. FEIS at 6-23. Exelon used a sensitivity analysis in order to show that transportation impacts from advanced LWR designs (as well as gas-cooled designs) would be bounded by the criteria identified in Table S–4. FEIS at 6-23.

Consequently, the Staff conducted an independent analysis of the impacts under normal operating and accident conditions of transporting unirradiated fuel to advanced reactor sites

and spent fuel and wastes from advanced reactor sites to disposal facilities. FEIS at 6-24 to 6-42. In order to make comparisons to the bounding values in Table S–4, the Staff normalized impacts to a reference reactor year. FEIS at 6-42. The Staff determined that because of the conservative approaches and data (with respect to the Table S-4 values) used to calculate doses, actual environmental effects are not likely to exceed those in the Staff's FEIS calculations. FEIS at 6-42.

The Staff concluded that the environmental impacts of transportation of fuel and radioactive wastes to and from advanced LWR designs would be SMALL, and would be consistent with the risks from current-generation reactors presented in Table S–4. FEIS at 6-42. However, the Staff found that for gas-cooled designs, while the impacts are likely to be small, it could not resolve the issue because verifiable information is not yet available for the designs. FEIS at 6-42. It therefore found that an applicant would need to provide appropriate data at the COL stage and the Staff would need to validate the assumptions in its EIS. FEIS at 6-42. These validations concerned fuel and cladding integrity following a traffic accident, as well as the bounding of assumptions about shipping cask design, unirradiated fuel initial core/refueling requirements, spent fuel generation rates, radioactive waste generation rates, and shipping cask capacities and accident source terms. FEIS at 6-42.

iii. Decommissioning Impacts

Finally, with respect to decommissioning impacts, the Staff noted that applicants at the ESP stage are not required to submit information regarding the process of decommissioning. FEIS at 6-43. Environmental impacts from the activities associated with the decommissioning of any LWR before or at the end of an initial or renewed license are evaluated in the Decommissioning GEIS, and if impacts from decommissioning are within the bounds described in NUREG-0586, the Staff expects they will be small. FEIS at 6-43. As Exelon did not provide data on decommissioning in its application, for whatever design ultimately selected, the Staff

concluded that the impacts from decommissioning are not resolved and would have to be assessed at the CP or COL stage. FEIS at 6-43.

g. FEIS Chapter 7, "Cumulative Impacts"

In Chapter 7 of the FEIS, the Staff evaluated the potential cumulative impacts of constructing and operating a proposed new unit at the Clinton ESP site. FEIS at 7-1. To determine cumulative impacts, the Staff examined the impacts of the proposed action in combination with other past, present, and reasonably foreseeable future actions in the vicinity of the Clinton ESP site that would affect the same resources impacted by the current GGNS. FEIS at 7-1. Pursuant to the definition of "cumulative" established in 40 C.F.R. § 1508.7, the Staff assessed these combined impacts, including consideration of individually minor but collectively significant actions taking place over a period of time. FEIS at 7-1.

The Staff reviewed the cumulative impacts associated with land use, including additional growth and land conversions to accommodate new workers and services. The Staff expected impacts to be minor, as the construction and operations work forces are predicted to be drawn from a much wider area than DeWitt County alone, including the large cities of Bloomington-Normal, Champaign-Urbana, and Decatur. FEIS at 7-2. The Staff also found that while lower tax rates or better services might encourage development, DeWitt County's comprehensive development plan would control development. FEIS at 7-2. Therefore, the Staff concluded that cumulative land-use impacts would be SMALL. FEIS at 7-2.

The Staff reviewed the cumulative impacts associated with air quality, noting that the Clinton ESP site is located in an area that is in attainment for criteria pollutants, that the State regulates any emissions to the atmosphere, and that the air-quality impacts of construction and operations are estimated to be small. As no other significant impacts from other actions were

identified, the Staff concluded that the cumulative impacts of air quality would be SMALL. FEIS at 7-2.

The Staff reviewed the cumulative impacts associated with water use and quality, and noted that, as with the existing CPS, the intake of water from, and the discharge of water to, Clinton Lake from a new nuclear unit would be regulated by the IEPA. FEIS at 7-3. Likewise, compliance with the NPDES permit would minimize the cumulative effects on aquatic resources. FEIS at 7-3. The Staff concluded that the potential cumulative water impacts of construction and operation of a new nuclear unit at the ESP site would be SMALL in normal years, but would be MODERATE in dry years. FEIS at 7-3.

The Staff reviewed the cumulative impacts associated with the terrestrial ecosystem, including the effects on plant and animal species and associated habitats from construction, cooling tower operation, transmission line operation, and right-of-way maintenance. FEIS at 7-3. The Staff concluded that the contribution of operations (including cooling tower operation, operation of the upgraded transmission system, and maintenance of the associated transmission line rights-of-way) and eventual decommissioning of the unit to cumulative impacts on terrestrial ecological resources in the region would be SMALL. FEIS at 7-5. However, because Exelon anticipates the addition of new transmission lines to upgrade the existing transmission system, but has not initiated selection of one or more transmission-system routes at this time, the actual need for and nature of transmission-system upgrades and the magnitude of associated construction impacts to terrestrial ecosystems would be evaluated by the transmission and distribution system owner and operator prior to or during the CP or COL phase. FEIS at 7-4, 7-5. Therefore, the Staff concluded that the contribution of construction of the ESP unit to cumulative impacts on terrestrial ecological resources in the region is unresolved. FEIS at 7-5.

The Staff reviewed the cumulative impacts associated with the aquatic ecosystem, including impacts from construction, water intake, consumption, and discharge. FEIS at 7-5. The Staff concluded that the contribution of construction of a new unit would be SMALL, because the amount of open water, shoreline, benthic habitat, and benthic fauna that would be lost due to construction represents a small fraction of the total found in Lake Clinton; further, fish and other mobile aquatic organisms temporarily displaced at the construction site would be expected to return once construction was completed. FEIS at 7-5, 7-6. The Staff concluded that the contribution of operational activities associated with the proposed Clinton ESP unit to the cumulative impacts related to water consumption and to impingement and entrainment of aquatic organisms would be SMALL to MODERATE (depending on whether best available technology is utilized at the CPS and localized reduction of fish occurs, beyond what natural recruitment can replace, as a result of joint operation of the CPS and the ESP unit), while the contribution to cumulative impacts of thermal discharge could be SMALL (during normal years) to MODERATE (during dry years). FEIS at 7-6, 7-7. However, because additional information on the intake structure design and NPDES permit requirements for the ESP unit is needed in order to determine the impacts to aquatic ecology due to the operation of one or more nuclear units at the Clinton ESP site, the Staff concluded that the cumulative aquatic ecology issues associated with operation of a proposed ESP unit are unresolved. FEIS at 7-8. Finally, the Staff concluded that the contribution of eventual decommissioning of the facility to the cumulative impact on aquatic ecological resources in the region would be SMALL, as it would result in the cessation of water consumption from the lake by the power plants and impingement and entrainment impacts would end. FEIS at 7-7.

The Staff reviewed the cumulative impacts associated with socioeconomics, historic and cultural resources, and environmental justice. These include impacts on housing, aesthetics,

transportation, tax revenues, and public services. FEIS at 7-8, 7-9. Because most of the Staff's earlier analysis of these topics already involve metrics that incorporate total and cumulative effects, and because the Staff did not identify any additional cumulative impacts, the Staff concluded that the contribution of the ESP facility to cumulative socioeconomic impacts (both adverse and beneficial) in these areas would still be SMALL or MODERATE. FEIS at 7-8, 7-9. The Staff likewise concluded that the cumulative impacts associated with historic and cultural resources and with environmental justice would be SMALL. FEIS at 7-9.

The Staff reviewed the cumulative impacts associated with nonradiological health. Because the Staff found minimal risk from thermophilic microorganisms in Clinton Lake, low occupational injury rates, and minimal impacts on the public and workers from noise and dust emissions and from acute EMFs, the Staff concluded that the ESP facility's cumulative impacts on nonradiological health would be small, though impacts from chronic EMFs remain unresolved. FEIS at 7-9.

The Staff reviewed the cumulative impacts associated with radiological impacts of normal operations. As radiological exposure limits and standards for the protection of the public and for occupational exposures have been developed assuming long-term exposures, and thus incorporate cumulative impact, and because the Staff's earlier evaluation determined that the public and occupational doses predicted from the ESP facility operations would be well below regulatory limits and standards, the Staff concluded that the cumulative radiological impacts of operations would be small. FEIS at 7-10. However, issues related to gas-cooled reactor design accidents are unresolved because of the lack of information. FEIS at 7-10.

Finally, the Staff reviewed the cumulative impacts associated with fuel cycle, transportation, and decommissioning. In light of the determinations made in its earlier analysis concerning the environmental impacts being approximately three times the impacts identified in

Table S–3 (10 C.F.R. § 51.51), the Staff concluded that the cumulative fuel cycle impacts of operating CPS and the proposed ESP unit(s) for the 1000-MW(e) light-water reactor scaled model to be SMALL. FEIS at 7-11. However, the Staff considered unresolved the cumulative impacts for other than light-water reactor designs because of a lack of information. FEIS at 7-11. With respect to transportation, the Staff noted that the addition of the proposed ESP facility would result in additional shipments of unirradiated fuel to the site and additional shipments of spent fuel and waste from the site, such that cumulative impacts would be approximately twice that of the existing operating plant. FEIS at 7-11. The Staff determined that because the proposed site values fell within the criteria specified in Table S–4 of 10 C.F.R. § 51.52, the cumulative impacts of transportation for operating both CPS and the proposed ESP unit would be SMALL, though cumulative impacts for non-LWR designs again were not considered to be resolved. FEIS at 7-11. Finally, as Exelon was not required to (and did not) address decommissioning in its ESP application, this issue is not resolved, although environmental impacts from decommissioning are expected to be small in accordance with the analysis in the Decommissioning GEIS. FEIS at 7-11.

For the range of impact areas it evaluated, the Staff concluded that the potential cumulative impacts resulting from construction and operation are generally SMALL, although several areas (water use and socioeconomic impacts) have the potential for a MODERATE impact. FEIS at 7-11. In certain cases (terrestrial and aquatic ecosystems, nonradiological health, and radiological impacts of operation of non-light-water reactor designs), because information was not available to resolve issues, an applicant for a construction permit or a combined license referencing the Clinton ESP would have to provide the necessary information at that stage. FEIS at 7-12.

h. FEIS Chapter 8, "Environmental Impacts of the Alternatives"

In Chapter 8 of the FEIS, the Staff evaluated alternatives to the proposed action and the environmental impacts of those alternatives. FEIS at 8-1. As part of a two-step evaluation process, the Staff first examined environmental issues at a reconnaissance level to determine if any alternative sites were environmentally preferable to the proposed ESP site; second, if any alternative site were to appear environmentally preferable, the Staff would consider various factors to determine if any such site would be obviously superior to the proposed site. FEIS at 8-1. As part of its evaluation, the Staff also examined the no-action alternative, alternative energy sources, and plant design alternatives. FEIS at 8-1.

i. No-Action Alternative

The Staff first reviewed the no-action alternative, which would entail denial of the ESP request. The Staff noted that in that scenario, no impacts from preliminary site work and preparation would occur, and, because no construction or operation would occur, the impacts assessed in the FEIS would not occur. FEIS at 8-2. However, the Staff stated that the no-action alternative would also preclude all benefits from the ESP process, including early resolution of siting issues prior to large resource investments in new plant design and construction, and early resolution of issues on the environmental impacts of construction and operation. FEIS at 8-2.

ii. Energy Alternatives

The Staff addressed alternative energy plans, including alternatives not requiring new generating capacity, those relying on new generating capacity, and combinations of options.

ii-a. Alternatives Not Involving New Generating Capacity

The Staff considered three alternatives that would not involve new generating capacity. These consisted of initiation energy-conservation measures (including implementing demand-side management actions), purchasing power from other utilities or power generators,

or reactivating or extending the service life of existing plants within the power system. FEIS at 8-3. Particularly in light of the deregulated Illinois power market, the Staff concluded that conservation or demand side management was not a reasonable alternative to an ESP directed at baseload electricity generation, and did not further consider this alternative. FEIS at 8-3. With respect to the purchased power alternative, the Staff noted that the environmental impacts of power production would still occur, but would be located elsewhere within the region, nation, or in another country. FEIS at 8-3, 8-4. The impacts would depend on the generation technology and location of the generation site and, therefore, are unknown. FEIS at 8-4. Finally, depending on whether new transmission lines and rights-of-way are necessary to receive the purchased power, the Staff concluded that the local environmental impacts could range from SMALL to LARGE. FEIS at 8-4. With respect to extension of the life of existing nuclear power plants, the Staff found that although the environmental impacts are significantly less than new construction, continued operation does not provide additional generation capacity. FEIS at 8-5. Similarly, additional power uprates for Exelon's existing nuclear plants will not provide the new generating capacity being considered. FEIS at 8-5. With respect to refurbishment, the Staff noted that most fossil plants available for refurbishment are older and would require extensive and expensive work to meet environmental standards. FEIS at 8-5. Therefore, the Staff concluded that these three alternatives are not reasonable alternatives to providing new baseload power generation capacity. FEIS at 8-5.

ii-b. Alternatives Involving New Generating Capacity

The Staff considered alternatives involving new generating capacity. These consisted only of sources that are technically reasonable and commercially viable. FEIS at 8-5, 8-6.

Coal-Fired Generation

The Applicant evaluated coal-fired generation in its environmental report, and in its evaluation the Staff (like the Applicant) assumed construction of four 550 MW(e) coal-fired units at the Clinton ESP site. FEIS at 8-6.

Air Quality: In terms of air quality, the Applicant estimated the coal-fired plant's annual emissions, including those for sulfur oxides (SOx) (7373 MT [8127 tons]), nitrogen oxides (NOx) (1863 MT [2054 tons]), carbon monoxide (CO) (1921 MT [2118 tons]), total suspended particulates ("TSP") (265 MT [292 tons]), and its subset of particulate matter (PM) of 10 microns in diameter or less (PM10) (61 MT [67 tons]). FEIS at 8-7. Exelon assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. FEIS at 8-6, 8-7.

A coal-fired plant would be subject to emissions caps and would have to obtain pollution credits, certain permits pursuant to the Clean Air Act, and comply with other source performance and visibility standards. FEIS at 8-7, 8-8. The Staff concluded that air quality impacts from coal-fired generation of 2200 MW(e) at the Clinton ESP site would be MODERATE to LARGE, with impacts that would be clearly noticeable and that, given the current state of Illinois air quality for SOx and NOx, could destabilize air quality. FEIS at 8-8.

Waste Management: The Applicant estimated that the coal-fired plant would consume approximately $7.7 \times 10^6$ MT ($8.5 \times 10^6$ tons) of coal and produce approximately $5.3 \times 10^5$ MT ($5.8 \times 10^5$ tons) of recoverable ash per year. FEIS at 8-8. Eighty-seven percent of the ash would be recycled, leaving approximately $6.9 \times 10^4$ MT ($7.6 \times 10^4$ tons) of ash per year for disposal, while SOx-control equipment would generate another $4.0 \times 10^5$ MT ($4.4 \times 10^5$ tons) per year of waste in the form of scrubber sludge. FEIS at 8-8. Approximately 94 ha (234 ac) would be required as a waste disposal site for both the ash and sludge over the 40-year life of

the plant. FEIS at 8-8. The Staff thus concluded that the impacts of disposing of waste generated from burning coal would be MODERATE. FEIS at 8-9.

Human Health: Given the regulatory oversight exercised by the EPA and State agencies, the Staff concluded that the human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal at newly constructed coal-fired plants would be SMALL. FEIS at 8-9.

Other Impacts: In terms of other impacts, the Staff concluded that the land-use impacts of siting, constructing, and operating a coal-fired unit at the ESP site would be MODERATE, as construction of the power block and coal storage area would impact approximately 120 ha (300 ac) of land at the Clinton site and further impacts for coal and limestone mining would occur in areas remote from the ESP site. FEIS at 8-9. As a result of construction and operations, including coal and limestone mining, construction of a rail spur, and fly ash disposal, the Staff concluded that the ecological impacts could be MODERATE to LARGE. FEIS at 8-10. The Staff found that impacts on water use and quality would be MODERATE due to the plant's use of a new cooling water system if once-through cooling were used, and that the impacts to water resources would be SMALL, if cooling towers were employed, or MODERATE to LARGE, if they were not. FEIS at 8-10.

The Staff found that socioeconomic impacts from the coal-fired plant would be SMALL, based on the proximity to the surrounding population area and the relatively small number of workers (about 250) needed to operate the plant. FEIS at 8-10. The Staff also concluded that tax revenues would have a MODERATE to LARGE beneficial impact for DeWitt County. FEIS at 8-10. The Staff also concluded that the visual and aesthetic impacts of a coal-fired generation plant would be MODERATE, based on the presence of large physical structures and exhaust stacks and plumes visible offsite, potential cooling towers, and noise audible offsite (particularly coal delivery). FEIS at 8-10. The Staff found that the historic and cultural resource

impacts would be SMALL (in light of the ability to minimize impacts with survey and recovery techniques), that environmental justice impacts would be SMALL (as there is no evidence of environmental justice issues at the ESP site), and that other construction and operation impacts would be SMALL. FEIS at 8-10 to 8-11.

Natural Gas-Fired Generation

The Applicant also evaluated natural gas-fired generation in its environmental report. The Staff (like the Applicant) assumed the use of four natural-gas-fired, combined-cycle plants of 550-MW(e) net capacity, consisting of two 184-MW(e) gas turbines (e.g., General Electric Frame 7FA) and 182 MW(e) of heat-recovery capacity, for a total of 2200 MW(e). FEIS at 8-11.

Air Quality: In terms of air quality, the Staff found that, compared with a coal-fired plant, a natural gas-fired plant would release similar types of emissions but in lower quantities. FEIS at 8-13. The Applicant estimated that a natural gas-fired plant would annually emit approximately 161 MT (177 tons) of SOx, 515 MT (568 tons) of NOx, 109 MT (120 tons) of CO, and 90 MT (99 tons) of TSP (all $PM_{10}$). FEIS at 8-13. The plant would also have to obtain certain permits pursuant to the Clean Air Act, and comply with other stationary source and visibility standards. FEIS at 8-13. The Staff concluded that air quality impacts from natural gas-fired power generation at the ESP site would be SMALL to MODERATE. FEIS at 8-13.

Waste Management: With respect to waste management, as combustion of natural gas results in few by-products because of the clean nature of the fuel, the Staff thus concluded that waste impacts from natural gas-fired power generation would be SMALL. FEIS at 8-13.

Human Health: With respect to human health risks, while the Staff noted its finding in the GEIS analysis that cancer and emphysema are potential health risks from natural gas-fired plants, it concluded that the impacts would be SMALL because it is not expected that human health effects would be detectable. FEIS at 8-14.

