May 11, 2004

Ms. Marilyn Kray
Vice President, Special Projects
Exelon Generation
200 Exelon Way, KSA3-E
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SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING THE ENVIRONMENTAL PORTION OF THE EARLY SITE PERMIT APPLICATION FOR THE EXELON GENERATION COMPANY SITE (TAC NO. MC1125)

Dear Ms. Kray:

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the application of Exelon Generation Company, LLC (EGC or Exelon) for an early site permit (ESP) for a site designated by Exelon as the EGC ESP site and has identified areas where additional information is needed to complete its review. Enclosed are the staff's RAIs. As discussed with your staff, we request that you provide your responses to these RAIs by July 23, 2004, in order to support the early site permit review schedule. If you have any questions, please contact me at (301) 415-1120.

Sincerely,

/RA/

Thomas J. Kenyon, Senior Project Manager
Environmental Section
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-007

Enclosure: As stated

cc w/enclosure: See next page

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Request for Additional Information Regarding
The Exelon Generation Company, LLC Early Site Permit Application

Unless otherwise indicated, section numbers refer to the applicant's environmental report (ER) for the early site permit (ESP).

General

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Section 2.4, Ecology

E2.4-1 **Section 2.4.1.1.4 (Wetland and Floodplain Forest)** - Provide a map of the EGC ESP site showing the habitats discussed in the ER, including the 4 less-than-1-acre wetlands mentioned in ER Section 4.3.1.4.2.4. Include an overlay of the EGC ESP facilities and laydown yards, indicating their likely location if constructed.

Section 3.4 and 4.2, Cooling System and Water-Related Impacts

E3.4-1 **Section 3.4.2.3 (Normal Heat Sink), Section 3.4.2.4 (Ultimate Heat Sink), and Section 4.2.1.2.1 (Construction Along Clinton Lake)** – In several locations, the ER states that the new intake structure will be next to the existing Clinton Power Station (CPS) intake structure. During the site visit in March 2004, an Exelon representative indicated that he did not think the intake structure could go next to the CPS intake structure because of existing piping. Confirm that the planned location for the proposed EGC ESP intake structure is next to the CPS intake structure.

Section 3.5, Radioactive Waste Management System

E3.5-1 **Section 3.5.2 (Gaseous Radioactive Waste Management System)** – This section presents a listing of normal radioactive gaseous effluents in Table 3.5-3; however, it does not specify which reactor designs were considered in development of the bounding gaseous effluent. Clarify what reactor designs were considered in the development of the bounding gaseous effluents.

Section 3.7, Power Transmission System and Section 5.6, Transmission System Impacts

E3.7-1 **Section 3.7 (Power Transmission System) and Section 5.6.1 (Terrestrial Ecosystems)** - Provide the right-of-way (ROW) management plan for the existing transmission and distribution system (ER and ESRP Sections 3.7). The ROW management plan for the existing system will be used to project impacts to terrestrial ecological resources that could result from operation and maintenance of transmission line corridors for the EGC ESP facility, assuming the same ROW management plan is applied to those corridors (ER and ESRP Sections 5.6.1).

Section 3.8, Transportation of Radioactive Materials

The following information is requested to support development of RADTRAN 5 computer code input files to model shipments of advanced reactor irradiated fuels to calculate incident-free exposures and accident risks. To assist in modeling the advanced reactor irradiated fuel and packaging systems, provide the following:

E3.8-1 **Radionuclide content of advanced design irradiated fuel** – For the IRIS reactor design, provide a detailed listing of all radionuclides and their inventories (e.g., Curies per metric ton uranium (Ci/MTU) or other suitable unit that can be used to calculate the inventories of each radionuclide in irradiated fuel shipments). In addition, for the ACR-700 reactor design, provide a detailed listing of all actinide radionuclides and their inventories. Explain the technical basis for the data (how the information was obtained) and the accuracy of the data.

E3.8-2 **Detailed information about the advanced fuel designs** – Provide information to support a preliminary comparative evaluation of the abilities of the advanced fuel designs to withstand structural and thermal accident conditions relative to current design fuel assemblies. In particular, provide the following information on the advanced fuels:

a. Fuel mechanical and thermal properties

b. For the fuel cladding:

1. material(s) used and form/manufacturing processes,
2. physical dimensions, and
3. mechanical and thermal properties

c. Investigation/analysis of fission product transport within and out of the fuel matrix

d. Irradiation and temperature effects on the mechanical and thermal properties discussed above

e. Assumptions about packaging that would be used as inner containers (i.e., overpack) inside a conceptual shipping cask

f. Expected release fractions from the fuel during accident conditions - if this information is given as a comparison to light-water-cooled reactor (LWR) fuels release fractions, provide the basis for the comparison

E3.8-3 **Information about the designs of shipping casks for advanced reactor irradiated fuels** – Provide capacities and dimensions of the shipping casks being modeled. It is assumed that the advanced LWR irradiated fuels would be shipped in casks similar to the current generation. For advanced non-LWR irradiated fuels, provide information about irradiated fuel handling, fuel behavior regarding failure and release fractions, and shipping cask concepts. Include all references and provide the basis for all assumptions made.