Other Impacts: In terms of other environmental impacts, the Applicant estimated that a natural gas plant would need approximately 44 ha (110 ac), and there could be some temporary ecological damage associated with the burial of the pipeline underground. FEIS at 8-14. In light of this relatively small land disturbance, the Staff concluded that land-use impacts from new natural gas-fired power generation would be SMALL, and ecological impacts (such as withdrawal of cooling makeup water, or construction of the pipeline) would be SMALL to MODERATE. FEIS at 8-14. The Staff found that impacts on water use and quality would be MODERATE due to the plant's use of a new cooling water system if once-through cooling were used, and that the impacts to water resources would be SMALL, if cooling towers were employed, or MODERATE to LARGE, if they were not. FEIS at 8-14.

The Staff found that socioeconomic impacts from the natural gas-fired plant would be SMALL, based on the proximity to the surrounding population area and the relatively small number of workers (approximately 40-80) needed to operate the plant. FEIS at 8-14, 8-15. The Staff also concluded that tax revenues would have a MODERATE to LARGE beneficial impact for DeWitt County. FEIS at 8-15. The Staff also concluded that the visual and aesthetic impacts of a natural gas-fired generation plant would be MODERATE, based on the presence of large physical structures and exhaust stacks and plumes visible offsite, as well as potential cooling towers. FEIS at 8-15. The Staff found that the historic and cultural resource impacts would be SMALL (in light of the ability to minimize impacts with survey and recovery techniques), that environmental justice impacts would be SMALL (as there is no evidence of environmental justice issues at the ESP site), and that other construction and operation impacts would be SMALL. FEIS at 8-15.[23]

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[23] The projected impacts of both the coal-fired and natural gas-fired alternatives are summarized in Tables 8-1 and 8-2 of the FEIS.

ii-c. Other Alternatives

Because a new nuclear unit at the ESP site would be a baseload generator and merchant plant, any feasible alternative to this facility would need to generate baseload power. FEIS at 8-17. Exelon's application identified other energy alternatives besides coal-fired and natural gas-fired generation, but because the Applicant determined that these alternatives either could not generate baseload power or could not do so economically, it concluded that these alternatives were not reasonable. FEIS at 8-17. These alternatives included wind, geothermal, hydropower, solar thermal power and photovoltaic cells, wood waste, municipal solid waste, biomass-derived fuels, fuel cells, and oil-fired generation. FEIS at 8-17 to 8-21. Based on its independent review (including, for some issues, reliance on the analysis in the GEIS), the Staff determined that Exelon's conclusion – that these alternatives are not reasonable – is acceptable. FEIS at 8-17.

The Staff also considered the possibility that some combination of alternatives might be more economical than the construction of a new nuclear unit at the proposed ESP site. Of the many possible combinations, the Staff evaluated the environmental impacts of an assumed combination of three 550 MW(e) natural gas combined-cycle generating units, 60 MW(e) of wind energy, hydropower, or pumped storage; 90 MW(e) from biomass sources, including municipal solid waste; and 400 MW(e) from purchased power, conservation and demand-side management. FEIS at 8-22. The Staff determined that the impacts associated with the combined-cycle natural-gas-fired units would be as discussed earlier (with magnitudes scaled for reduction in capacity), and while the demand-side management measures would have few environmental impacts, operation of the new natural gas-fired plant would result in increased emissions and other environmental impacts. FEIS at 8-22. Furthermore, the environmental impacts associated with power purchased from other generators would still occur, but would be located elsewhere within the region or the Nation or in another country. FEIS at 8-22.

Therefore, after comparing the environmental impacts with those assessed for a new nuclear unit at the ESP site, the Staff concluded that, from an environmental perspective, none of the viable energy alternatives (including a combination of alternatives) was preferable to construction of a new baseload nuclear unit. FEIS at 8-22 to 8-24; Tbl. 8-4.

iii. Plant Design Alternatives

The Staff also addressed plant design alternatives. The Application discusses wet cooling tower heat dissipation systems, hybrid wet/dry cooling tower heat dissipation systems, and dry cooling towers' heat dissipation systems, but Exelon stated that full wet or hybrid wet/dry cooling processes have been assumed for most purposes because they have the greatest consumptive water use of the proposed options. FEIS at 8-25. As the specific cooling system design for a new nuclear unit at the Clinton ESP site has not been selected, system design alternatives would be discussed at the CP or COL stage if an application were submitted to build a new nuclear unit at the site. FEIS at 8-25.

With respect to wet cooling towers, the Staff noted that use of wet cooling towers (mechanical or natural draft) systems would, through evaporation, result in a consumptive loss of about 2.0 $m^3/s$ (70 cfs) from Clinton Lake's water budget, which in turn would result in reduced downstream flows and lower lake elevations during dry periods. FEIS at 8-25. The Staff stated that while this system would not discharge significant amounts of heat as blowdown to the lake, a new nuclear unit would also contribute to higher temperatures in Clinton Lake by decreasing the volume of water available in the lake to assimilate and dissipate the rejected heat in the once-through discharge from the existing CPS unit; these higher temperatures, in turn, would contribute to greater induced evaporation. FEIS at 8-25.

With respect to hybrid wet/dry cooling towers, because Exelon did not include bounds for a hybrid wet/dry cooling system design in the PPE, the Staff assumed that a hybrid wet/dry design would be bounded by the combined maximum values of the wet and dry cooling towers,

an assumption that would need to be validated at the COL stage if Exelon were to proceed with a hybrid wet/dry design at that time. FEIS at 8-25, 8-26. Finally, because Exelon did not provide information on a dry cooling system or address its adverse environmental impacts, the Staff did not perform a detailed site-specific evaluation of a dry cooling system during its review. FEIS at 8-25, 8-26.

iv. Region of Interest and Alternative Site Selection Process

The Staff examined the Applicant's region of interest ("ROI") for possible siting of a new nuclear power plant, as well as its alternative site selection process. Because Exelon's proposal involves siting a merchant plant that would sell generated power in a deregulated marketplace, Exelon defines its ROI to be the State of Illinois on the basis of current deregulation policies, the availability of transmission facilities in the state, market flexibility, and the proximity of Exelon's customer base; the Staff considered this definition to be reasonable. FEIS at 8-26.

With respect to Exelon's alternative site selection process, Exelon considered existing nuclear power plant sites, greenfield sites, and brownfield sites within its ROI, and it used the candidate site criteria presented in NUREG-1555 to select six alternative sites from among the candidate sites. FEIS at 8-27. The alternative sites selected were the Braidwood Generating Station, Byron Generating Station, Dresden Generating Station, LaSalle County Generating Station, Quad Cities Generating Station, and Zion Generating Station. FEIS at 8-27.

Exelon identified these alternative sites as the result of a three-step process. The first step was to identify existing nuclear facilities within the ROI because the proposed ESP facility would be co-located with an existing facility; these consisted of the six Exelon nuclear facilities in the ROI. FEIS at 8-27. As part of its second step, the Applicant evaluated undeveloped greenfield and brownfield sites and concluded that, compared to sites with existing nuclear

facilities, the environmental impacts from building on either a greenfield or brownfield site would be greater than or equal to those at the proposed ESP site. FEIS at 8-27. Also as part of its second step, the Applicant evaluated sites with an existing nuclear facility to determine if the sites met the minimum land requirements specified in the PPE; although the Applicant determined that three of the six sites were not environmentally preferable because they would have insufficient land for a new nuclear unit, the Staff considered all six sites in its review. FEIS at 8-29. As its final step, the Applicant compared the alternative sites with the proposed site, and did not find that any of the sites were environmentally preferable. FEIS at 8-29.

The Applicant's ER summarized the advantages of the proposed ESP site, noting criteria such as equivalent consumptive water use; the lack of critical habitat or spawning grounds for endangered species; comparable NPDES effluent discharge and impact on terrestrial and aquatic environments; population density meeting 10 C.F.R. Part 100 criteria; and the lack of need for either a) preemption or land-use changes for construction and operation or b) decommissioning or dismantlement of an existing facility. FEIS at 8-29, 8-30. The Staff reviewed the methodology used by Exelon for selecting and evaluating the alternative sites and considers Exelon's methodology to be reasonable. FEIS at 8-30.

v. Evaluation of Alternative Sites

The Staff conducted its own independent examination of each of the six alternative sites, an evaluation that included visiting each site as well as the proposed Clinton ESP site to collect additional reconnaissance-level information. FEIS at 8-30.

v-a. Dresden Generating Station

The Staff began its analysis with the Dresden Generating Station site. The site is located in Goose Lake Township, Grundy County, Illinois, on the south shoreline of the Illinois River at the confluence of the Des Plaines and Kankakee Rivers, and consists of approximately 1000 ha (2500 ac) owned by Exelon with an additional 0.4 ha (1 ac) of river frontage leased

from the State of Illinois. FEIS at 8-30. In addition to the two operating nuclear reactors and their turbine building, intake and discharge canals, cooling pond and canals, and auxiliary buildings, the site includes switchyards and Dresden Unit 1, which permanently ceased operation on August 31, 1984. FEIS at 8-30. The station uses once-through cooling with the Illinois River as the source and receiving water, and it also has a cooling canal and cooling pond to reduce heat load in the river during periods of high water temperature. FEIS at 8-31.

With respect to land use, the Staff found that, given the largely rural character of the site area, the fact that the entire Dresden site has been a large power-generating facility since 1965, and the likelihood that a new unit could be configured to fit within previously disturbed land on the existing Dresden site, land-use impacts associated with a new nuclear unit at the Dresden site would be SMALL. FEIS at 8-31. Similarly, because the Staff assumed that any transmission system additions or modifications would likely involve expansions of existing rights-of-way, the Staff concluded that, for reasons similar to those identified in Chapters 4 and 5 of the FEIS, the land-use impacts of transmission-line rights-of-way expansion at Dresden would be SMALL. FEIS at 8-32.

Based on NPDES permit requirements and the assumption that a new unit at Dresden would withdraw makeup water from the Illinois River and use wet cooling towers, the Staff concluded that the water-use and water quality impacts of an additional unit at the Dresden site would be SMALL. FEIS at 8-32. For terrestrial resources, the Staff concluded that construction impacts on terrestrial resources and on threatened or endangered species could range from SMALL to LARGE, depending primarily on the potential impacts from transmission system upgrades on various wildlife areas (and on six Federally protected or candidate species) in the vicinity. FEIS at 8-33 to 8-35.

Similarly, for aquatic resources, the Staff concluded that construction and operational impacts would be SMALL because any construction disturbance would be localized and of

relatively short duration, and because a new nuclear unit at Dresden would be required to meet the new EPA Phase I ruling, which is likely to require closed-cycle cooling, resulting in significantly less impingement and entrainment loss. FEIS at 8-36, 8-37. As no Federally listed aquatic plant or animal species have been found in the vicinity of the Dresden site, and the three Illinois listed endangered or threatened species that have been collected near the site either have only been collected downstream of Dresden Island Lock and Dam or prefer a more complex channel substrate than is found near Dresden, the Staff concluded that the overall impact on Federally listed threatened or endangered aquatic species from construction and operation would be SMALL. FEIS at 8-37.

In terms of socioeconomic impacts, because the potential increases in population (including those associated with a potential multiplier effect of new jobs) do not represent a large percentage increase in the total population for the most impacted counties, the Staff concluded that the demographic impact of both construction and operation of a new unit at Dresden would be SMALL. FEIS at 8-37, 8-38. The Staff similarly concluded that the beneficial impacts of construction and station operation on the economy of the region would be SMALL everywhere in the region except Grundy County, where the impacts could be MODERATE because of its relatively smaller economic base. FEIS at 8-39. The Staff found that, in light of the total amount of taxes Illinois collects annually, overall beneficial impacts of corporate and personal income, sales, use, and property taxes would be SMALL during construction, and SMALL to MODERATE during operation (depending on the impacts of deregulation) for Grundy County and SMALL for Will County (and in all instances beneficial). FEIS at 8-39, 8-40.

The Staff determined that construction impacts on transportation would be SMALL to MODERATE (where some mitigation might be warranted) due to highway congestion, though subsequent operational impacts from the workforce would be SMALL. FEIS at 8-41. The Staff

found only SMALL aesthetic impacts, generally similar to those of the existing Dresden facility. FEIS at 8-41, 8-42. In terms of housing, the Staff concluded that construction impacts would be SMALL given the significant population within 50 miles of the site, while operational impacts would be SMALL in both Will and Grundy counties, if workers came mostly from the region, to SMALL (Will County) to MODERATE (Grundy County), if a larger percentage of workers relocate to the region. FEIS at 8-42. Finally, while minority and low-income populations exist in the site vicinity, the Staff did not identify or observe any location-dependent disproportionate impacts affecting these populations, and it concluded that the environmental justice consequences of the construction and operation of a new nuclear unit at Dresden would be SMALL. FEIS at 8-43.

v-b. Braidwood Generating Station

The Staff also evaluated the alternative of the Braidwood Generating Station site. The site is located in the southwest corner of Will County, southwest of Joliet about 17 km (11 mi) southeast of the Dresden Generating Station, and covers 1804 ha (4457 ac), of which the cooling pond occupies about 1027 ha (2537 ac); two nuclear units are currently operating. FEIS at 8-44. The site is approximately 5 km (3 mi) west of the Kankakee River at a point 22 km (14 mi) upstream from its confluence with the Des Plaines River. FEIS at 8-44.

With respect to land use, the Staff found that, because the area is still largely agricultural, and because a new unit could be configured to fit within the existing, previously disturbed site area, impacts associated with site-preparation, construction, and operation of a new nuclear unit at Braidwood would be SMALL. FEIS at 8-44. Similarly, because the Staff assumed that any transmission system additions or modifications would likely involve expansions of existing rights-of-way, the Staff concluded that, for reasons similar to those

identified in Chapters 4 and 5 of the FEIS, the land-use impacts of transmission-line rights-of-way expansion at Braidwood would be SMALL. FEIS at 8-45.

Based on NPDES permit requirements and the assumption that a new unit at Braidwood would withdraw makeup water from the Kankakee River and use wet cooling towers, the Staff concluded that the water-use and water quality impacts of an additional unit at the Braidwood site would be SMALL. FEIS at 8-45. For terrestrial resources, the Staff concluded that construction impacts on terrestrial resources and on threatened or endangered species would be SMALL, because structures for a new nuclear unit would be primarily constructed in areas already cleared of forest; because most of the land cover potentially affected by transmission line upgrades is agricultural and the associated loss of woodland would be insignificant; and because the one Federally listed threatened or endangered terrestrial species that may occur in the vicinity of the Braidwood site and transmission lines is considered unlikely to be found on the site. FEIS at 8-45 to 8-47.

Similarly, for aquatic resources, the Staff concluded that construction and operational impacts would be SMALL because any construction disturbance would be localized and of relatively short duration, and because a new nuclear unit at Braidwood would be required to meet the new EPA Phase I ruling, which is likely to require closed-cycle cooling, resulting in significantly less impingement and entrainment loss. FEIS at 8-47, 8-48. As no Federally protected aquatic species are found in the vicinity of the Braidwood site, the Staff concluded that the overall impact on Federally listed threatened or endangered aquatic species from construction and operation would be SMALL. FEIS at 8-48.

In terms of socioeconomic impacts, because the potential increases in population (including those associated with a potential multiplier effect of new jobs) do not represent a large percentage increase in the total regional population, the Staff concluded that, as with Dresden, the demographic impact of both construction and operation of a new unit at

Braidwood would be SMALL. FEIS at 8-49. The Staff similarly concluded that the beneficial impacts of construction and station operation on the economy of the region would be SMALL, as the magnitude of the impacts in Will County would be diffused within the larger economic base. FEIS at 8-49. The Staff found that, in light of the total taxes Illinois and Will County collect annually, overall beneficial impacts from taxes would be SMALL. FEIS at 8-50.

The Staff determined that construction impacts on transportation would be SMALL to MODERATE (where some mitigation measures might be warranted) due to highway congestion, though subsequent operational impacts from the workforce would be SMALL. FEIS at 8-50, 8-51. The Staff found only SMALL aesthetic impacts, generally similar to those of the existing Braidwood units. FEIS at 8-51. In terms of housing, the Staff concluded that construction impacts would be SMALL given the significant population within 50 miles of the site, while operational impacts (in the event of larger-than-expected relocation of new workers) would be SMALL for Will County and MODERATE for Grundy County given its smaller housing base and vacant units. FEIS at 8-52. Finally, while minority and low-income populations exist in the site vicinity, the Staff did not identify or observe any location-dependent disproportionate impacts affecting these populations, and it concluded that the environmental justice consequences of the construction and operation of a new nuclear unit at Braidwood would be SMALL. FEIS at 8-53.

v-c. LaSalle County Generating Station

The Staff also evaluated the alternative of the LaSalle County Generating Station site. The site is located in the southeast corner of LaSalle County, Illinois, approximately 112 km (70 mi) southwest of the center of Chicago and 39 km (24 mi) west-southwest of Dresden Nuclear Power Station, and 8 km (5 mi) south of the Illinois River. FEIS at 8-53. LaSalle occupies approximately 1238 ha (3060 ac) and has two nuclear units in operation, and although

the Illinois River is its primary surface-water source, LaSalle does not significantly affect the river's surface-water use because of an 833-ha (2058-ac) cooling pond. FEIS at 8-53, 8-54.

With respect to land use, the Staff found that, because the area is predominantly agricultural, and because a new unit could be configured to fit within previously disturbed land on the site, impacts associated with site-preparation, construction, and operation of a new nuclear unit at LaSalle would be SMALL. FEIS at 8-54. Similarly, because the Staff assumed that any transmission system additions or modifications would likely involve expansions of existing rights-of-way, the Staff concluded that, for reasons similar to those identified in Chapters 4 and 5 of the FEIS, the land-use impacts of transmission-line rights-of-way expansion at LaSalle would be SMALL. FEIS at 8-54.

Based on NPDES permit requirements and the assumption that a new unit at LaSalle would withdraw makeup water from the Illinois River and use wet cooling towers, the Staff concluded that the water-use and water quality impacts of an additional unit would be SMALL. FEIS at 8-55. For terrestrial resources, the Staff concluded that construction impacts on terrestrial resources and on threatened or endangered species would be SMALL, because structures for a new nuclear unit would be primarily constructed in areas already cleared of forest; because most of the land cover potentially affected by transmission line upgrades is agricultural; and because the two Federally listed threatened or endangered terrestrial species that may occur in the vicinity of the LaSalle site and transmission lines are not known to have night roost sites in LaSalle County (bald eagle) or have critical habitat close to the site (Indiana bat). FEIS at 8-56, 8-57.

Similarly, for aquatic resources, the Staff concluded that construction and operational impacts would be SMALL because any construction disturbance would be localized and of relatively short duration; because the Illinois River is a recovering river system and operation of

the current LaSalle nuclear facility is not a significant factor in the overall quality of aquatic habitats in the vicinity of the plant; and because a new nuclear unit at LaSalle would be required to meet the new EPA Phase I ruling, which is likely to require closed-cycle cooling, resulting in significantly less impingement and entrainment loss. FEIS at 8-57, 8-58. As no Federally protected aquatic species have been found in the vicinity of the LaSalle site, the Staff concluded that the overall impact on Federally listed threatened or endangered aquatic species from construction and operation would be SMALL. FEIS at 8-58.

In terms of socioeconomic impacts, because the potential increases in population (including those associated with a potential multiplier effect of new jobs) do not represent a large percentage increase in the total population for LaSalle County and the region, the Staff concluded that the demographic impact of both construction and operation of a new unit at LaSalle would be SMALL. FEIS at 8-59. The Staff similarly concluded that the beneficial impacts of construction and station operation on the economy of the region would be SMALL everywhere in the region except LaSalle County, where the impacts could be MODERATE because of Exelon's relatively larger contribution to its tax base. FEIS at 8-60. The Staff found that, in light of the total taxes Illinois and LaSalle County collect annually, overall beneficial tax impacts would be SMALL in LaSalle County during construction, and SMALL to MODERATE during operation. FEIS at 8-60.

The Staff determined that construction impacts on transportation would be SMALL to MODERATE (depending on mitigation measures) due to highway congestion, though subsequent operational impacts from the workforce would be SMALL. FEIS at 8-61, 8-62. The Staff found that aesthetic impacts, mainly from the new unit's cooling tower and its plume, would be SMALL. FEIS at 8-62. In terms of housing, the Staff concluded that construction and operational impacts would both be SMALL in the context of the nearby six-county area and in

light of housing availability in LaSalle County itself. FEIS at 8-62, 8-63. Finally, while minority and low-income populations exist in the site vicinity, the Staff did not identify or observe any location-dependent disproportionate impacts affecting these populations, and it concluded that the environmental justice consequences of the construction and operation of a new nuclear unit at LaSalle would be SMALL. FEIS at 8-63, 8-64.

v-d. Quad Cities Generating Station

The Staff also evaluated the alternative of the Quad Cities Generating Station site. The site is located in Rock Island County, Illinois, on the east bank of Pool 14 of the Mississippi River, about 26 km (16 mi) below Dam 13 and 21 km (13 mi) from Dam 14, and the station is approximately 800 km (500 mi) upstream from the Mississippi's confluence with the Ohio River. FEIS at 8-64. The region within 10 km (6 mi) of the site includes portions of Rock Island and Whiteside Counties in Illinois and Scott and Clinton Counties in Iowa. FEIS at 8-64. The site consists of 331 ha (817 ac), including two nuclear reactors and their turbine buildings, intake and discharge canals, and ancillary buildings, switchyards, and a retired spray canal now used to raise fish, and the station uses a once-through cooling system with the Mississippi River as source and receiving waters. FEIS at 8-64.

With respect to land use, the Staff found that, as a new unit could be configured to fit within the existing, previously disturbed site area, impacts associated with site-preparation, construction, and operation of a new nuclear unit at Quad Cities would be SMALL. FEIS at 8-65. Similarly, because the Staff assumed that any transmission system additions or modifications would likely involve expansions of existing rights-of-way, the Staff concluded that, for reasons similar to those identified in Chapters 4 and 5 of the FEIS, the land-use impacts of transmission-line rights-of-way expansion at Quad Cities would be SMALL. FEIS at 8-65.

Based on NPDES permit requirements and the assumption that a new unit at Quad Cities would withdraw makeup water from the Mississippi River and use wet cooling towers, the Staff concluded that the water-use and water quality impacts of an additional unit at the Quad Cities site would be SMALL. FEIS at 8-65, 8-66. For terrestrial resources, the Staff concluded that construction impacts on terrestrial resources could range from SMALL to LARGE, depending primarily on the potential impacts from transmission system upgrades on various wildlife areas (and on five State-listed threatened or endangered species) in the vicinity. FEIS at 8-66 to 8-67. The Staff found that the impact from construction or transmission system upgrade on the six Federally listed threatened or endangered species that may occur in the site vicinity would be SMALL, because occurrences of the Indiana bat, Iowa Pleistocene snail, western and eastern prairie fringed orchids, and prairie bush clover on the Quad Cities site are unlikely, while the bald eagle nest nearest to the Quad Cities site is sufficiently distant to preclude disturbance. FEIS at 8-68, 8-69.

Similarly, for aquatic resources, the Staff concluded that construction and operational impacts would be SMALL because any construction disturbance would be localized and of relatively short duration; because a new nuclear unit at Quad Cities would be required to meet the new EPA Phase I ruling, which is likely to require closed-cycle cooling, resulting in significantly less impingement and entrainment loss. FEIS at 8-70. However, the Staff concluded that impacts on Federally listed threatened or endangered aquatic species from construction and operation of a new nuclear unit at the Quad Cities site would be SMALL if mitigation measures are followed, but could be MODERATE if measures are not followed to protect the endangered Higgins' eye pearlymussel. FEIS at 8-70, 8-71.

In terms of socioeconomic impacts, because the potential increases in population (including those associated with a potential multiplier effect of new jobs) do not represent a

large percentage increase in the total population base for the region, the Staff concluded that the demographic impact of both construction and operation of a new unit at Quad Cities would be SMALL. FEIS at 8-71, 8-72. The Staff similarly concluded that the beneficial impacts of construction and operation on the economy of the region would be SMALL because it would be diffused within the larger economic base of the Quad Cities region. FEIS at 8-72. The Staff found that, in light of the total taxes Illinois and Rock Island County collect annually, overall beneficial tax impacts of both construction and operation would be SMALL. FEIS at 8-73.

The Staff determined that construction impacts on transportation would be SMALL to MODERATE due to highway congestion (and depending on mitigative measures), though subsequent operational impacts from the workforce would be SMALL. FEIS at 8-73, 8-74. The Staff found only SMALL aesthetic impacts, generally similar to those of the existing Quad Cities units (such as the cooling tower plume). FEIS at 8-74, 8-75. In terms of housing, the Staff concluded that construction and operational impacts would be SMALL given housing availability in the six-county area, even if a greater percentage of workers relocated to the region. FEIS at 8-75, 8-76. Finally, while minority and low-income populations exist in the site vicinity, the Staff did not identify or observe any location-dependent disproportionate impacts affecting them, and it concluded that the environmental justice consequences of the construction and operation of a new nuclear unit at Quad Cities would be SMALL. FEIS at 8-76.

v-e. Byron Generating Station

The Staff also evaluated the alternative of the Byron Generating Station site. The site is located in Ogle County in northern Illinois, 6 km (3.7 mi) south-southwest of the City of Byron (pop. 2917), 27 km (17 mi) southwest of Rockford, Illinois (pop. 150,115), 3.5 km (2.2 mi) east of the Rock River, and approximately 112 km (70 mi) west of downtown Chicago. FEIS at 8-77. Byron occupies approximately 721 ha (1782 ac) of land; two nuclear units are in operation at the site, and Rock River provides source and receiving waters. FEIS at 8-77.

With respect to land use, the Staff found that, because the area is still largely agricultural, and because a new unit could be configured to fit within the existing area of the main site, impacts associated with site-preparation, construction, and operation of a new nuclear unit at Byron would be SMALL. FEIS at 8-77. Similarly, because the Staff assumed that any transmission system additions or modifications would likely involve expansions of existing rights-of-way, the Staff concluded that, for reasons similar to those identified in Chapters 4 and 5 of the FEIS, the land-use impacts of transmission-line rights-of-way expansion at Byron would be SMALL. FEIS at 8-78.

Based on NPDES permit requirements and the assumption that a new unit at Byron would withdraw makeup water from the Rock River and use wet cooling towers, the Staff concluded that the water-use and water quality impacts of an additional unit would be SMALL. FEIS at 8-78. For terrestrial resources, the Staff concluded that construction impacts on terrestrial resources and on threatened or endangered species would be SMALL, because structures for a new nuclear unit would be primarily constructed in agricultural or fallow field areas; because most of the land cover potentially affected by transmission line upgrades is agricultural and the associated loss of woodland would be insignificant; and because the four Federally listed threatened or endangered terrestrial species that may occur in the vicinity of the Byron site and transmission lines are unlikely (or not known) to occur or have critical habitat on the site. FEIS at 8-79 to 8-80.

Similarly, for aquatic resources, the Staff concluded that construction and operational impacts would be SMALL because any construction disturbance would be localized and of relatively short duration, and because a new nuclear unit at Byron would be required to meet the new EPA Phase I ruling, which is likely to require closed-cycle cooling, resulting in significantly less impingement and entrainment loss. FEIS at 8-81. As no Federally protected aquatic species have been found in the site vicinity, the Staff concluded that the overall impact

on Federally listed threatened or endangered aquatic species from construction and operation would be SMALL. FEIS at 8-81, 8-82.

In terms of socioeconomic impacts, because the potential increases in population (including those associated with a potential multiplier effect of new jobs) do not represent a large percentage increase in the total population base in the region, the Staff concluded that the demographic impact of both construction and operation of a new unit at Byron would be SMALL. FEIS at 8-82. The Staff similarly concluded that the beneficial impacts of construction and station operation on the economy of the region would be SMALL everywhere in the region (because the impacts would be diffused within the larger economic base of the surrounding counties) except Ogle County, where the impacts could be MODERATE in light of the contributions of the existing units to the tax base. FEIS at 8-83. The Staff found that, in light of the total taxes Illinois and Ogle County collect annually, overall beneficial tax impacts would be SMALL during construction, and SMALL, to MODERATE in Ogle County, during operation (and in all instances beneficial). FEIS at 8-83.

The Staff determined that construction impacts on transportation would be SMALL to MODERATE due to highway congestion (depending on mitigative actions), though subsequent operational impacts from the workforce would be SMALL. FEIS at 8-84, 8-85. The Staff found only SMALL aesthetic impacts, generally similar to those of the existing Byron units (such as from the cooling tower and its plume). FEIS at 8-85. In terms of housing, the Staff concluded that construction and operational impacts would be SMALL in light of the housing availability in the three-county area around Byron. FEIS at 8-85, 8-86. Finally, while minority and low-income populations exist in the site vicinity, the Staff did not identify or observe any location-dependent disproportionate impacts affecting these populations, and it concluded that the environmental justice consequences of the construction and operation of a new nuclear unit at Byron would be SMALL. FEIS at 8-86.

v-f. Zion Generating Station

Finally, the Staff evaluated the alternative of the Zion Generating Station site. The site is located at the extreme eastern edge of the City of Zion (pop. 22,866) in Lake County Illinois, on the west shore of Lake Michigan, approximately 5 km (3 mi) south of the Illinois-Wisconsin state line, 67 km (42 mi) south of Milwaukee, Wisconsin (pop. 596,574), about 13 km (8 mi) south of Kenosha, Wisconsin (pop. 90,352), and 10 km (6 mi) north-northeast of Waukegan, Illinois (pop. 87,901). FEIS at 8-87. Lake County (pop. 644,356) is in the northern suburb region of the Chicago metropolitan area. FEIS at 8-87. Both nuclear units at Zion Generating Station permanently ceased operation in 1998 and are currently in SAFSTOR with active decontamination and dismantling scheduled to begin in 2014. FEIS at 8-86.

With respect to land use, the Staff found that impacts associated with site-preparation, construction, and operation of a new nuclear unit at Zion would be SMALL, assuming that the existing units are decommissioned and removed. FEIS at 8-87. However, as stated in the FEIS and based on the March 2004 site visit, the Staff assumed that sufficient land does not exist within the current Zion site to accommodate use of cooling towers, which would most likely be required to meet the new EPA Phase I regulations. FEIS at 8-87. Similarly, because the Staff assumed that a new unit could use the existing transmission lines, and any transmission system additions or modifications would likely involve expansions of existing rights-of-way, the Staff concluded that, for reasons similar to those identified in Chapters 4 and 5 of the FEIS, the land-use impacts of transmission-line rights-of-way expansion at Zion would be SMALL. FEIS at 8-87, 8-88.

Based on NPDES permit requirements and the assumption that a new unit at Zion would withdraw makeup water from Lake Michigan, the Staff concluded that the water-use and water quality impacts of an additional unit at the Zion site would be SMALL. FEIS at 8-88. For terrestrial resources, the Staff concluded that construction impacts on terrestrial resources and

on threatened or endangered species could range from SMALL to LARGE, depending primarily on the potential impacts from acquiring additional offsite land for normal closed-cycle wet cooling towers and from effects of transmission system upgrades on Illinois Beach State Park biota. FEIS at 8-89, 8-90.

For aquatic resources, the Staff concluded that construction and operational impacts would be SMALL because any construction disturbance would be localized and of relatively short duration, and because a new nuclear unit at Zion would be required to meet the new EPA Phase I ruling, which is likely to require closed-cycle cooling, resulting in significantly less impingement and entrainment loss. FEIS at 8-91. As no Federally protected aquatic species have been found in the vicinity of the Zion site, the Staff concluded that the overall impact on Federally listed threatened or endangered aquatic species from construction and operation would be SMALL. FEIS at 8-92.

In terms of socioeconomic impacts, because the potential increases in population (including those associated with a potential multiplier effect of new jobs) do not represent a large percentage increase in the total base population, the Staff concluded that the demographic impact of both construction and operation of a new unit at Zion would be SMALL. FEIS at 8-92. The Staff similarly concluded that the beneficial impacts of construction and station operation on the economy of the region would be SMALL because it would be diffused within the larger economic base of Lake County and the Chicago Metropolitan area. FEIS at 8-93. The Staff found that, in light of the total taxes Illinois and Lake County collect annually, overall beneficial tax impacts would be SMALL. FEIS at 8-93.

The Staff determined that construction impacts on transportation would be MODERATE to LARGE due to significant highway traffic (depending on mitigative actions), though subsequent operational impacts from the workforce would be SMALL. FEIS at 8-94. The Staff found that aesthetic impacts, primarily from the construction and operation of the cooling

systems for a new nuclear unit, would be SMALL. FEIS at 8-95. In terms of housing, the Staff concluded that construction and operational impacts would be SMALL given the housing availability in the nearby metropolitan areas (including Chicago). FEIS at 8-95. Finally, while minority and low-income populations exist in the site vicinity, the Staff did not identify or observe any location-dependent disproportionate impacts affecting these populations, and it concluded that the environmental justice consequences of the construction and operation of a new nuclear unit at Zion would be SMALL. FEIS at 8-96.

v-g. Generic Impacts Consistent Among Alternative Sites

Because the Staff found that several impact areas did not vary among the sites analyzed – and therefore did not affect the evaluation of whether an alternative site is environmentally preferable to the proposed site – the Staff discussed these issues generically rather than with respect to each site.

First, the Staff found that air quality impacts of construction and operation of a new nuclear unit – including dust from disturbed land, roads, and construction activities and emissions from construction equipment – would likely be similar at the proposed ESP site and the alternative sites and would be similar to the impacts associated with any large construction project. FEIS at 8-97. The Applicant discussed measures that it would take to mitigate air quality impacts at the proposed ESP site, and as the Staff assumed that the same or similar measures would be taken if a new nuclear unit were to be constructed at any of the alternative sites, it concluded that air quality impacts of construction of a new nuclear unit at the alternative sites likely would be SMALL. FEIS at 8-97. Likewise, the Staff assumed that the air quality impacts of emissions from vehicles used for construction worker transportation likely would be SMALL at all sites (although sites in nonattainment of ambient air quality standards might require further analysis if those sites were found to be environmentally preferable) and that operational impacts would be SMALL assuming that Exelon would comply with all regulations

related to emissions from generators and boilers and that cooling towers would use current technology to minimize drift. FEIS at 8-97.

The Staff relied on conclusions in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 in finding that terrestrial impacts resulting from the operation of cooling towers and from transmission line operation and transmission line right-of-way maintenance would be SMALL, as would certain operational impacts of cooling water systems on aquatic ecology. FEIS at 8-97 to 8-100.

With respect to socioeconomics, the Staff found that the physical impacts of station construction and operation on workers and the local public would be similar at all six sites and, as residential and commercial areas are located well away from the alternative site boundaries, applicable air-pollution regulations would have to be met by Exelon, and applicable best management practices would be put in place, those impacts would be SMALL. FEIS at 8-101. Similarly, the Staff found that given distances from site boundaries, impacts to offsite buildings would be SMALL at each of the sites. FEIS at 8-101. The Staff concluded that physical impacts of construction on roads in the vicinity of the alternative sites would be SMALL if railroad spurs were used for delivery of heavy construction materials and equipment and MODERATE if they are not, while the operational effects would be SMALL for all sites, as it is not expected that increased commuter traffic from station operations would place undue wear and tear on the roads or cause them to physically deteriorate at a faster rate than at present. FEIS at 8-102. The Staff also determined that both construction and operational impacts on aesthetics would be SMALL, in light of onsite erosion and stormwater runoff control measures, and the mostly rural locations of the alternative sites. FEIS at 8-102, 8-103. The Staff further found that the potential impacts of the facility construction and operations on public services and education would be SMALL at all sites, in light of the generally minor demographic impacts

from the relocation of workers (and of potential associated families) expected at each of the sites. FEIS at 8-103, 8-104.

Based on (1) the Staff's reconnaissance-level review of information obtained from IHPA, (2) previous environmental reports, and (3) the protective measures that would be in place before and during construction and operation, the Staff concluded that the impacts of construction and operation of an ESP unit on historic and cultural resources at any of the alternative sites would be SMALL. FEIS at 8-104.

With respect to nonradiological health impacts, the Staff found that health impacts to construction workers resulting from the construction of a new nuclear unit at any of the alternative sites would be SMALL, noting that applicable Federal and State regulations on air quality and noise would be complied with during the plant construction phase, and that none of the alternative sites has site characteristics that would be expected to lead to fewer or more construction accidents than would be expected for any of the other alternative sites; occupational and public health impacts would likewise be equivalent and SMALL. FEIS at 8-105.

Even with differences in exposure pathways and atmospheric and water dispersion factors, doses estimated to the maximally exposed individual for the alternative sites would be expected to be well within the 10 C.F.R. Part 50, Appendix I design objectives. FEIS at 8-106. The Staff determined that population doses within 80 km (50 mi) of the proposed facility would be higher for those alternative sites closer to major population centers (i.e., Braidwood, Dresden, and Zion), but would still be small compared to the population dose from natural background radiation; the Staff concluded that radiation doses and resultant health impacts from a new nuclear unit's operations would be SMALL at all of the alternative sites. FEIS at 8-106. Similarly, noting that the advanced reactor design of a new unit would likely result in

less occupational exposure annually than from current operating plants, the Staff concluded that the occupational radiation doses from a new nuclear unit's operation would be SMALL for all of the alternative sites. FEIS at 8-106. The Staff concluded that no measurable radiological impact on biota is expected from the radiation and radioactive material released to the environment as a result of the routine operation of a new nuclear unit and that the impacts to biota of radiation doses at any one of the alternative sites would be SMALL. FEIS at 8-106.