The following are specific questions related to Section 3.8 of the ER:

E3.8-4 **General** – Provide a transportation risk assessment for gas-cooled reactor spent fuel shipments using an accepted methodology, such as RADTRAN V. Provide justification that the best available information has been used to generate the RADTRAN input values, and that those values are appropriate for gas-cooled fuel shipments. Provide a comparison of the results of that assessment with the spent fuel shipment risk estimates contained in NUREG-0170, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes*.

E3.8-5 **General question** – For the light water reactor designs, what is the bounding value for (1) the number of truck shipments of irradiated fuel annually per unit, and (2) MTU of spent fuel per truck cask?

E3.8-6 **Section 3.8.1 (Light-Water-Cooled Reactors)** – This section states that the AP1000 is a single unit. This is contrary to other sections in the ER which state that the plant parameter envelope assumed two AP1000 units in the evaluation. For example, ER Section 3.5.1 states that two AP1000 units were used in developing the bounding radioactive liquid effluent release. Clarify why two AP1000 units weren't considered in the evaluation of transportation impacts.

E3.8-7 **Section 3.8.1, p. 3.8-4, top of page (Light-Water-Cooled Reactors)** - Provide justification for the statement that the Department of Energy (rather than licensees) would make the decision on transport mode.

E3.8-8 **Section 3.8.2.2, p. 3.8-6, last paragraph (Gas-Cooled Reactors - Analysis)** - The ER states that adjustments have been made on the basis of electrical output, but on p. 3.T-17, the note to Table 3.8-2 states that results were not adjusted. Describe all adjustments or normalizations that have been made (e.g., decay time, shipment, electrical generation, etc.).

E3.8-9 **Section 3.8.2.5, p. 3.8-10, first paragraph (Risk Contributors - Contents)** - The ER states that the reference LWR used a 90-day decay time, but on p. 3.T-16, 150 days is entered for decay time prior to shipment in the Reference LWR column of Table 3.8-2. What reference LWR decay time was used for the impact evaluation? In addition, what gas-cooled reactor radionuclide inventory was used for the impact evaluation?

E3.8-10 **Section 3.8.2.5, p. 3.8-9, first paragraph (Risk Contributors - Contents)** - Justify the applicability of the depletion code used to calculate the isotopic content of spent fuel for the new reactor designs.

Explain the in-core differences between a commercial LWR and the new reactor designs and how these differences affect the performance of the depletion calculation. These differences may include: initial enrichment, fuel configuration, type of moderator, specific power, fuel temperature, moderator temperature, and the presence of soluble, burnable and integral poisons.

E3.8-11 **Section 3.8.2.5, p. 3.8-10, third paragraph (Risk Contributors - Contents)** - The ER provides a comparison of reference LWR actinide and gas-cooled fuel inventories that states that the actinide inventory in Ci/MTU for the gas-cooled fuel exceeds that of the reference LWR, and that the pebble bed modular reactor (PBMR) would have essentially the same MTU per cask as the reference LWR. Provide the basis for the total actinide inventory per gas-cooled fuel truck cask. Does the increased actinide inventory call for additional cask shielding relative to that needed for reference LWR fuel? If so, does the added shielding affect cask payload and the number of shipments by truck, as shown in Table 3.8-2 on p. 3.T-16?

E3.8-12 **Section 3.8.2.6, p. 3.3-11, second paragraph (Gas-Cooled Reactors - Discussion)** - The ER quotes NUREG/CR-6703, *Environmental Effects of Extending Fuel Burnup Above 60 Gwd/MTU* [gigawatt days/MTU], (p. 3), regarding actinide dose contribution; however, the quoted text relates to pressurized water reactor (PWR) fuels burned in the presence of burnable poison rod assemblies. Describe the relevance of this information to the type of gas-cooled reactor spent fuel shipments contemplated in the ER.

E3.8-13 **Section 3.8.2.6, p. 3.8-12, second paragraph (Gas-Cooled Reactors - Discussion)** - For each gas cooled reactor technology proposed, demonstrate/quantify how the increased actinide activity in the fuel impacts neutron dose.