Finally, because the probability-weighted consequences estimated for severe accidents for a new nuclear unit at the proposed site are well below the consequences estimated for severe accidents at current generation reactors, the Staff noted that the consequences of severe accidents at the any of the alternative sites likely would be less than the consequences of a severe accident at an existing plant at the site. FEIS at 8-107. Therefore, because the Commission has determined that the probability-weighted consequences of severe accidents are SMALL for all existing plants (10 C.F.R. Part 51, Subpart A, Table B-1), the Staff concluded that, for the purposes of consideration of alternative sites, the impact of severe accidents at each of the alternative sites likely would be SMALL. FEIS at 8-107.

l. FEIS Chapter 9, "Comparison of the Impacts of the Proposed and Alternative Sites"

In Chapter 9 of the FEIS, the Staff compared the environmental impacts of a new facility at the Clinton ESP site with the impacts (discussed in Chapter 8) of the alternatives to the proposed action, in order to determine 1) if any of the alternative sites are environmentally preferable, and 2) if so, whether there is a site that is obviously superior to the proposed site. FEIS at 9-1, 9-2.

In its analysis earlier in the FEIS – supported by examination of the application and supporting documents, the Staff's site visits, and its independent review -- the Staff found that Exelon reasonably identified alternative sites, adequately evaluated the environmental impacts

of construction and operation, and used a logical means of comparing sites. FEIS at 9-2. To compare the proposed action with the alternatives, the Staff weighed the impact significance levels (SMALL, MODERATE, or LARGE) it had determined with respect to Clinton for each major impact area with the corresponding levels for each of the six identified alternative sites. FEIS at 9-2, 9-3, Tbls. 9-1 & 9-2. Where the Staff had been unable to reach a single determination level for Clinton due to insufficient information, the Staff indicated a likely impact level for unresolved issues – so that a comparison could be made – based on professional judgment, experience, and consideration of controls likely to be imposed under required Federal, State, or local permits that would not be acquired until an application for a construction permit or combined license is underway. FEIS at 9-2, 9-3.

The Staff determined that the impact level from construction would be SMALL for most of the environmental issues at each of the sites. *See* FEIS at Table 9-1. The Staff's issue-by-issue impact determinations were explained more fully in Chapter 4 for the Clinton ESP site and in Chapter 8 for the alternative sites. Similarly, the Staff determined that the impact level from operations would be SMALL for most of the environmental issues at each site. *See* FEIS Table 9-2. Once again, the Staff's issue-by-issue impact determinations were explained more fully in Chapter 5 for the Clinton ESP site and in Chapter 8 for the alternative sites.

The Staff then analyzed whether any of the alternative sites are environmentally preferable. First, with respect to construction impacts, while the Staff concluded that impacts were generally small for all seven analyzed sites, the Staff identified several differences between the environmental impacts of construction at the proposed and alternative ESP sites. FEIS at 9-8. The SMALL to MODERATE impact of construction traffic on roads is common to the Clinton ESP site and the alternative sites, while the potential MODERATE impact of

construction on housing could occur if the construction workers relocated to the Clinton Power Station area rather than commute from their present residences. FEIS at 9-8. However, there are SMALL to potentially MODERATE impacts on threatened and endangered species at Quad Cities and SMALL to potentially LARGE impacts at Dresden and Zion, while in addition to the SMALL to MODERATE impact of construction traffic on roads at all sites, construction workers would be expected to have potentially MODERATE impacts on transportation at all six of the alternative sites. FEIS at 9-8. The Staff concluded that none of these differences were sufficient to determine that any of the alternative sites is environmentally preferable to the Clinton ESP site. FEIS at 9-8.

Second, with respect to operational impacts, the Staff again noted that impacts were generally small for all seven analyzed sites, and identified several differences between the environmental impacts at the proposed and alternative ESP sites. FEIS at 9-8, 9-9. For example, under normal water availability, the impact of operation of a new nuclear unit at the Clinton ESP site on recreation would be SMALL, but in severe drought years, the impact level could be MODERATE if the water use of the unit caused the level of Clinton Lake to drop enough to limit use of the lake for recreational purposes. FEIS at 9-8, 9-9. Similarly, impacts on housing would be SMALL if, as expected, the residences of the workforce required to operate a nuclear unit at the Clinton ESP site are distributed throughout the area; however, impacts could be MODERATE should the workforce locate predominately in the smaller towns in the area. FEIS at 9-9.

By contrast, while most of the impacts of operating a new nuclear unit at the alternative sites would be SMALL, there could be MODERATE impacts on housing at either the Dresden or Braidwood sites depending on the location of the operational workforce; these impacts would be similar to the housing impacts that could occur in small towns near the CPS site. FEIS

at 9-9. Also, for Dresden and Quad Cities, there could potentially be SMALL to LARGE impacts if there were threatened or endangered species located in the transmission line rights-of-way. FEIS at 9-9. However, the Staff again concluded that none of the differences were sufficient to determine that any of the alternative sites is environmentally preferable to the Clinton ESP site. FEIS at 9-8, 9-9.

Because the Staff determined that none of the alternative sites was environmentally preferable to the Clinton ESP site, it concluded by extension that none of the alternative sites is obviously superior to the Clinton ESP site. FEIS at 9-9.

Finally, the Staff compared the proposed action with the no-action alternative. The Staff noted that denial of the ESP application would prevent early resolution of safety and environmental issues for the site, and it further found that although Exelon could follow any of several paths to satisfy its electric power needs, each of the paths would have associated environmental impacts. FEIS at 9-9, 9-10. The Staff additionally reiterated its conclusion that the potential site-preparation activities described in Exelon's site redress plan would not result in any significant adverse impacts that could not be redressed. FEIS at 9-10.

3. Findings Regarding "Baseline" NEPA Determinations

As was noted previously, *see supra* Part III, in accordance with the notice of hearing issued in this case, this Licensing Board is required to make the following "baseline" determinations regarding NEPA issues:

> (1) Determine whether the requirements of Section 102(2) (A), (C), and (E) of NEPA and Subpart A of 10 C.F.R. Part 51 have been complied with in this proceeding;
>
> (2) independently consider the final balance among the conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and

(3) determine, after considering reasonable alternatives, whether the ESP should be issued, denied, or appropriately conditioned to protect environmental values.

*See* 68 Fed. Reg. 69427.

In its response to the questions certified to it by the Chief Administrative Judge, providing guidance to licensing boards regarding the appropriate standard of review to be used when making these "baseline" NEPA determinations, the Commission stated that "licensing boards must reach their own independent determination on uncontested NEPA 'baseline' questions — i.e., whether the NEPA process 'has been complied with,' what is the appropriate 'final balance among conflicting factors,' and whether the 'construction permit should be issued, denied or appropriately conditioned.'" *Exelon Generation Company, LLC* (Early Site Permit for Clinton ESP Site), CLI-05-17, 62 NRC 5, 45 (2005). In reaching these independent determinations, "boards should not second-guess underlying technical or factual findings by the NRC Staff," and "[t]he only exceptions to this would be if the reviewing board found the Staff review to be incomplete or the Staff findings to be insufficiently explained in the record." *Id.* The Commission further directed licensing boards to follow the approach set forth in *Calvert Cliffs' Coordinating Comm., Inc. v. AEC*, in which the United States Court of Appeals for the District of Columbia Circuit stated:

> The Commission's regulations provide that in an uncontested proceeding the hearing board shall on its own determine whether the application and the record of the proceeding contain sufficient information, and the review of the application by the Commission's regulatory staff has been adequate, to support affirmative findings on various nonenvironmental factors. NEPA requires at least as much automatic consideration of environmental factors. In uncontested hearings, the board need not necessarily go over the same ground covered in the detailed [environmental impact] statement. But it must at least examine the statement carefully to determine whether the review . . . by the Commission's regulatory staff has been adequate. And it must independently consider the final balance among conflicting factors that is struck in the staff's recommendation.

449 F.2d 1109, 1118 (D.C. Cir. 1971) (footnote and internal quotation marks omitted). The findings the Board should make with respect to these three "baseline" NEPA issues are set forth below.

a. Staff Compliance With Section 102(2)(A),(C), and (E) of NEPA and Subpart A of 10 C.F.R. Part 51

i. Based on the Board's review of the record of this proceeding, particularly the FEIS, the Board should conclude that (1) the Staff utilized a systematic, interdisciplinary approach integrating its use of the natural and social sciences in its decision-making regarding environmental impacts as required under NEPA; and (2) the Staff has complied with the requirements set forth in section 102(2)(A),(C), and (E) of NEPA.[24] The FEIS documents the Staff's environmental review, in which the Staff considered the potential environmental impacts of the proposed action, i.e., issuance of an ESP. The Staff considered numerous subjects and impacts, including: purpose and need for the proposed action, the alternatives to the proposed action, compliance with applicable regulations, meteorology and air quality, geology, the radiological environment, water resources and water use, local ecology, socioeconomics, aesthetics, cultural resources, environmental justice, threatened and endangered species, transportation, noise, land use, public and worker health, accidents, waste management and fuel cycle impacts, decommissioning, cumulative impacts, and resource commitments. See FEIS at v to xviii. The Staff utilized the expertise of professional scientists, engineers, and social scientists in conducting its review. *See id.* at Appendices A and B. If the Board finds the Staff's conclusions to be well-documented and logical, the Board can concur with the Staff's conclusions and adopt them as its own.

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[24] NEPA section 102(2)(A) requires all federal agencies to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment." 42 U.S.C. § 4332(2)(A).

ii. Section 102(2)(c) of NEPA requires a federal agency to address in its environmental impact statement: (1) the environmental impact of the proposed action; (2) any unavoidable adverse impacts associated with implementation of the proposed action; (3) alternatives to the proposed action; (4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and (5) any irreversible and irretrievable commitment of resources that might result from the proposed action. *See* 42 U.S.C. § 4332(2)(c). The Staff has complied with these requirements in performing its environmental review. Chapters 1, 8, and 9 of the FEIS describe the proposed action and examine reasonable alternatives, including the no-action alternative. *See* FEIS at 1-6 to 1-8, ch. 8, ch. 9. Chapters 4, 5, and 6 detail the potential impacts associated with the construction, operation, and decommissioning of a reactor or reactors having characteristics that fall within the parameters for the site, while Chapter 7 addresses the cumulative impacts. *See id.* at ch. 4, ch. 5, ch. 6, ch. 7.

iii. NEPA section 102(2)(c) also requires that an agency "consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved." 42 U.S.C. § 4332(2)(c). The Staff has complied with this requirement. Appendix B lists the agencies and persons consulted during the Staff's review. *See* FEIS at Appendix B. Appendices D and E contain public comments received by the Staff at its scoping meeting and in response to its DEIS. *See id.* at Apps. D, E.

iv. Finally, section 102(2)(E) of NEPA requires a federal agency to "study, develop, and describe appropriate alternatives to the recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4332(2)(E). The FEIS includes a detailed discussion of alternatives to the proposed action. *See* FEIS at chs. 8 and 9.

v. Subpart A to 10 C.F.R. Part 51 contains various requirements, both procedural and substantive, that are applicable to an ESP EIS. These requirements include notice of intent to prepare an EIS and conduct scoping, distribution of a draft EIS, responding to public comments, notice and public availability of the final EIS, and identifying in the EIS the purpose and need for the action, alternatives to the action, and the affected environment. As reflected in the contents of the FEIS (in particular, Chapters 1, 2, 8, and 9, and Appendices D and E) and associated Federal Register notices (referenced therein), the Staff concluded that the applicable Subpart A requirements have been satisfied.

b. Consideration of Balance Among Factors and of Reasonable Alternatives

In performing its evaluation, the Staff considered energy alternatives, plant design alternatives, the Applicant's alternative site selection process, and the Applicant's six alternative sites. *See* FEIS at chs. 8 and 9. The Staff considered whether the ESP Applicant (1) reasonably identified alternative sites, (2) evaluated the likely environmental impacts of construction and operation at these sites, and (3) used a logical means of comparing sites that led to the Applicant's selection of the proposed site. FEIS at 9-2. While the Staff identified some differences in the environmental impacts of both construction and operation at the proposed and alternative ESP sites, the Staff concluded that none of these differences is sufficient to determine that any of the alternative sites is environmentally preferable to the Clinton ESP site. FEIS at 9-8, 9-9. The Staff concluded that none of the alternative sites identified is environmentally preferable or obviously superior to the proposed Clinton ESP site. FEIS at 9-8, 9-9. In sum, based on the information in the record as summarized above in Part IV.B.2, the Board 1) can independently consider the balance among the factors contained in the record, and 2) can find that the Staff has met its obligations under NEPA with respect to consideration of alternatives.

c. Ultimate NEPA Determination Regarding License Issuance

The Board is undertaking, without second-guessing technical and factual findings by the Staff, an independent review of the Exelon application with respect to the three NEPA "baseline" questions. Based upon its review of the record, primarily the FEIS, the Board should agree with the Staff that none of the alternative sites identified is environmentally preferable or obviously superior to the proposed Clinton ESP site. Accordingly, the Board should agree with the Staff's recommendation that the early site permit be issued to Exelon, and find that protection of the environment does not require denial or any further conditioning of the permit.

## V. CONCLUSION

As described above, the Staff has identified the Staff's basis with respect to all five of the findings identified by the Board. For these reasons, the Board will have adequate grounds to make each of these findings and should, therefore, adopt the Staff's conclusions and recommendations with respect to issuance of the ESP.

Respectfully submitted,

Ann P. Hodgdon

Ann P. Hodgdon
Patrick A. Moulding
Counsel for the NRC Staff

Dated at Rockville, Maryland
this 14th day of September, 2006

ATTACHMENT A

CLINTON ESP
NRC Staff Response to Board's Follow-up
FSER INQUIRIES

| Q# | Page | Section | INQUIRY |
|---|---|---|---|
| 1 | 1-9 | 1.7 | Summary of Combined License Action Items. How did the staff ensure that COL action items identified by the applicant in the SSAR are all included and consistent with the COL action items discussed in this section and Appendix A.2. Also for completeness, this section should reference Appendix A.2, COL Action Items Table. |
| | | | Response<br>A review of the type described in this question was not performed. Because COL action items constitute information requirements but do not form the only acceptable set of information addressed in the final safety analysis report, the staff did not identify an exhaustive list of COL action items. Instead, as stated in section A.2 of this report, "The staff identified . . . COL action items with respect to individual site characteristics in order to ensure that particular significant issues are tracked and considered during the review of a later application . . . ." |
| | | | Follow-up Inquiry<br>Is there any difference between the list of COL Action Items identified by the Applicant and that of the Staff? If so, which list is correct and what is the foundation for the differences? |
| | | | Follow-up Response<br>The application does not include COL Action Items. The COL Action Item is a tool for the NRC Staff to identify significant issues that the Staff identified during the ESP or a design certification review that should be considered during review of the COL application. The issues typically need additional information not available at the ESP or DC stage to reach a resolution; the COL Action Item ensures that this issue is addressed. |
| 2 | 2-7 | 2.1.3.1 | Population Distribution. The applicant estimated the population distribution within a 50-mile radius of the proposed ESP site based on the most recent U.S. Census data. Then population estimates up to 2060 were projected. How did the staff determine, and what is their evaluation of, the basis for the applicant's population projection? |

| Q# | Page | Section | INQUIRY |
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| | | | Response<br>The 2nd and 3rd paragraphs on page 2-9 of the FSER (NUREG-1844) discuss that the staff compared the applicant's population data by comparing them with US Census Bureau internet data. The staff also reviewed the population projection data provided by the applicant to year 2060, based on year 2000 census data. The applicant used population projections for 2010 and 2020 for each county provided by Illinois State University. Based on these data, the applicant estimated the expected population change rates (percent change) between 2000 and 2010 and between 2010 and 2020 for each county. The applicant then assumed that the expected population change rate for the four 10-year increments between 2020 and 2060 would be similar to the estimated population change rate between 2010 and 2020. These population rates were then applied using U.S. Census Bureau data from 2000 to each census block within a county. Population forecasts for each sector were calculated by assuming an even distribution of population throughout the census block. The applicant estimated transient population using the same growth percentages. The staff considered this applied assumption by the applicant reasonable in calculating the population projections to year 2060. The staff also reviewed and considered appropriate the bases, sources and calculations of transient populations provided by the applicant and addressed in 3rd paragraph on page 2-9. |
| | | | Follow-up Inquiry<br>The Staff states that it "considered the applied assumption by the applicant reasonable in calculating the population projections to year 2060." How did the Staff come to this determination? What was the Staff's logic and basis? Does the Staff know of any other population projections to year 2060 that have been performed? Is so, how do the applicant's projections compare to those? |

| Q# | Page | Section | INQUIRY |
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| | | | Follow-up Response<br>The Applicant based its population projection to 2060 assuming the expected population change rate by county for the four 10-year increments between 2020 and 2060 would be similar to the population change rate by county between 2010 and 2020 as predicted by the Illinois State University. The Staff believes that assuming the county-by-county projected population change rate between 2010 and 2020 will continue through 2060 is a reasonable assumption. The regulatory guidance for assessing population considerations for site suitability (see, for example, Regulatory Position 4 of Regulatory Guide (RG) 4.7, "Reactor Site Criteria") recognizes the uncertainty inherent in population projections over extended periods. The Staff is not aware of any other county-by-county population projections to the year 2060 that have been performed for the State of Illinois. The U.S. Bureau of the Census has projected population growth nationally to the year 2050 and on a statewide basis to the year 2030; the Applicant's intermediate projections for Illinois are not inconsistent with those of the Bureau.<br><br>The Staff based its site suitability determination on its analysis of the methods used to project population growth, whether the assumptions that were made were unreasonable, and whether the results for the appropriate periods were consistent with other reputable analyses. The Staff has no information to indicate that the Applicant's projections are unreasonable or that the approach was inappropriate. The Commission already recognizes that population growth in the site vicinity after initial site approval is normal and expected. As outlined in Regulatory Position 4 of RG 4.7, if population growth patterns depart from those considered for initial site approval, then they will be periodically factored into the emergency plan for the site. |
| 4 | 2-18 | 2.2.3.4 | Nearby Industrial, Transportation, and Military Facilities. The staff "concludes that the site location is acceptable." However, the staff identified, in other parts of Section 2.2, a number of areas wherein the staff will review and evaluate impacts at the COL stage. Did the staff mean to state that the site location is acceptable subject to satisfactory results of those reviews? If so, provide an appropriate amendment to the FSER identifying all such conditions to this approval. |

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| | | | Response<br>In Section 2.2 of the FSER the staff identified the need for assessing design-specific interactions that could arise between the nearby existing unit and any new units that may be constructed on the proposed site. In the absence of a specific new unit design and its geographic placement in relation to the existing unit, it is not feasible to identify specific hazards that may be introduced by the proximate co-location of the existing and new units. Examples of potential hazards may include site proximity missiles (e.g., turbine missiles), as well as accidental airborne chemical (toxic) or radiological releases. In the absence of specific design details, including plant location and orientation, these types of interface hazards cannot be evaluated at the ESP stage. However, hazards of this type had been addressed satisfactorily for the existing unit, such that it is reasonable to expect that they also can be evaluated and, if need be, accommodated for a new unit. On this basis, the staff found the proposed site to be acceptable in conjunction with the need for additional review and evaluation at the COL stage. |
| | | | Follow-up Inquiry<br>See Part III of the Order to which this table is appended. |
| | | | Follow-up Response<br>The Staff has developed a table as ordered by Part III of the Order dated August 17, 2006. The table is attached to this filing. |
| na #1 | 2-29 | 2.3.1.3 | Additional Inquiry<br>Section 2.3.1.3, pg 2-29 states, "the staff has chosen not to include the proposed ground snow load value of 40 lbf/ft$^2$ as an ESP site characteristic. Once the roof design is known, the COL or CP applicant has the option to demonstrate that the 48-hour PMWP could neither fall nor remain entirely on top of the 100-year snowpack and/or building roofs."<br><br>It would appear that this is an open COL item since the design load will need to be determined at the COL stage based on the structure of the roof design. Yet, Appendix A.2 does not include this as an item in section 2.3, nor does table A.3, Site Characteristics, include it as an open item. Please explain where this and similar items that are not defined are tabulated as open or missing items. See also Part III of the Order. |

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| | | | Additional Inquiry Response<br>The site characteristics listed in Appendix A.3 include the two winter precipitation site characteristics (i.e., the 100-year snowpack and the 48-hour probable maximum winter precipitation) that must be used in evaluating roof designs at the COL stage. No specific COL Action Items or Permit Conditions are necessary; the Staff expects that Appendix A.3 will become a part of the permit document. According to paragraph 52.79(a)(1) of 10 CFR Part 52, an application that references an early site permit must contain information sufficient to demonstrate that the design of the facility falls within the parameters specified in the early site permit. The proposed 10 CFR Part 52 rule would revise this portion for clarity, in 52.79(b)(1), stating that the COL final safety analysis report "must contain . . . information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the early site permit." |
| 8 | 2-34 | 2.3.1.4 | The staff states that it also reviewed the applicant's PPE values (referring to the Applicant's SSAR Section 1.3) and finds them to be reasonable. The staff goes on to state that it "did not perform a detailed review of these parameters." Provide the staff documents wherein the referenced (not-detailed) review is documented and the staff's conclusions that the PPE values are reasonable is explained. If no such document exists, provide a written explanation of the facts underlying and the logic supporting this staff conclusion. |
| | | | Response<br>In reference to page 2-34, no specific staff document exists that documents the staff's conclusions that the PPE values are reasonable. NRR review standard RS-002, Processing Applications for Early Site Permits, provides guidance that "[e]ach staff reviewer should determine whether the PPE values are sufficient to support the review, and that the PPE values are not unreasonable for consideration in the staff findings to comply with 10 CFR Part 52, Subpart A." (ADAMS Accession No. ML040700236 - three copies of page 16 are provided.) |

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| | | | Follow-up Inquiry<br>The Staff's reference to NRR review standard RS-002 is unresponsive to our original inquiry. As originally requested, the Staff shall provide a written explanation of the facts underlying and the logic supporting this staff conclusion that PPE values are reasonable.<br><br>Also, the Staff shall explain why the lack of information regarding other reactor designs is addressed thoroughly in the FEIS in connection with a variety of environmental impacts associated with the use of a PPE and such information is not addressed at all in the FSER. |
| | | | Follow-up Response<br>Before directly addressing the Board's question, the Staff briefly describes the interplay between siting and design in the context of Part 52.<br><br>*Design characteristics* are defined as the actual features of a reactor or reactors. *Site parameters* are defined as the postulated physical, environmental and demographic features of an assumed site. Design characteristics and site parameters are specified in a standard design approval, standard design certification, or a manufacturing license.<br><br>*Design parameters* are defined as the postulated features of a reactor or reactors that could be built at a proposed site. *Site characteristics* are defined as the actual physical, environmental and demographic features of a site. Design parameters and site characteristics are specified in an early site permit. Site characteristics may be specified in a final safety analysis report for a combined license. As the Clinton ESP Applicant had not selected a specific design, the plant parameter envelope (PPE) was set forth to provide design details to support the NRC Staff's review of the ESP application. The PPE is intended to bound multiple reactor designs, the actual design being selected in the COL or CP application. In this case, the PPE is a surrogate for the design parameters considered in an ESP review. (If an applicant chooses a particular design, the Staff may consider factual design characteristics in an ESP review.)<br><br>The statement of consideration for the 10 CFR Part 52 proposed rulemaking, dated March 13, 2006, addresses this relationship. (71 FR 12786) |

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| | | | The Staff's evaluation of the reasonableness of PPE values concerns only whether the values are consistent with the parameters of a facility that could practicably be selected for the proposed site; for example, the Staff would consider unreasonable a PPE corresponding to a design that was vastly smaller or larger than a facility a COL applicant could reasonably select for the site in question. However, as indicated in the various sections of the SER, the PPE values advanced by the Clinton ESP Applicant are facially consistent with the parameter values of the major designs being considered, and the Staff therefore considered these parameter values to be not unreasonable.<br><br>As for the difference between the SER and FEIS with respect to certified and non-certified designs, the Staff reviewed how it addressed designs other than the ABWR and AP1000 in Section 5.10 of the final environmental impact statement (FEIS) and Chapter 15 of the final safety evaluation report (FSER). The Staff does not believe that the depth of its analyses for these designs is markedly different. In both the FEIS and the FSER, the analyses related to accidents focused on the ABWR and the AP1000 because of the level of information available for these designs. In the case of the FSER, the Staff had already evaluated accidents for these designs as part of the design certification reviews. So, in essence, most of the work had already been done. For the FEIS, the Staff was for the first time evaluating the environmental impacts of accidents for these designs at a site, so that analysis was new. For the other reactor designs in both the FEIS and the FSER, the Staff indicated that there was not as much information available, but the Staff judged the results for the ABWR and the AP1000 as likely to bound the results for the other designs. In both documents, the Staff indicated that, if a design other than the ABWR or AP1000 were chosen at the COL stage, the assumption that the results were bounded would have to be confirmed.<br><br>The Staff can also address, in general terms, some fundamental differences between the approaches used for the FEIS and the FSER. The sources of the differences are the legislative and regulatory requirements for each review. The Staff's safety review is performed under the Atomic Energy Act and in accordance with the regulations in 10 CFR Part 52. The environmental review is performed under the National Environmental Policy Act (NEPA) as implemented in NRC regulations at 10 CFR Part 51. Whereas the safety review is focused primarily on protecting the health and safety of the public, the environmental review considers a much broader range of impacts to the environment as a whole. |

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| | | | Starting from NEPA and Part 51, for an environmental review the Staff evaluates the reasonably foreseeable impacts. In addition, the Staff has the latitude, if numerical data is not available, to qualitatively evaluate the impacts.[1] In contrast, the safety review generally focuses on the results of conservative analyses. As an example, in considering χ/Q values the Staff used "typical" meteorological conditions in the FEIS (see page 5-63). "Typical" is defined as those conditions that give atmospheric dispersion factors that are exceeded [i.e., dispersion is lower] 50 percent of the time. In contrast, for the Chapter 15 analyses in the FSAR, the Staff used values for χ/Q associated with "adverse" meteorological conditions (defined as those conditions that give atmospheric dispersion factors that are exceeded no more than 5 percent of the time).<br><br>Another reason for differences in approach between the FEIS and the FSER is the matter of perspective. For example, both the FEIS and the FSER consider impacts related to hydrology. But in these two documents, the Staff is looking at hydrology for very different reasons. In the FEIS, the Staff is evaluating the impacts on the hydrology of the surrounding area of building and operating a nuclear plant (or plants). In the FSER, in contrast, the Staff is evaluating the potential impacts of local hydrology on the plant. Thus, in one case the Staff is looking from the inside out, and in the other case it is looking from the outside in. This difference in perspective leads to very different evaluations in relation to the same resource. Specifically, the analyses in the FSER address, for example, concerns related to the probable maximum flood, an issue unrelated to the environmental review. On the other hand, the analyses in the FEIS address concerns related to issues such as reductions in lake level, changes in flows, and the thermal plume.<br><br>In summary, because of the differences in the basic goals of the analyses in the FEIS and the FSER, there are differences in the data used and the approaches applied by the Staff in the analyses. Based upon the reasoning described above, these differences are to be expected between the FEIS and FSER reviews. |

[1] As stated in 10 CFR § 51.70(d), "The analysis for all draft environmental impact statements will, to the fullest extent practicable, quantify the various factors considered. To the extent that there are important qualitative considerations or factors that cannot be quantified, these considerations or factors will be discussed in qualitative terms."

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| 10 | 2-39 | 2.3.2.3 | Local Meteorology. Supply information on flooding and other effects from the 14.25 inches of rain in one day (May 8, 1961) at Clinton sufficient for the Board to comprehend the staff's conclusions. |
| | | | Response<br>The staff's conclusion in Section 2.3.2.4 states that the applicant's identification and consideration of the meteorological characteristics of the site and surrounding area meet the requirements of 10 CFR 100.20(c) and 10 CFR 100.21(d). §100.20(c) states that the meteorological characteristics of the site that are necessary for safety analysis or that may have an impact upon plant design (such as maximum probable precipitation) must be identified and characterized. §100.21(d) states that the physical characteristics of the site (including meteorology and hydrology) must be evaluated and site parameters (e.g., site characteristics) established such that potential threats from such physical characteristics will pose no undue risk to the type of facility to be located at the site. The staff estimated the local intense precipitation rate for the ESP site to be 18.15 in./h and identified this value as a Site Characteristic in Section 2.4.2.3 of the SER. The local intense precipitation site characteristic of 18.15 in./h clearly bounds the highest recorded 1-day precipitation total of 14.25 inches of rain and will be used to mitigate impacts of local site flooding based on grading and drainage design at the COL stage. Note that SER Section 2.4.2 provides additional information pertaining to identifying and evaluating floods at the site. |
| | | | Follow-up Inquiry<br>The Board is interested in the actual effects of the May 8, 1961 rainfall. The Staff shall provide any specific information it has regarding the effects of the 14.25 inches of rain at Clinton on May 8, 1961. |
| | | | Follow-up Response<br>The 14.25 inches of rain in one day was recorded at the Clinton Climatic Station, which is located approximately 7 miles from the Clinton ESP site and 1 mile from the town of Clinton, IL. The rainfall event was recorded almost 15 years before the existing Clinton Power Station received its construction permit on February 24, 1976, when neither the man-made Lake Clinton nor the Clinton Power Station were in existence. |

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| | | | The U.S. Weather Bureau publication "Storm Data" dated May 1961 (Volume 3 No. 5) provides the following description for the storm event that resulted in 14.25 inches of rain at Clinton on May 8, 1961.<br><br>Place: Central and Southern Illinois<br>Date: May 5-8, 1961<br>No. Of Persons Killed: 2<br>No. Of Persons Injured: 2<br>Estimated Property Damage: $5,000,000–$50,000,000<br>Estimated Crop Damage: $50,000–$500,000<br>Character of Storm: Heavy rain, wind, hail, lightning<br><br>Heavy rains accompanied by thunderstorms, high winds and hail overflowed lakes, rivers and streams flooding cities, towns and farmlands in central and southern Illinois. Hundreds of families were evacuated from their homes in the worst flooding since 1943. Heaviest 4 day rainfall totals were generally recorded on a line from East St. Louis to Vincennes, Indiana where generally 10 to 13 inches occurred. Heaviest 4 day amount occurred at Clinton where 15.77 inches fell. 3 to 6 feet of water flooded streets in Browns, Centralia, Edwardsville, Collinsville, Belleville, Marion, Clinton, Mt. Carmel and other locations. At least 25 major highways were blocked by high water. One man suffered a fatal heart attack as his car plunged into deep water on a highway near Centralia. A New Athens farmer was drowned in an overflowed creek. At Tower Hill, a woman was burned by lightning, which struck and set fire to her home. In Decatur a man was injured by lightning, which blasted an 8 × 10 hole in his house. Golf ball sized hail broke 350 windows in a green house in Milford and caused considerable damage to homes in the area. |
| 19 | 2-91 | 2.4.3.3 | According to the text on p. 2-90, Fig. 2.4-8 is for outflow only. The caption of the table should be corrected. |
| | | | <u>Response</u><br>The hydrograph shows the flow time history and includes inflow as well as outflow from the reservoir. |
| | | | <u>Follow-up Inquiry</u><br>According to the text on page 2-90, Fig. 2.4-8 is for outflow only; however, comparison with Fig. 2.4-6 suggests that Fig. 2.4-8 is for inflow only. Please clarify. |

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| | | | Follow-up Response<br>As the Staff's first cycle of response was based on a version of the FSER Section 2.4 that did not have the updated figures found in NUREG 1844, the answers to the Board's questions were not fully responsive. The Staff's version of the SER did not have any reference to Fig. 2.4-8 on page 2-90. The Staff's earlier response addressed Fig. 2.4-6. Staff agrees with the Board that the caption of Fig. 2.4-8 (on page 2-91 in NUREG 1844) should be corrected. Fig. 2.4-8 only shows outflow from the Clinton Lake under three different loss rate scenarios. The caption of Fig. 2.4-8 should read as follows:<br><br>"Figure 2.4-8 Outflow hydrograph from Clinton Dam during the PMF event using the HEC-HMS model and the seven sub-basins + lake method." |
| 22 | 2-109 | 2.4.7.1 | Ice Effects. The staff states "the applicant will revise the SSAR to include additional information on ice depth." Has this been done? Was it part of the revision provided in response to RAI 2.4.7-4? If so, what is the staff's assessment of the additional information and compliance of the revised section of the SSAR? If it has not been done, when is it expected and when is the staff's evaluation thereof expected? Is this addressed by the applicant's commitment to "consider ice sheet effects at the COL stage"? (See p. 2-108). |
| | | | Response<br>Yes. Please see page 2-122 bottom paragraph. |
| | | | Follow-up Inquiry<br>The Staff's reply is non-responsive as the referenced page 2-122 does not provide any discussion of the Staff's assessment of the Applicant's information. What is the Staff's assessment of the additional information and compliance of the revised section of the SSAR? |

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| | | | Follow-up Response<br>The Applicant revised its ice thickness calculation in response to DSER Open Item 2.4-9. The Applicant recalculated the ice thickness based on the methodology the Staff had used to conduct its independent analysis. This revised value has been submitted in REV. 4 of Clinton SSAR pages 2.4-10 to 2.4-12. The following paragraph in the SER describes the Applicant's revision (on page 2-122 in NUREG-1844) :<br><br>"The applicant revised its ice thickness estimation and described the revisions to the application in a letter dated December 21, 2005, to the NRC. The applicant stated that ice thickness was estimated for the Clinton Lake during the period 1902-2001. The applicant obtained AFDD data for Decatur, Illinois, from the ERDC and revised its estimation of ice thickness using the procedure described in the USACE Engineering and Design-Ice Engineering Manual (EM1110-2-612) and USACE technical note ERDC/CRREL TN-04-3. The applicant used a value of 0.8 for the coefficient of ice cover condition ($\alpha$ in the equation above). The applicant reported that the mean ice thickness estimated over the period 1902-2001 is 16.2 in. with a maximum ice thickness of 27.0 in. during the 1977-78 winter."<br><br>The Staff reviewed the Applicant's submission to determine that the Applicant's new estimate of ice thickness agreed with the Staff's independent estimate. Staff concluded that DSER Open Item 2.4-9 was resolved. This issue was separate from that addressed by RAI 2.4.7-4. RAI 2.4.7-4 was related to frazil and anchor ice formation, not to ice thickness on Clinton Lake. |
| 24 | 2-115 | 2.4.7.3 | What is the relevance of Fig. 2.4-12? |
| | | | Response<br>See page 2-114 2nd paragraph from bottom. |
| | | | Follow-up Inquiry<br>The Staff's answer is unresponsive. To clarify, explain "stage-discharge" and state the relevance of Fig. 2.4-12 to "ice-jam-induced stage increase of 2.0 ft." |

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| | | | Follow-up Response<br>The term "stage" refers to the elevation of the free water surface in a stream or a reservoir. "Discharge" is the volumetric rate of flow in the stream or from the outlet works of a reservoir. Under normal conditions, there is a unique discharge associated with a given stage. The relationship between stage and discharge is called a "stage-discharge" relationship such as the one shown in Fig. 2.4-12. The Staff prepared the stage-discharge relationship for Salt Creek at Rowell using peak discharge and associated gauge height data (Fig. 2.4-12).<br><br>As described at the beginning of SER Section 2.4.7.3 (on page 2-114 in NUREG-1844), the Staff found that the peak discharge on February 11, 1959, the day an ice-jam was reported on Salt Creek near Rowell, was 7500 cfs. The maximum gauge height (the stage) for the same day was reported as 24.84 ft. Staff used the stage-discharge relationship shown in Fig. 2.4-12 to determine that normally the stage associated with a discharge of 7500 cfs near Rowell would approximately be 22.8 ft. Staff concluded, therefore, that the ice-jam on February 11, 1959 caused an increase of approximately 2.0 ft (24.84 ft observed - 22.8 ft expected under normal conditions for a 7500 cfs discharge). |
| 26 | 2-128 | 2.4.8.1 | Cooling Water Canals and Reservoirs. The applicant stated that the overtopping of the dam would occur for a duration of 2.5 hours. How did the staff confirm this duration? |
| | | | Response<br>The dam is not safety related. The lag time for overtopping the dam has no safety consequence. |
| | | | Follow-up Inquiry<br>Explain why the lag time for overtopping the dam has no safety consequence. |

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| | | | Follow-up Response<br>The lag time between starting and stoppage of overtopping, or the duration of overtopping was estimated by the Applicant as 2.5 hours. The Clinton Dam is not a safety-related structure. Staff considered the worst case scenario during overtopping of the Clinton Dam, such that the dam would fail. Staff is required to consider failure of dams, both upstream and downstream of the ESP site as detailed in SER Section 2.4.4. Failure of Clinton Dam could result in draining of Clinton Lake. However, water in the submerged UHS pond, held back by the submerged UHS dam would still be available for safe shutdown using the UHS of the proposed ESP unit. Therefore, the duration of overtopping has no safety consequence. |
| 27 | 2-128 | 2.4.8.1 | Cooling Water Canals and Reservoirs. "The applicant stated in the SSAR Section 2.4.8.1.3 that the ESP facility requires no changes to the auxiliary spillway." How did the staff confirm this statement? |
| | | | Response<br>The safety related water supply does not depend on the design of the auxiliary spillway. |
| | | | Follow-up Inquiry<br>Is the Staff not required to confirm (because the safety related water supply is not dependent) the applicant's statement that "the ESP facility requires no changes to the auxiliary spillway"? |

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| | | | Follow-up Response<br>Yes, and the Staff confirmed this statement. There are two spillways on the Clinton Dam. The service spillway, with a crest elevation of 690 ft MSL, is designed to pass the 100-year flood with the water surface elevation in Clinton Lake at 697 ft MSL. The auxiliary spillway, with a crest elevation of 700 ft MSL, is designed to pass floods greater than the 100-year flood. During independent calculations, Staff used the parameters of the two spillways to route the PMF through Clinton Lake as described in SER Section 2.4.3.3. According to the Staff's independent calculations, the maximum water surface elevation in Clinton Lake during the PMF event was 710.6 ft MSL (Table 2.4-6)[2], 1.2 ft below the top elevation of the Clinton Dam. Since the hydrostatic water surface elevation in Clinton Lake did not rise above the top elevation of the dam, Staff concluded that the auxiliary spillway does not require any modifications to safely pass the PMF. |
| 30 | 2-137 | 2.4.8.3 | Cooling Water Canals and Reservoirs. Explain more fully why a "depth-averaged model may not be conservative" (see last full paragraph). |
| | | | Response<br>Paragraphs 1 and 2 on page 2-138 provide a fuller discussion and the reason for closing the issue. |
| | | | Follow-up Inquiry<br>The cited discussion does not address why the depth-averaged model is or is not conservative. The Staff shall address that issue. |

[2] Instantaneous passage of the PMF through the watershed of the Clinton Lake yielded a water surface elevation of 712.2 ft MSL, but this approach was considered too conservative by the Staff and consequently refined to include a translation lag time for the flood waters through the watershed. Staff used the SCS and Mitchell unit hydrographs to parameterize this translation lag. The resulting water surface elevation in Clinton Lake are shown in Table 2.4-6 for all three methods.