E3.8-14 **Section 3.8.2.6, p. 3.8-12, second paragraph (Gas-Cooled Reactors - Discussion)** - Justify the representation that only minor modifications to the amount of neutron shielding on the transportation packages will allow them to be used for fuel with a significantly higher neutron source term.

Address the effect of additional neutron shielding on other design aspects of the package performance such as the ability to reject the thermal heat load, the method for attaching the shielding, and the size of the impact limiter which affects the package's performance during a drop accident. Address the effect of additional shielding on package diameter, impact limiter size, rail or truck bed width, package weight, cask capacity, and number of shipments needed.

Address how the neutron source term for gas-cooled reactor fuel will be distributed when the fuel is shipped, and how that distribution might affect the shielding design of the transportation cask.

Section 4.3, Ecological Impacts

E4.3-1 **Section 4.3.1 (Impacts to Terrestrial Ecosystems from Construction)** - Provide an estimate of the total number of acres that would be disturbed by construction of the EGC ESP facilities and laydown yards, etc., including an estimate of the number of acres that would be permanently lost (displaced by structures) and that would be temporarily lost (e.g., laydown yards). Provide an estimate of the number of acres of each habitat type that would be disturbed, including an estimate of the number of acres of each habitat type that would be permanently lost (displaced by structures) and that would be temporarily lost (e.g., laydown yards).[1]

E4.3-2 **Section 4.3.1 (Impacts to Terrestrial Ecosystems from Construction)** - The additional transmission lines that could be required for the EGC ESP facility apparently would use existing rights-of-way (ROWS) (ER Section 3.7.2 and 4.3.1.2). The current ROWS are both 250 feet wide (ER Section 2.2.2). The new lines would require ROWs 250 feet wide (ER Section 3.7.2). However, evidently there would be a need to widen the ROWs into forest habitat (ER Section 4.3.1.2) and construction would occur "along" existing ROWs (ER Section 4.3.1.4.2.4). The amount of disturbance would depend on the construction practices used (ER Section 4.3.1.4.2.4). Provide greater detail on transmission line impacts that would result from construction of the EGC ESP facility, i.e., where along the existing lines disturbance due to ROW widening would occur and how many acres of what habitats would be affected, etc. (See ESRP Section 4.3.1).

Section 4.4, Socioeconomic Impacts

E4.4-1 **Section 2.5.2.7 (Public Services and Facilities), Section 4.4.2.7 (Public Services and Facilities), and Section 5.8.2.7 (Public Services and Facilities)** - The ER indicates there was a survey completed of "…water and water facilities in the region, and the facilities have excess capacity to accommodate a potential increase in the population in the region" – p. 2.5-9. Later in Chapters 4.0 and 5.0, the survey is referenced again (pages 4.4-4 and 5.8-5). The survey is not cited in the reference section. Provide a copy of the survey or the source of the data.

E4.4-2 **Section 4.4.2 (Social and Economic Impacts)** - The ER states that EGC is planning to hire 3150 construction personnel to build what appears to be multiple units. Dominion's ESP ER for North Anna indicates they plan to hire 5000 construction workers to build two units. EGC also states, "Experience from the construction of the CPS indicates that a significant number of the construction workforce came from other areas; however, the construction workforce was at

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[1]Alternatively, provide electronic versions of aerial photos that display the habitats on the EGC ESP Site and a GIS layer of polygons representing EGC ESP facilities and laydown yards, etc., that can be superimposed on the aerial photos to derive the above estimates.

least three times larger than what is anticipated for the EGC ESP Facility (p. 4.4-2)." Provide further information on how EGC arrived at the 3150 construction workforce.

Section 4.5, Radiation Exposure to Construction Workers

E4.5-1 In Section 4.5.3.2 of the EGC ESP application, Exelon states that "area TLD measurements during the third quarter of 2002 at the CPS protected area fenceline varied between 0.005 and 0.050 mrem/hr with an average fenceline dose rate of approximately 0.021 mrem/hr." Exelon used this value of 0.021 mrem/hr to derive the annual estimated dose per individual construction worker of less than 0.045 rem. As a result of discussions during the March 2004 site audit, Exelon stated that they were going to revise the method used to calculate the estimated annual construction worker dose. Exelon proposed to base this revised dose on the average of all of the fenceline TLD data for the time period between the second quarter 2001 through the first quarter 2003 (eight quarters of data). The data from all 16 fenceline TLDs would be included in this data.