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| | | | Follow-up Response<br>The LAKET model is based on the vertically and laterally (i.e., width-wise) integrated forms of the governing equations, and captures only one-dimensional (i.e., longitudinal) variations of water temperature throughout the lake. Therefore, the model does not simulate vertical gradients of water temperature. In response to RAI 2.4.8-1, the Applicant stated that models that simulate vertical thermal gradients would compute water temperatures at the lake's surface that are higher than those computed by the depth-averaged model LAKET. The Applicant stated in the RAI response that the use of a depth-averaged model is more conservative for this analysis since heat transfer rates to the atmosphere would be less than expected.<br><br>In response to the Applicant's statement, the Staff agreed that a depth-averaged temperature is less than the temperature at the water surface for a thermally stratified water column when all temperatures in the water column are above 4°C. The subsequent use of the depth-averaged water temperature may lead to a decreased estimate of heat transfer from the water's surface to the atmosphere. If the heat transfer is assumed, however, to be less in the depth-averaged model, as the Applicant stated, this condition corresponds to an underestimation in the evaporative loss of water from the lake. Therefore, although the depth-averaged model may be conservative at estimating the temperature in the lake, it may not be conservative when used to compute the volume of water evaporated and hence lake water levels computed by the model may be higher than expected. This implies that a depth-averaged model may not be conservative in terms of the volumetric analysis during periods of relative drought.<br><br>Low water considerations are discussed in SER Section 2.4.11, including a bounding analysis performed by the Staff based on evaporation rates provided by the Applicant in its PPE. The LAKET model was not used by the Staff. The results of this analysis show that the Applicant has met the requirements for low-water conditions at the ESP site. |
| 31 | 2-138 | 2.4.8.1 | Cooling Water Canals and Reservoirs. The estimate of the makeup needs for the UHS is given as 87 ac. ft. by the applicant. Later the applicant states that the ESP facility NHS may use either dry cooling in combination with wet cooling, or only wet cooling. Did the staff verify that the makeup needs would still be only 87 ac. ft. with a wet cooled NHS? |

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| | | | Response<br>NHS is a non-safety function. Please see page 2-172, full paragraphs 2 and 3 for a more detailed explanation. |
| | | | Follow-up Inquiry<br>The Staff's reply is non-responsive, it does not provide a clear answer to our original inquiry. The Staff shall address the Board's original question. |
| | | | Follow-up Response<br>The normal heat sink (NHS) and the ultimate heat sink (UHS) are two separate systems. Design of the NHS does not affect the functioning of the UHS, and vice-versa. The makeup need for the UHS depends only on the design of the UHS cooling system. The makeup volume of 87 ac-ft is a PPE value reported by the Applicant. The actual makeup water required for the UHS will depend on its design, which is not available at the ESP stage. COL Action Item 2.4-8 requires the COL applicant to design the UHS such that its maximum 30-day makeup water requirement does not exceed 87 ac-ft.<br><br>At the Clinton ESP site, the Clinton Lake is the source of water for the NHS, irrespective of the design of the NHS being dry-and-wet combination or wet cooling. Unavailability of Clinton Lake (e.g., due to failure of the Clinton Dam) is an emergency situation that will render the NHS inoperable and the UHS will immediately be pressed into service to shut down the ESP facility using water stored in the submerged UHS pond. |
| 33 | 2-149 | 2.4.11.1 | Explain "dividing by 0.7 to conservatively adjust the forced-evaporation rate" (2nd last paragraph). |
| | | | Response<br>As described in response to Q #29, the staff explanation is provided in the .3 section. The 0.7 factor is an adjustment for 100% load factor. This is a conservative assumption related to the existing CPS unit. On page 2-156 staff discusses the conservative assumptions made in its independent analysis of low water condition. Staff has identified COL Action Item 2.4-11 for plant shutdown protocol that needs to be established during a COL review. |
| | | | Follow-up Inquiry<br>Explain the origin of the number 0.7, and why "this is a conservative assumption related to the existing CPS unit." |

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| | | | Follow-up Response<br>The number 0.7 refers to the 70% load factor that the two originally planned CPS plants' forced evaporation estimate was based upon. Dividing the forced evaporation estimated for the two originally planned CPS plants by 0.7 adjusts the estimate to 100% load factor, which is the load factor assumed for the existing CPS and the proposed ESP facility for lake drawdown calculations during droughts. Since there is some downtime for all nuclear power plants, assuming that plants operate at 100% load factor is a conservative assumption regarding cooling water consumption. |
| 44 | 2-220 et. seq. | 2.5.2.1.6 | Safe Shutdown Earthquake. Provide a brief summary of the differences between the currently accepted methodology and the different "performance based" approach used by the applicant, describing the facts which underlie the staff's assessment of this new approach and outlining, in bullet form, the logic of the staff's conclusion that this methodology is acceptable. The Board seeks a concise summary here - do not merely regurgitate the content of this section (which, we note, includes a derivation of this approach). Why does the staff believe that an assumed beta of 0.4 [page 2-235] is acceptable? How does the conclusion that the objective is satisfied for a mean 10exp-5 frequency follow from the observation that "10exp-5 annual frequency of core damage from seismic events corresponds to 50% of U.S. nuclear power reactors where a full seismic PRA has been done"? (See pp. 2-238 - 239) Why is this an appropriate standard? Provide a concise statement of facts and logic supporting the staff conclusion in clause (4) on p. 2-240 that the "target 10exp-5 annual performance goal results in a plant that is as safe as the plants currently operating." Explain how that conclusion comports with the earlier statements to the effect that it corresponds to 50% of currently operating plants. Explain how the response to the foregoing questions correlates with the discussion on pp. 2-263 - 268. |
| | | | Response<br>Section 2.5.2.1.6 provides a description of the performance-based approach including a derivation of the underlying equations and model parameters; however, it does not contain the staff evaluation of the performance-based approach. The staff evaluation of the performance-based approach is provided in Section 2.5.2.3.6. Section 2.5.2.3.6 provides an evaluation of the target performance goal, model parameters (i.e., beta), and other modeling assumptions. |

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| | | | Follow-up Inquiry<br>The Staff's answer is not responsive to the Board's inquiry; the Staff shall address the original question. |
| | | | Follow-up Response<br>The NRC Staff uses the principal geologic and seismic considerations provided in 10 CFR 100.23 to evaluate the suitability of a proposed site, including the determination of the Safe Shutdown Earthquake (SSE) ground motion. An acceptable method for meeting the requirements of 10 CFR 100.23 is provided in Regulatory Guide (RG) 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion." RG 1.165 provides guidance on a number of different procedures that together satisfy the requirements of 10 CFR 100.23 for determining the SSE. Specifically, RG 1.165 provides guidance on (1) conducting geological, geophysical, seismological, and geotechnical investigations, (2) identifying and characterizing seismic sources, (3) conducting probabilistic seismic hazard analyses (PSHA), and (4) determining the SSE.<br><br>For determination of the SSE (Step 4), the premise of RG 1.165 is that the seismic designs of currently licensed operating nuclear power plants (NPPs) provide adequate protection of public health and safety. In RG 1.165, the NRC Staff recommended basing an SSE for proposed sites on the median (50th percentile) annual probability of exceeding the SSE ground motion for a group of 29 operating NPP sites in the Central and Eastern United States (CEUS). This probability is defined as the reference probability. Based on seismic source and ground motion models available at the time it was written, RG 1.165 incorporated a reference probability for the 29 CEUS operating NPP sites. This reference probability or frequency was determined to be $1 \times 10^{-5}$/yr, which implies that new NPP sites in the CEUS should be designed to remain functional during and after an earthquake ground motion level with a median recurrence interval of 100,000 years. |

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| | | | The Staff and industry have both recognized that the reference probability approach is somewhat problematic due to the difficulty in updating the reference probability value as new advances are made in the earth sciences. As mentioned above, the reference probability is computed from the median probabilities of exceeding the SSEs at 29 sites in the CEUS. The selected sites were intended to represent relatively recent designs, which used conservative seismic designs, in order ensure an adequate level of conservatism in determining the SSE for future sites. However, as the reference probability is based on the probability of exceeding the SSEs at all 29 sites, new models of seismic activity or ground motion in the vicinity of a few sites would necessitate updating the seismic hazard estimates for all of the sites in order to determine a new reference probability. Or, in other words, each prospective siting application would need to potentially justify a current reference probability value, which would require it to update the seismic hazard estimates for all of the 29 CEUS sites.<br><br>The guidance in RG 1.165 was first used when prospective site owners submitted the ESP applications for CEUS sites in 2003. Because the reference probability recommended in RG 1.165 is based on seismic hazard models from the late 1980s, the Staff recognized that this value was likely to be out of date. Two of the three ESP applicants found that using the reference probability approach recommended by RG 1.165 produced unreasonably high SSE ground motions. The main reason for the high SSE ground motion in the CEUS is due to new models to estimate earthquake ground motion and updated models for earthquake sources in seismic regions such as eastern Tennessee, and around both Charleston, SC, and New Madrid, MO. Based on the new information from the earth sciences described above, the Staff now estimates that the ground motion recurrence interval is likely to be lower for some CEUS sites.[3] |

[3] Based on the evaluations of the Individual Plant Examination for External Events Program, the Staff determined that seismic designs of operating plants in the CEUS still provide an adequate level of protection. However, the Staff recognizes that the probability of exceeding the SSE at some of the currently operating sites in the CEUS is higher than previously understood and recommended that the impact of a higher seismic hazard on operating NPPs in the CEUS be evaluated through the generic issue identification and resolution process as Generic Issue 199.

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| | | | Exelon followed the guidance in RG 1.165 for the first three steps, listed above, but rather than using the reference probability approach, the Applicant used a new approach for the final determination of the SSE (Step 4). The approach used by the Applicant to determine the SSE is referred to as the performance-based approach and is described in American Society of Civil Engineers (ASCE) Standard 43-05, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities."<br><br>The principal difference between the reference probability approach, described in RG 1.165, and the ASCE 43-05 performance-based approach is that the performance-based approach incorporates both the seismic hazard at a plant site as well as a model of the seismic structural fragility to arrive at an integrated risk of unacceptable performance. The SSE is then back calculated to achieve a specified target level of performance.<br><br>ASCE 43-05 provides seismic design criteria in order to ensure that nuclear facilities can withstand the effects of earthquakes with a desired performance level, expressed as a target performance goal. ASCE 43-05, for the most stringent seismic design basis category recommends using a target performance goal of 1x10-5/yr for the minimum structural damage state, which is described as essentially elastic behavior. Specifically, essentially elastic behavior means that localized inelasticity might occur at stress concentrations, but the overall seismic response will be essentially in the elastic range.<br><br>The Staff's review of the performance-based approach focused primarily on the adequacy of (1) the performance target, (2) the modeling and parameter assumptions, and (3) the final SSE ground motion spectrum. |

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| | | | NRC Staff verified that the target performance goal of 1 x 10-5/yr for the minimum damage state was adequate by comparing this value to the seismic core damage frequency (SCDF) values determined through seismic probabilistic risk assessments of 25 nuclear power plants provided in NUREG-1742, "Perspective Gained From the Individual Plant Examination of External Events (IPEEE) Program." The median SCDF value for the 25 nuclear power plants in NUREG-1742 is 1x10-5/yr, which is the same as the target value used for the performance based approach. The Staff concluded that equating the target performance goal with the median SCDF value for the 25 plants is conservative since seismic core damage represents a higher damage state (i.e., actual failure of structures and components) while the minimum damage state specified by ASCE 43-05 implies that structures and components remain essentially elastic in their performance.<br><br>The Staff also reviewed the underlying equations as well as parameter and modeling assumptions used to develop the performance-based approach. The performance-based approach is derived from the risk integral (SER Equation 2.5.2-9), which combines the mean site seismic hazard curves and seismic structural fragility curves. To ensure the adequacy of the final equations used to determine the SSE ground motion, the Staff requested the site seismic hazard curves from the Applicant. Using the site seismic hazard curves, the Staff performed direct numerical convolution of the risk integral to ensure that the simplifying assumptions used to develop the final performance-based equations provide SSE values that are the same as those from direct convolution of the risk integral.<br><br>Using the performance-based SSE values, the Staff then calculated SCDF values for comparison with those presented in NUREG-1742. The Staff used a range of structural fragility parameter values (beta from 0.3 to 0.6) and assumed that the seismic margin against core damage is 1.67, as specified for new standard plant designs (see SRM dated July 21, 1993, on SECY 93-087). SCDF values for the Clinton performance-based SSE values are close to 1x10-6/yr, which is about 10 times lower than the median SCDF value for the 25 nuclear power plants in NUREG-1742. |

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| | | | Based on its evaluation, NRC Staff concluded that the approach described in ASCE Standard 43-05 for the most stringent seismic design basis category provides acceptable seismic SSE ground motion spectra. In accordance with this decision, the NRC Staff is currently preparing a new regulatory guide that will describe in detail its recommendations for implementation of the performance-based approach, as referenced in ASCE 43-05.<br><br>The Staff also concluded that the performance-based approach is an advancement over the solely hazard-based reference probability approach recommended in RG 1.165. The performance-based approach:<br><br>• Uses not only the seismic hazard characterization of the site from the PSHA, but also basic seismic fragility SSC modeling in order to obtain an SSE that directly targets a structural performance frequency value. SER at 2-268.<br><br>• Also, as described by the ACRS (repeated in Appendix E to the SER):<br>The alternative, performance-based, method uses a target frequency that does not change with time as new Information on the seismicity of power plant sites changes. In this sense, the alternative method provides some additional regulatory stability. For this reason, if no other, we expect that the alternative method will be attractive to licensees and applicants for a variety of purposes.<br>SER at E-3. |

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| | | | *Why does the staff believe that an assumed beta of 0.4 [page 2-235] is acceptable?* The Staff verified the conservatism of all of the modeling and parameter assumptions, including the assumed beta value, used for the performance-based approach by directly convolving the risk integral (SER Equation 2.5.2-9), which is the basis of the approach. The Staff verified that the beta value of 0.4 is a conservative estimate of the variability (beta values are most likely in the 0.4 to 0.5 range) as lower values result in slightly larger SSE ground motions. The Staff also verified that the Applicant assumed a conservative value for the seismic margin, which is the ratio of the HCLPF capacity value and the SSE. Developers of the performance-based approach originally assumed a margin of 1.67, which is the required margin between the SSE and seismic core damage. However the ASCE 43-05 performance-based approach conservatively assumes a margin of 1.0, which as shown in SER Eqn 2.5.2-19 results in larger SSE ground motions.<br><br>*How does the conclusion that the objective is satisfied for a mean 10exp-5 frequency follow from the observation that "10exp-5 annual frequency of core damage from seismic events corresponds to 50% of U.S. nuclear power reactors where a full seismic PRA has been done"? (See pp. 2-238 - 239)* The selected performance target value is 1x10-5/yr and corresponds to the minimum structural damage state, which is described as essentially elastic behavior. The target value of 1x10-5/yr also corresponds to the median SCDF value for the 25 nuclear power plants in NUREG-1742. The Staff concluded that equating the target performance goal with the median SCDF value for the 25 plants is conservative since seismic core damage represents a higher damage state (i.e., actual failure of structures and components) while the minimum damage state specified by ASCE 43-05 implies that structures and components remain essentially elastic in their performance.<br><br>*Why is this an appropriate standard?* The Staff has not accepted nor evaluated the ASCE 43-05 standard in its entirety. Rather, the Staff has focused its review of ASCE 43-05 only on the portion that specifies the development of seismic design response spectra. The acceptable design of nuclear power plant structures, systems, and components is specified in NUREG-0800, "Standard Review Plan For the Review of Safety Analysis Reports For Nuclear Power Plants." |

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| | | | *Provide a concise statement of facts and logic supporting the staff conclusion in clause (4) on p. 2-240 that the "target 10exp-5 annual performance goal results in a plant that is as safe as the plants currently operating." Explain how that conclusion comports with the earlier statements to the effect that it corresponds to 50% of currently operating plants. Explain how the response to the foregoing questions correlates with the discussion on pp. 2-263 - 268.* The Staff evaluated the adequacy of the SSE ground motion developed by the Applicant using the ASCE 43-05 performance-based approach by determining corresponding SCDF values thru direct convolution of the risk integral (SER Equation 2.5.2-9). Using the performance-based SSE values, the Staff calculated SCDF values for comparison with those presented in NUREG-1742. The Staff used a range of structural fragility parameter values (beta from 0.3 to 0.6) and assumed that the seismic margin against core damage is 1.67, as specified for new standard plant designs (see SRM dated July 21, 1993, on SECY 93-087). SCDF values for the Clinton performance-based SSE values are close to 1x10-6/yr for beta equal to 0.4, which is about 10 times lower than the median SCDF value for the 25 nuclear power plants in NUREG-1742. The range in SCDF values, shown in Table 2.5.2-6 on page 2-265, varies from 0.08x10-5/yr to 0.32x10-5/yr for the range of beta values from 0.3 to 0.6. Figure 2.5.2-17 on page 2-266 provides a comparison of the SCDF values for the Clinton performance-based SSE compared to the SCDF values for the 25 nuclear power plants in NUREG-1742. Based on the premise of RG 1.165 that the seismic designs of currently licensed operating NPPs provide adequate protection of public health and safety, the SSE developed by the Applicant for the Clinton site was determined by the Staff to be acceptable. |

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| 48 | 2-253<br>2-254 | 2.5.2.3.3 | The staff states that "the estimates of uncertainty or variability about the median ground motion predictions are considerably higher for recent ground motion attenuation relationships" compiled by EPRI compared to its original study, and therefore, the applicant decided to use the updated model. Explain how the staff assessed this increased uncertainty and the logic of acceptance of this updated model.<br><br>Explain the relevance to this application of the fact that staff has concluded that Dominion, during the review of North Anna, had adequately resolved staff concerns regarding development by EPRI of new ground motion models for CEUS with respect to the staff's evaluation of an application for an ESP for North Anna. Concisely describe the facts and logic of any such relevance and the applicability of the staff concerns regarding the North Anna application to this matter. |
| | | | Response<br>The staff did not evaluate the original ground motion attenuation model used for the 1986 EPRI PSHA for its review of the Clinton ESP application. In the mid 1980's, there were only a few attenuation models developed for the Central and Eastern United States (CEUS). Over the ensuing 20 years, several new attenuation models for the CEUS have been developed. The 2004 EPRI ground motion model uses a combination of 13 different CEUS attenuation relationships. The staff focused its review on the 2004 EPRI ground motion model rather than the obsolete 1986 EPRI ground motion model.<br><br>The staff performed a detailed review of the 2004 EPRI ground motion model for the Dominion (North Anna) ESP application, since its was the first application received by the staff. For the Clinton ESP review, the staff asked only for clarification of the distance conversion method used for the 2004 EPRI ground motion model. |
| | | | Follow-up Inquiry<br>The Staff states that it "performed a detailed review of the 2004 EPRI ground motion model for the Dominion (North Anna) ESP application." What is the basis for the Staff determination that the details of those findings need not be incorporated into the Clinton ESP FSER? |

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| | | | Follow-up Response<br>The Staff explicitly refers to its review and acceptance of the EPRI 2004 ground motion models as part of the review of the Dominion ESP for the North Anna site in paragraph 3 of page 2-254 of the Clinton ESP SER.<br><br>The ESP applicant for the North Anna, Virginia, site also used the EPRI 2003 ground motion study for its PSHA. Many of the staff's RAIs and the open item related to the updated EPRI CEUS ground motion modeling are described in Section 2.5.2 of the staff's final SER for North Anna (ADAMS Accession No. ML051610246). After reviewing the North Anna ESP applicant's responses to the staff's RAIs and open item, the staff concluded that Dominion had adequately resolved each of the staff's concerns with regard to the development by EPRI of new ground motion models for the CEUS.<br><br>The Staff's evaluation of the EPRI ground motion models covers 4.5 pages in the North Anna SER (pgs 2-193 to 2-197). |
| 52 | 2-290 | 2.5.4.1.8 | Stability of Subsurface Materials and Foundations. Explain "blowcount procedure" here, rather than referring to a Reg. Guide. |
| | | | Response<br>The term "blowcount" refers to the applicant's use of the Standard Penetration Test (SPT) blowcount procedure. This procedure is used for all site explorations to determine the strength and stability of the subsurface soil layers. |
| | | | Follow-up Inquiry<br>The prior answer is incomplete because the procedure is only named; the Staff shall explain the procedure. |

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| | | | Follow-up Response<br>The SPT blowcount procedure refers to the use of exploratory borings using 2-inch outside diameter drive samplers. The SPT is performed inside boreholes by advancing a spoon sampler into the base of the borehole by blows from a hammer with a standard weight of 140 pounds falling a height of 30 inches. Specifically, the blowcount refers to the number of blow counts per foot of penetration on an 18-inch deep sample round, using a 140-lb hammer dropping 30 inches, pushing a 2-inch outside diameter sampler, while recovering a 1-3/8 inch diameter sample. The number of blows required to advance the sampler a distance of 1 foot into the soil is recorded and considered to be indicative of the soil density or consistency, the stress state, and the nature and size distribution of particles and soil structure. |
| 58 | 11-2 | 11.3.1 and 2 | Radiological Effluent Release Dose Consequences From Normal Operations. The applicant estimated bounding quantities of radioactive gas and liquid waste that might be discharged to support their capability to comply with 10 C.F.R. Part 20. How did the staff verify the adequacy of these bounding values? |
| | | | Response<br>The staff did not perform any independent verification of the applicant's estimated bounding quantities of radioactive gaseous and liquid waste to meet the concentration values in Appendix B to 10 CFR Part 20. However, the staff did perform independent calculations of dose to members of the public, using the applicant's source term data, meteorological data, and liquid dispersion data. |
| | | | Follow-up Inquiry<br>Explain the logic and basis for the Staff's decision to accept the applicant's estimated bounding quantities of radioactive gaseous and liquid waste without verification. Is the Staff planning to perform any independent verification at the COL stage? |

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| | | | Follow-up Response<br>The Staff has not routinely performed independent verification of the source term because of the low risk significance associated with the calculated doses to members of the public from routine radioactive gaseous and liquid effluents. The historical data from licensee radiological effluent release reports and associated dose calculations support the position that doses are well within the NRC's ALARA criteria (Appendix I to 10 CFR Part 50) for power reactors. The ALARA dose criteria in Appendix I to Part 50 are a requirement in each power reactor's license. Additionally, there is also a license condition that limits the concentration of radionuclides in routine liquid effluent discharges to the concentrations in Appendix B, Table 2 to 10 CFR Part 20. Thus, the NRC requires dose and concentration controls to maintain routine effluents ALARA. These license conditions are routinely inspected by NRC Regional Inspectors. The inspection examines the licensee's radiological effluent monitoring and release programs to ensure their programs meet NRC requirements. Thus, the data and inspection reports support the conclusion that the existing fleet of nuclear reactors meets NRC's ALARA criteria.<br><br>For the ESP review, the Staff was asked to review the Applicant's data using a Plant Parameter Envelope (PPE) concept. The PPE does not contain enough detailed information on plant systems and components that will be used to control radioactive material generated and sent to radioactive waste reduction systems for the Staff to validate the Applicant's assumptions.<br><br>In summary, based on the information described above, the Staff did not independently derive the routine effluent source term.<br><br>At the COL stage, the Staff will have specific details on the applicant's reactor design, radioactive waste processing systems, locations of effluent release points, and distances to receptors. Although this detailed information will allow the Staff to perform independent verification and calculations of the radioactive source term and the dose to members of the public, the Staff has not yet determined the level of independent verification and calculation that will be performed by the Staff at the COL application stage. |

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| 61 | 13-7 | 13.3.1.1 | Significant Impediments to the Development of Emergency Plans. The applicant references a 1993 evacuation time estimate (ETE) that assumes it could take up to 1 hour to assemble school buses to evacuate school children and that some of these buses may be located at the school. Recent trends in school system bus operations have led to the contracting out of bus services to private companies. As a result, a contractor may serve multiple schools or even school districts with the same buses, which might lead to wait times in excess of an hour. How did the staff confirm the validity of this 1-hour assumption? |
| | | | Response<br>The staff did not confirm the validity of this 1-hour assumption. |
| | | | Follow-up Inquiry<br>Explain the logic and basis for the Staff's decision not to confirm the validity of the applicant's 1-hour assumption. Is the Staff planning to confirm the validity of this assumption at the COL stage? What other inputs were not confirmed by the Staff? |

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| | | | Follow-up Response<br>Section 5.4, "Evacuation Preparation Times and Departure Distributions," of the 1993 ETE study (ML040790801) states that for school facilities, it was assumed that up to one hour may be required to assemble buses, transport vehicles to schools and to load students onto buses. Vehicles stationed at the facilities at the time of the ordered evacuation could be loaded in as little as 15 minutes following notification. Accordingly, school buses were loaded onto the evacuation network from the period between 30 and 90 minutes following the decision to evacuate. This is in agreement with the previous study's assumption after discussions with DeWitt County Emergency Services and Disaster Agency officials.<br><br>In addition, the Applicant provided specific details on bus transportation in Attachment A to its response to NRC RAI 13.3-20 (ADAMS ML050250305). The Staff believed the additional specific information provided regarding plans for busing was reasonable, and relied on the Applicant's affirmation that the time needed to assemble buses was reasonable.<br><br>The Staff requested specific details on inputs and parameters considered necessary to substantiate the review (see Response to Request for Additional Information Letter No. 12, ADAMS ML050250305). The Staff requested clarification on populations, special facility departure times, vehicle demand including potential for transport dependent populations, roadway characteristics, traffic control, and direct model inputs including 'Area Type' used in establishing the NETVAC model. The Applicant provided acceptable responses regarding input and parameters considered in the ETE evaluation.<br><br>Some information in the Staff's follow-up response to Question #64 also bears on this question. |
| 64 | 13-11 | 13.3.1.1 | Significant Impediments to the Development of Emergency Plans. The applicant indicates that park and ride shuttles would be used to transport the transient population attending the Pork and Apple Festivals. Did the staff confirm that the buses used for such shuttles are not the same ones used to transport school children? Also, this section gives an estimate of a maximum attendance of 50,000. How did the staff verify that this estimate is valid for the projected time period to 2060? |

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| | | | Response<br>The staff did not confirm that the busses used for the park and ride shuttles were the same ones used to transport school children. The staff did not verify the projected attendance at the festival. |
| | | | Follow-up Inquiry<br>Explain the Staff's logic and basis for its decision not to verify that the busses used for the park and ride shuttles were not the same ones used to transport school children and its decision not to verify the projected attendance at the festival. Is the Staff planning to verify this data at the COL stage? |
| | | | Follow-up Response<br>Section 2.3.4, "Analysis - Special Event," of the EGC ESP Emergency Plan states that the Apple and Pork Festival is held on the last full weekend in September. Since schools are not in session on weekends, there would not be a need to use the same buses for school evacuation.<br><br>The 1993 ETE estimated that total peak population in the area at any given time during the Apple and Pork Festival in Clinton was 50,000. The 1993 ETE adds 50,000 people to the transient population exclusively for the event. The total population in the area (Table 6-4 in the 1993 ETE) during the festival is estimated to be 78,422 in the ETE (the 50,000 plus the base population). The Staff received an Apple and Pork Festival brochure provided by the Clinton Chamber of Commerce (CCC) on July 14, 2004, that estimates the total attendance for the two-day Apple and Pork Festival to be 70,000. Therefore, the 1993 ETE estimate of a total population of 78,422 at any given time during the festival (50,000 at any given time plus base population) is still a valid assumption for the analysis. For additional information requested regarding the Apple and Pork Festival, see RAIs 13.3-20 (i) and 13.3-20(j) (ADAMS ML050250305). |

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| | | | The Applicant did not provide an estimate of the projected population in 2060 for this event, nor is it required to complete an ETE for populations in 2060, per guidance in NUREG-0654 Rev.1, Supp 2 and NUREG/CR-4831. The ETE analysis is an emergency planning tool that can be used to assess, in a organized and systematic fashion, the feasibility of developing emergency plans for the site (NUREG-0654 Rev.1. Supp 2) As stated in NUREG-0654 Rev.1, Supp 2, "an ETE analysis should include an estimate of the number of people to be evacuated. Permanent residents, transients, and persons in special facilities should be considered in the population estimate."<br><br>Changes in the population and roadway capacity must be regularly monitored and updated (NUREG/CR-4831). As a general rule, a 10% increase in population indicates a need to check evacuation times (NUREG/CR-4831). At the time that a future applicant would use the ESP, that applicant would be expected to provide an update if necessary. |
| na #2 | 13-3 | 13.3.1.1 | Additional Inquiry<br>Section 13.3.1.1 of the SER describes the Technical Information in the Application on significant impediments to the development of emergency plans. This section references the NETVAC program. Please provide a description of the NETVAC program along with a discussion of the verification and validation of the code that was done by the applicant, the staff, and others.<br>The Staff's responses to the Board's questions No. 61 and 64 (also the subject of the two preceding follow-up inquiries) state that the staff did not confirm the validity of the assumptions concerning bussing. Are these assumptions used as inputs to the NETVAC code?<br>If so, how sensitive are the results of the NETVAC code to these assumptions?<br>What other inputs to the NETVAC code were not confirmed by the staff? |

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| | | | Additional Inquiry Response<br>Section 1.1, "General," of the "Evacuation Time Estimates for the Clinton Power Station," dated July 1993, states the following: The NETVAC model was developed specifically to provide evacuation time estimates for emergency response planning. The NETVAC model has been used at over 30 nuclear facilities throughout the country, and meets the requirements of NUREG-0654/FEMA-REP-1, Rev. 1 and related regulatory guidance. The model has been reviewed and accepted by FEMA (now DHS) and used by the NRC at several Atomic Safety and Licensing Board hearings.<br><br>The Staff retained contract support to assist in the review of the ETE analysis. Experienced contractors reviewed the analysis against the guidance provided in Appendix 4 to NUREG-0654/FEMA-REP-1, Rev. 1, NUREG/CR-4831, and RS-002 to identify significant impediments to evacuation or the taking of other protective actions. The Staff relied upon the contractor's affirmation. The NRC contractor requested specific details on NETVAC inputs and parameters considered necessary to substantiate the review (see Response to Request for Additional Information Letter No. 12, ADAMS ML050250305). Clarification was requested on populations, special facility departure times, vehicle demand including potential for transport dependent populations, roadway characteristics, traffic control, and direct model inputs including 'Area Type' used in establishing the NETVAC model. The NRC contractor relied upon the applicant's affirmation regarding these inputs.<br><br>The NETVAC code allows for entry of assumptions related to the time to assemble school buses and special events such as the Apple and Pork Festival. Although the Staff has no direct knowledge of the sensitivity of the NETVAC model to assumptions related to the time needed to assemble buses or evacuation route loading during special events, the Staff believes that in these situations it is non-consequential.<br><br>Based upon the review by the contractor and the content of Section 1.1 described above, no further verification and/or validation of the code was done by the Applicant, the Staff, or others. |

## ATTACHMENT B

Staff Response to Part III of the Board's Order of August 17, 2006
"Supplementation of the FSER"

Board's Order:

The Board has previously expressed its concern regarding the documentation of issues that have been identified as needing further review and evaluation at the COL stage. The Staff has prudently identified and labeled a number of issues as "COL Action Items," documented throughout the FSER and in Appendix A.2. Our concern, however, lies with those issues for which the Staff states that further evaluation and review is required but were neither treated as COL Action Items, nor tabulated or recorded in a manner which will alert a future COL reviewer. (See, e.g., Follow-up Inquiry for Question #2, and Question regarding page 2-29 in Attachment A).

The Early Site Permit proceeding is intended to promote efficiency in the review of the applications; however, this efficiency is defeated if the Staff charged with the review of a COL application must comb the pages of an ESP FSER for issues that the have not been documented as COL action items, but have, nonetheless, been found to need additional review and evaluation at the COL stage. Accordingly, the Staff shall tabulate all such matters in a supplement to this FSER so that the Staff and COL applicant will be alerted to the need to address them.[11]

Staff Response:

A table responsive to the Board's request is attached. As suggested in the Board's footnote, this table indicates the relevant subsection and page of the FSER, as well as the subject matter for which consideration is delayed.

With respect to the two other factors noted in the Board's footnote, none of the deferred considerations discussed in the table would impact the Applicant's right to commence site preparation activities. Therefore, this issue is not addressed item-by-item in the attached table.

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[11] This is of particular importance given that the life of the permit may be up to 20 years and a COL application may not be submitted until late in that period. This Board suggests that such a table contain four columns indicating: (a) the subsection and page of the FSER; (b) the subject matter for which consideration is delayed; (c) whether or not such delay impacts the Applicant's right to commence site preparation activities; and (d) is so, why.

| SER Section Page | Subject To Be Addressed |
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| 2.2.3<br>2-17 | The Staff reviewed the Applicant's analysis of the effects of potential explosions and the formation of flammable vapor clouds. The Staff finds that, because of the distance of the potential ESP facility from the worst-case train tank explosion accident (according to RG 1.91), no significant damage would be expected to the typical nuclear power plant safety related structures, systems, and components that might be located on the ESP site. The Staff relied on the CPS USAR analysis of a single year of rail shipment data during the 1981–1982 period. Reporting of significant changes in the shipment data for the Gilman Rail Line will be required at the COL stage to account for current shipment characteristics and the actual design of the control room systems of the new nuclear unit(s). |
| 2.2.3<br>2-17, 2-18 | The Staff reviewed the Applicant's analysis of potential toxic chemical accidents. These accidents include train and truck tanker spills of anhydrous ammonia, chemical materials that are stored and used on site at CPS and that could be used and stored at future facilities that might be constructed on the ESP site, and anhydrous ammonia storage tank failure at the Van Horn-DeWitt facility. Since the PPE does not specify a control room design, no specific determination can be made with respect to control room habitability in the event of a toxic chemical accident at the site or in the vicinity. Although the Applicant cited the USAR's inventory of toxic chemicals, the actual determination of their impact on a specific plant design cannot be determined at the ESP stage without a precise set of plant design parameters. Therefore, the Staff cannot evaluate the potential effects of accidents on control room habitability at this time. The Staff will evaluate such effects at the COL stage. |
| 2.2.1.3-.2.2.3<br>2-14 | The Staff identified the need for assessing design-specific interactions that could arise between the nearby existing unit and any new units that may be constructed on the proposed site. In the absence of a specific new unit design and its geographic placement in relation to the existing unit, it is not feasible to identify specific hazards that may be introduced by the proximate co-location of the existing and new units. Examples of potential hazards may include site proximity missiles (e.g., turbine missiles), as well as accidental airborne chemical (toxic) or radiological releases. In the absence of specific design details, including plant location and orientation, these types of interface hazards cannot be evaluated at the ESP stage. However, hazards of this type were addressed satisfactorily for the existing unit, such that it is reasonable to expect that they also can be evaluated and, if need be, accommodated for a new unit. On this basis, the Staff found the proposed site to be acceptable in conjunction with the need for additional review and evaluation at the COL stage. |