When modifying Section 4.5 of the ESP application to include this revised data, Exelon should provide the following:

a. A table listing the quarterly TLD readings (net dose in mrem) for each of the 16 protected area fenceline TLDs for each of the calender quarters between the second quarter 2001 through the first quarter 2003 (eight quarters of data). This table should provide the average plant capacity factor for each of these eight quarters.

b. A figure of the plant and protected area indicating the locations of the 16 fenceline TLD locations.

c. The revised (based on the eight quarters of dose data) estimated annual dose to an individual construction worker of approximately 0.025 rem.

d. A discussion of why the eight quarters of TLD data used is considered to be bounding data for calculating the estimated annual dose to a construction worker.

Section 5.2, Water-Related Impacts

E5.2-1 **<u>Section 5.2.1.2.2 (Droughts)</u>** - Provide model (with documentation and inputs) that was used to perform the drawdown analysis discussed in ER Section 5.2.1.2.2.

E5.2-2 **<u>General</u>** - Quantify seasonal variability, if any, in consumptive losses of water from the wet cooling tower.

E5.2-3 **<u>Section 5.2.1.2.3 (Temperature and Water Quality)</u>** - Provide model (with documentation and inputs) that was used to perform the lake temperatures analysis described in ER Section 5.2.1.2.3.

E5.2-4 **<u>Section 5.2.1.2.3 (Temperature and Water Quality)</u>** - Explain why the reduction in lake volume due to the wet cooling tower does not make the conclusion stated in ER Section 5.2.1.2.3 ('the increase in lake temperature would be 8% or less') nonconservative.

E5.2-5 **<u>General</u>** - Provide wetlands delineations and jurisdictional determinations from the US Corps of Engineers for all lands that may be impacted directly or indirectly by the plant construction or operation.

Section 5.3, Cooling System Impacts

E5.3-1 **<u>Section 5.3.4.1, p. 5.3-11 (Thermophilic Organisms)</u>** - Provide the basis on which the following statement was made - "The increase in heat rejected to the lake due to the uprate would be greater than the increase due to the EGC ESP Facility; therefore, the EGC ESP Facility logically would not increase the risk significantly."

Section 5.4, Radiological Impacts of Normal Operations

E5.4-1 **<u>Section 5.4.2, p. 5.4-3 (Radiation Doses to Members of the Public)</u>** – ESRP Section 5.4.2 identifies the need for information on occupational radiation dose estimates. Provide occupational dose estimates for the plant parameter envelope reactor designs.

Section 7.1, Design Basis Accidents

E7.1-1 **<u>Section 7.1.2 of ER (Evaluation of Radiological Consequences)</u>** - ER Section 7.1.2 states that the site 50th percentile χ/Qs from Table 2.3-52 of the Clinton SSAR were used for the radiological consequence evaluations. Identify χ/Q values used for the surrogate plants (e.g., AP1000, ABWR, ESBWR, and ACR-700) used in Chapter 7 tables for evaluating the radiological consequences in these tables. Westinghouse has revised its χ/Qs in the AP1000 design certification control document since submittal of the EGC ESP application. Using the certified χ/Qs in the Westinghouse AP1000 Design Control Document, revise the site-specific doses and fission product releases for all design basis accidents (DBAs) in ER Chapter 7 accordingly, or note where the AP1000 values used in the ER have been revised but Exelon has elected not to use the updated values in the accident analyses.

E7.1-2 **Section 7.1.2 of ER** - ER Section 7.1.2 shows the time intervals used for the exclusion area boundary (EAB) and low population zone (LPZ). Clarify whether the 0- to 2-hour EAB time period is for the 2-hour period with the greatest EAB doses.

E7.1-3 **Section 7.1.2 of ER** - ER Table 7.1-2 summarizes the resulting doses at the ESP site for postulated design basis accidents using the AP1000, the ABWR, and the ACR-700 as surrogate reactor designs. Update the table for each design basis accident to include (1) AP1000, ABWR, and ACR-700 doses used for the EAB and LPZ, and (2) the ratios of site-specific χ/Qs to design certification χ/Qs used.

E7.1-4 **Section 7.1.2 of ER** - Several tables in ER Chapter 7 present doses for ABWR design basis accidents in total effective dose equivalent (TEDE) units. The ABWR design was certified with thyroid and whole body doses, not TEDE. Provide tables to show doses in thyroid and whole body doses as well as TEDE.

E7.1-5 **Section 7 of ER (Environmental Impacts of Postulated Accidents Involving Radioactive Materials)** - Several tables in ER Chapter 7 present the time-dependent activity releases for each design basis accident. Provide the references and the methodology used to determine the time-dependent activity release values in these tables. Note that the values in these tables should appropriately reflect the certified AP1000 design χ/Qs, as discussed in RAI E7.1-1.

Sections 7.2, Severe Accidents

E7.2-1 **Section 7.2.2 (Evaluation of Potential Severe Accident Releases)** - Provide an up-to-date, site-specific assessment of the adverse health effects from fallout onto open bodies of water, considering the EGC ESP site characteristics (e.g., water flow rates and contaminant residence times). Justify that the generic conclusion with respect to such matters that was reached in NUREG-1437 is valid for a future reactor at the ESP site.

E7.2-2 **Section 7.2.2 (Evaluation of Potential Severe Accident Releases)** - Provide an up-to-date, site-specific assessment of the adverse health effects from potential releases to groundwater, considering the ESP site characteristics. Justify that the generic conclusion with respect to such matters that was reached in NUREG-1437 is valid for a future reactor at the ESP site.

E7.2-3 **Section 7.2 (Severe Accidents)** - Provide a site-specific analysis of the environmental consequences of a potential severe accident at a new reactor located on the EGC ESP site using a Level 3 probabilistic risk assessment (PRA) consequence code such as the MACCS2 code. This could involve characterizing the spectrum of credible releases from candidate future plant designs, in terms of representative source terms and their respective frequencies, and using these release characteristics in conjunction with site-specific population and meteorology to determine site-specific risk impacts for the potential design. Release characteristics could be developed through a survey of severe accident analyses for previously certified advanced LWRs and/or operating reactors. The following information should be provided as part of this analysis:

a. a description of the computer code used as the basis for the calculations, including any modifications to the officially released version of the code, and important deviations from recommended or default code input values,

b. a description of the site-specific meteorology data used in the calculation, including the treatment of rain/precipitation events, and the degree to which the data represents or bounds year-to-year variations in weather at the ESP site,

c. a description of the site-specific population data used in the calculation, and justification that this data is representative of the time period through which new unit operations could extend,

d. a description of the major input assumptions for modeling economic impacts, including farm and non-farm values, evacuation costs, value of crops and milk contaminated or condemned, costs of decontamination of property, and costs associated with loss of use of property as a result of the accident (including contamination and condemnation of property),

e. a description of the protective actions considered in the evaluation, including criteria for sheltering and evacuation, criteria for interdiction and condemnation of property and/or crops, and the assumed level of medical support to aid the exposed population,

f. a description of the source terms used to represent the reference or surrogate plant design(s), including the radionuclide inventory and the release frequency and characteristics for each release category. These characteristics include release fractions for the major radionuclide groups, release times and durations, and elevation and energy of release,

g. the results of the calculations in terms of probabilistically-weighted population dose, early and latent fatalities, economic costs, and contaminated and condemned land areas, for the reference or surrogate plant design(s). Sufficient information should be provided to enable results to be displayed in a manner similar to later final environmental statements (FESs, e.g., Tables 5.10 through 5.13 in NUREG-0921), and

h. a listing of the input file for the ESP site (including population and meteorology) for the MACCS2 code.

E7.2-4 **<u>Section 7.2 (Severe Accidents)</u>** - Provide a comparison of the (probabilistically weighted) environmental risk of severe accidents for a future reactor at the EGC ESP site with:

a. the risks (doses) associated with normal and anticipated operational releases from a future reactor at the ESP site, and

b. the risk of severe accidents for the current generation of operating plants (at their respective sites), as characterized in such studies as NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*, and the plant-specific risk study for Clinton Power Station.

Section 9.3, Alternative Sites

ESRP Sections 9.3 and 9.4.3 provide guidance to the staff to consider transmission corridors in its evaluation of alternative sites. Provide information in response to the following questions for each of the alternative sites.

E9.3-1 **<u>General question</u>** - Do the existing transmission lines that connect the site to the grid have the capacity to carry the bounding case power output for additional units at the site?

E9.3-2 **<u>General question</u>** - Do the existing transmission towers have room for additional circuits that could carry the bounding case power output?

E9.3-3 **<u>General question</u>** - Do the existing rights-of-way have room for all additional circuits that would be needed to carry the bounding case power output?

E9.3-4 **<u>General</u>** - ESRP Sections 9.3 and 9.4.3 identify the need for information regarding presence of habitats, including wetlands, on each of the alternate sites and their transmission line corridors, and potential impacts to the same for each of the alternate sites. None of this information is currently provided in ER

Section 9.3. Provide an estimate of the number of acres of each habitat type that would be disturbed at each alternate site.[2]

[2]Alternatively, provide electronic versions of aerial photos that display the habitats on each alternative site and a GIS layer of polygons representing EGC ESP facilities and laydown yards, etc., that can be superimposed on the aerial photos to derive the above estimates.

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