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| 2.3.1<br>2-28, 2-29 | Consistent with the Staff's branch position on winter precipitation loads, the winter precipitation loads included in the combination of normal live loads considered in the design of a nuclear power plant that might be constructed on a proposed ESP site should be based on the weight of the 100-year snowpack or snowfall, whichever is greater, recorded at ground level. Likewise, the winter precipitation loads included in the combination of extreme live loads considered in the design of a nuclear power plant that might be constructed on a proposed ESP site should be based on the weight of the 100-year snowpack at ground level plus the weight of the 48-hour PMWP at ground level for the month corresponding to the selected snowpack. Once the roof design is known, a COL or CP applicant may choose to justify an alternative method for defining the extreme winter precipitation load by demonstrating that the 48-hour PMWP could neither fall nor remain on the top of the snowpack and/or building roofs. |
| 2.3.1<br>2-33 | The Staff acknowledges that long-term climatic change resulting from human or natural causes may introduce trends into design conditions. However, no conclusive evidence or consensus is available on the rapidity or nature of such changes. If in the future the ESP site is no longer in compliance with the terms and conditions of the ESP (e.g., new information shows that the climatic site characteristics no longer represent extreme weather conditions resulting from climate change), the Staff will seek to modify the ESP or impose requirements on the site in accordance with the provisions of 10 CFR 52.39, "Finality of Early Site Permit Determinations." |
| 2.5<br>1-177<br><br>2.5.5.1<br>2-307 | SSAR Section 2.5.5, "Stability of Slopes" defers the analysis of slope stability to the combined license (COL) application.<br><br>The Applicant stated that it did not perform a slope stability analysis for the ESP site application. If a new intake structure into Clinton Lake is required for a future design, the Applicant stated that it would perform an additional assessment of the slope stability at the point of entry into the lake. The Applicant further stated that the slopes for the existing CPS Unit 2 facility are approximately 30 ft deep and are located over 500 ft from the ESP site, and therefore do not pose a hazard. In addition to slopes associated with the potential future intake structure, the Applicant stated that it will analyze the slopes associated with the construction of the power block or the outfall at the COL stage. Currently, the foundation depth of the new generating system is unknown, and the Applicant stated that these depths are necessary to assess the potential height of slopes required for construction. |

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| 2.5.1.1.2<br>2-194 | The Applicant used the ISGS landslide potential map for Illinois to determine that the landslide potential for DeWitt County is low. The only slopes near the ESP site are those associated with Clinton Lake. These slopes are located approximately 800 ft northwest of the ESP site. The Applicant stated that they have been very stable for the past 30 years, and therefore landsliding does not pose a hazard. In addition, the Applicant concluded that the distance between the ESP site and the slopes is such that, if landsliding were to occur, it would not extend to the ESP site. The Applicant stated that further slope stability studies may be necessary during the COL stage in the area of the outfall pipe, if a new outfall is constructed. At the ESP stage, the Applicant stated that it has not yet determined the need for an outfall. |
| 2.5<br>2-177<br><br>2.5.6.1.1<br>2-308 | SSAR Section 2.5.6, "Embankments and Dams," defers the re-analyses of the Clinton Power Station (CPS) ultimate heat sink (UHS) under the updated SSE to the COL application.<br><br>SSAR Section 2.5.6.1, "Design of Main Dam and CPS UHS," states that there are no plans to modify or rely on the Clinton Lake main dam for emergency cooling water for potential future nuclear facilities on the ESP site. The Applicant stated that the ESP facility will use cooling towers for cooling, with Clinton Lake being used to provide makeup water to the cooling towers. Since the ESP facility will use the CPS UHS to supply makeup water to the cooling towers, the Applicant stated that it would perform evaluations (if appropriate) at the COL stage to assess the performance of the submerged dam forming the UHS under the ESP SSE ground motion. The Applicant stated that the starting point for its COL assessment of the CPS UHS will be the CPS USAR. SSAR Section 2.4.8, "Cooling Water Canals and Reservoirs," provides the main description of the Applicant's plans to use the CPS UHS to supply shutdown cooling water for the existing CPS facility as well as makeup water to the ESP facility cooling towers. |
| 2.5.4<br>2-177<br><br>2.5.4.3.7<br>2-303 | Section 2.5.4.7, "Response of Soil and Rock to Dynamic Loading," defers the evaluation of SSI to the COL stage.<br><br>In SSAR Section 2.5.4.7, the Applicant stated that it deferred the analyses of the SSI for the ESP site to the COL stage. Since the SSI analyses will depend on the geometry and weight of the selected power generating system and the ESP Applicant has not selected a reactor design or location within the ESP site, it did not perform SSI analyses. The Staff concurs with the Applicant's decision to defer the SSI analyses to the COL stage; however, the Staff expected to review the Applicant's determination of the free-field site amplification response in SSAR Section 2.5.4.7. |

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| 2.5.4<br>2-177 | Sections 2.5.4.10, "Static Stability," through 2.5.4.14, "Construction Notes," describe analyses and evaluations that the Applicant has deferred to the COL stage. |
| 2.5.4.3.10<br>2-305 | SSAR Section 2.5.4.10 states that the Applicant deferred the determination of static stability to the COL stage. The Applicant stated that since it has not selected a nuclear power plant design, it did not estimate the bearing capacity, settlement, or lateral earth pressures for the ESP site. These analyses depend on factors such as building footprint size, depth of embedment, and effective weight. |
| 2.5.4.3.12<br>2-306 | SSAR Section 2.5.4.12 states that until the power generating system is selected, the need for ground improvement for the ESP site is unknown. The Applicant stated that structures that are founded at depths of 55 ft or above could require ground improvement, and that "decisions regarding the need for and type of ground improvement will be made during the COL stage." |
| 2.5.4.4<br>2-306, 2-307 | In SSAR Sections 2.5.4.5, 2.5.4.6, 2.5.4.10, 2.5.4.11, and 2.5.4.12, the Applicant did not provide sufficient information for the Staff to perform a complete evaluation. In addition, the Applicant did not provide any information on the relationship of the foundation and underlying materials (Section 2.5.4.3 in RS-002). The Staff reviewed SSAR Sections 2.5.4.13 and 2.5.4.14 as part of its review of SSAR Section 2.5.4.5. Each of these topics depends on specific information related to building location and design and will be needed as part of any COL or CP application. |
| 2.5.4.4<br>2-307 | SSAR Table 1.4-1 states that "soils above 60 ft bgs [are] to be replaced or improved"; however, in SSAR Section 2.5.4.12 the Applicant stated, "decisions regarding the need for and type of ground improvement will be made during the COL stage." An unequivocal commitment by the Applicant to improve or replace and remove the soils above 60 ft below the ground surface is Permit Condition 6. The second site characteristic value specifies a minimum bearing capacity of 25 tsf. This value is based on the CPS site soil properties and not the ESP site properties, since the Applicant deferred the determination of bearing capacity values to the COL stage. |
| 2.5.5.4<br>2-308 | SSAR Section 2.5.5 states that the Applicant will provide slope stability analyses at the COL stage. As such, at this time the Staff is unable to reach any conclusions regarding the stability of slopes that have not been designed or constructed. |

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| 2.5.6.2<br>2-309 | Since the Applicant decided to defer the analyses of dam failure and slope stability until the COL stage, the Staff did not evaluate the regulatory compliance of SER Section 2.5.6. |
| 2.5.4.1.4<br>2-286, 2-287 | The Applicant conducted geophysical surveys at the ESP site in order to determine the S-wave velocity of the soil and upper layer of rock. The Applicant stated that it would use this information to determine the response of the site to seismic ground motion propagating up from the rock to the ground surface. In addition, the Applicant stated that it may use the results of the geophysical surveys during the COL stage of design to evaluate SSI. |
| 2.5.4.1.10<br>2-291 | The Applicant did not estimate the bearing capacity, settlement, or lateral earth pressures for the ESP site, since it has not selected a nuclear power plant design. The Applicant stated that each generating system has different footprint sizes, depths of embedment, and effective weights, and these variables will affect the determination of bearing pressures, settlement, and lateral earth pressures. For this reason, the Applicant deferred the determination of static stability to the COL stage. |
| 2.5.4.1.11<br>2-292 | SSAR Section 2.5.4.11, "Design Criteria," states that the design criteria for the ESP site Category I structures will be established during the COL stage when the physical characteristics of the operating system are known. The Applicant stated that it would use the CPS USAR as a starting point for developing design criteria for the ESP site. |
| 2.5.4.1.12<br>2-292 | SSAR Section 2.5.4.12, "Techniques to Improve Subsurface Conditions," states that until the power generating system is selected, the need for ground improvement for the ESP site is unknown. The Applicant stated that systems that are founded at depths of 55 ft or above could require ground improvement and that decisions regarding the need for and type of ground improvement will be made during the COL stage. |
| 2.5.4.1.14<br>2-292 | SSAR Section 2.5.4.14 states that the CPS USAR provides valuable information from the construction of the CPS facilities and that this information will be used during the COL stage of the project. The Applicant stated the following: Any future excavation associated with the construction of a new generating system will be mapped to confirm that soil types and consistency are in general accord with the conditions identified during previous construction at the site and that have been interpreted from the field explorations carried out at the EGC ESP Site. This field mapping will involve inspecting excavated slopes for the presence of previously unknown fault offsets. |
| 2.5.4.3<br>2-293 | The Applicant deferred the determination of static stability to the COL stage. |

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| 2.5.4.3.2 2-296 | The work being carried out for the EGC ESP was being done before a reactor plant design was selected. Therefore, some of the spacing and depth requirements given in Appendix C of Regulatory Guide 1.132 could not be established. Once a reactor plant design is selected, the requirements in Appendix C of Regulatory Guide 1.132 will be reviewed again during the COL stage, along with the design requirements of the reactor plant design, to determine whether additional drilling and sampling is needed. |
| 2.5.4.3.2 2-296 | Concerning the appropriate spacing of borings or soundings, RG 1.132 states that for favorable uniform geologic conditions, at least one boring should be made at the location of every safety-related structure. Where variable conditions occur, RG 1.132 states that the spacing between borings should be smaller. For larger, heavier structures, such as the containment and auxiliary buildings, RG 1.132 recommends a boring spacing of at least 100 ft with a number of additional borings along the periphery, at corners, and other selected locations. Regarding the appropriate depth for borings, RG 1.132 states that all borings should extend at least 33 ft below the lowest part of the foundation. With regard to these recommendations in RG 1.132, the Staff cannot accept as sufficient the Applicant's concluding statement to review RG 1.132 at the COL stage to "determine whether additional drilling and sampling is needed". While the Staff's review of the Applicant's geotechnical field and laboratory test results confirmed the similarity between the CPS and ESP subsurface soil layers and properties, this similarity does not eliminate the need for further soil borings during the COL stage. There are enough variations in the soil properties within the ESP site itself to necessitate further exploration at the COL stage. Examples include variations in SPT blowcount values, S-wave velocities, and other static and dynamic properties, which may indicate localized areas of variable subsurface material. |
| 2.5.4.3.2 2-300, 2-301 | The Staff notes that in response to Open Item 2.5.4-1 the Applicant committed to perform additional investigations (soil borings) once it has selected the building locations, as recommended in RG 1.132 (see Open Item 2.5.4-1 above). The COL (or construction permit (CP)) applicant will need to describe these additional investigations in its COL (or CP) application. (See COL Action Item 2.5.4-2.) |
| 2.5.4.3.5 2-302 | SSAR Section 2.5.4.13 states that the Applicant will perform settlement analyses at the COL stage and will be able to use previous settlement measurements made by the licensee for the CPS plant structures. The Applicant's assertion is based on the assumption of similar soil conditions between the two sites and that the new facilities will be similar in size, load, and foundation level to those constructed at the CPS site. The need for the COL or CP applicant to perform settlement analyses is covered below in SER Section 2.5.4.3.10. |

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| 13.3<br>13-2 | Notwithstanding any Staff approval of a proposed major feature in this SER, all features of the emergency plan requiring a description pursuant to Appendix E to 10 CFR Part 50 but that are not described in the ESP application will be reviewed in the context of a combined license (COL) or operating license (OL) application. The Staff will review complete and integrated emergency plans submitted in a COL or OL application to determine whether they comply with such requirements, as well as the requirements of 10 CFR 50.47, "Emergency Plans." |
| 13.3.3.8.1<br>13-36 | As indicated in Section 16.4, "Emergency Plan and Agreement Revisions," of the EGC ESP Emergency Plan, when an application for a COL references the EGC ESP Emergency Plan pursuant to Subpart C, "Combined License," of 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," it is anticipated that the application will incorporate the EGC ESP Emergency Plan into the EGC nuclear standardized radiological emergency plan in effect at that time, including, in an appropriate annex, the addition of plant-specific information associated with the EGC ESP facility. Along with the adoption of the EGC nuclear standard radiological emergency plan, the COL facility will adopt consistent public information publications and distribution practices. |
| 13.3.3.9.1<br>13-39, 13-40 | Sections 8.1.2 and 8.1.3 of the EGC ESP Emergency Plan provide brief, general statements and do not give facility-specific or equipment-specific information. In RAI 13.3-12, the Staff requested that the Applicant discuss to what extent it intended the application for an ESP to address evaluation criteria V.H.1 and V.H.2 of Supplement 2 for the TSC, OSC, and EOF for an ESP, including whether it intended the application to address NUREG-0696, "Functional Criteria for Emergency Response Facilities—Final Report," dated February 1981. In addition, the Staff asked the Applicant to state whether EGC intends to utilize the existing TSC, OSC, and EOF, which support CPS, for the ESP site. In response to RAI 13.3-12, the Applicant stated that the EGC ESP Emergency Plan addresses evaluation criterion V.H.1 of Supplement 2 in Section 8.1, which provides the full ESP discussion of the major features of the TSC and OSC, including the NUREG-0696 criteria applicable for a major features discussion. Because the COL application is expected to reference a certified design that has already addressed the details of the design of these facilities, EGC did not include them in the ESP application. The specific designs vary; thus, providing these details in the ESP application could result in discrepancies with the to-be-selected certified design. The COL application will address any details not included in the combined to-be-referenced ESP and design certification document. The EGC ESP facility does not intend to use the TSC or OSC that support the existing Clinton unit and, thus, there will be no impact from the new facility on the existing CPS TSC and OSC. |

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| 13.3.3.9.1<br>13-40 | Section 8.2, "Emergency Operations Facility," of the EGC ESP Emergency Plan addresses evaluation criterion V.H.2 of Supplement 2. Section 8.2 provides a full discussion of the major features of the EOF, including the NUREG-0696 criteria applicable for a major features discussion. The Applicant also stated that, as indicated in Section 8.2, the EGC ESP facility intends to use the existing common EOF currently located in the EGC Cantera facility in Warrenville, Illinois. This facility supports the existing Clinton unit, as well as other existing units in Illinois, and has been previously evaluated against the NUREG-0696 criteria. Since the EOF is already established to support numerous nuclear facilities, the only impact is incorporating the appropriate documents and any necessary communication inputs. Thus, including the EGC ESP facility in the existing EOF is expected to have minimal impact. Completion of the activities will occur at the COL stage and these and other NUREG-0696 criteria can be readily confirmed by inspection at that time (consistent with the process utilized for the previously licensed facilities). |
| 13.3.3.9.3<br>13-42 | In Sections 8.1.2, 8.1.3, and 8.2 of the EGC ESP Emergency Plan, the Applicant provided general descriptions of the OSC, TSC, and EOF and equipment. With regard to the Applicant's response to RAI 13.3-12, the Applicant did not address the adequacy of the facilities and related equipment in support of emergency response. In addition, the Applicant did not address, with specificity, such facility and equipment details such 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. In Open Item 13.3-3, the Staff identified the need for additional specific information related to the OSC, TSC, and EOF. In its submission to the NRC dated April 26, 2005, the Applicant responded to Open Item 13.3-3. The Applicant stated that as indicated in its response to RAI 13.3-12, the EGC ESP addresses evaluation criterion V.H.1 of Supplement 2 to NUREG-0654/FEMA-REP-1 in Section 8.1 of the emergency plan and provides the EGC ESP discussion of the major features of the TSC and OSC. Because the COL application is expected to reference a certified design that has already addressed the details of the design of these facilities, the ESP does not include these details. The specific designs vary; thus, providing these details in the ESP could result in discrepancies with the to-be-selected certified design. The COL application will address any details not included in the combined to-be-referenced ESP and design certification document. |

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| 13.3.3.9.3<br>13-42, 13-43 | Similarly, Section 8.2 of the EGC ESP Emergency Plan provides the discussion of the major features of the EOF to address evaluation criterion V.H.2 of Supplement 2 to NUREG-0654/FEMA-REP-1. As indicated in Section 8.2, the EGC ESP facility intends to use the existing common EOF currently located in the EGC Cantera facility in Warrenville, Illinois. This facility supports the existing Clinton unit, as well as other existing units in Illinois, and has been previously approved as an acceptable centralized EOF, as addressed in SECY-02-0033, "Amergen's Request to Consolidate the Clinton Power Station Emergency Operations Facility (EOF) into the Centralized EOF Operated by Exelon Generation Co.," and its associated Commission staff requirements memorandum. Since the EOF is already established to support numerous nuclear facilities, the only impact is incorporating the appropriate documents and any necessary communication inputs. Thus, including the EGC ESP facility in the existing EOF is expected to have minimal impact. Completion of the activities will occur at the COL stage and these and other NUREG-0696 criteria can be readily confirmed by inspection at that time (consistent with the process utilized for the previously licensed facilities). |
| 15.3.4<br>15-9 | At the COL stage, in accordance with 10 CFR 52.79(a)(1), the Staff will evaluate whether the design of the facility falls within the parameters specified in an ESP, should one be issued for the EGC ESP site. Should the COL applicant reference a certified design as well as the ESP, and should the site characteristic $\chi/Q$ values specified in the ESP fall within the postulated $\chi/Q$s for the chosen certified design, the Staff will likely conclude that the COL applicant has satisfied this requirement [the requirement of 10 CFR 50.34]. Should the COL applicant reference the ESP but not a certified design, the Staff will evaluate the source term for the chosen design and will use that source term and the site $\chi/Q$s determined at the ESP stage to determine whether the applicable regulations at 10 CFR 50.34 regarding dose consequence evaluation factors have been met. In the event of the filing of a CP referencing the ESP, the Staff will evaluate the design's source terms and use the site $\chi/Q$s from the ESP to determine compliance with the requirements of 10 CFR 50.34. |

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSINC BOARD

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| In the Matter of | ) | |
| | ) | |
| EXELON GENERATION COMPANY, LLC. | ) | Docket No. 52-007-ESP |
| | ) | |
| (Early Site Permit for Clinton ESP Site) | ) | |

CERTIFICATE OF SERVICE

I hereby certify that copies of the "NRC STAFF's BRIEF IN RESPONSE TO THE LICENSING BOARD'S ORDER OF AUGUST 2, 2006," and two attachments, "NRC Staff Response to Board's Follow-Up FSER Inquiries" and "Staff Response to Part III of the Board's Order of August 17, 2006," in the above-captioned proceeding have been served on members of the Licensing Board by hand delivery and the following by deposit in the NRC's internal mail system as indicated by a single asterisk, or by deposit in the U.S. Mail, first class, as indicated by a double asterisk, this 14th day of September, 2006:

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