APPENDIX E

REPORT BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

ACRSR-2182

March 24, 2006

The Honorable Nils J. Diaz
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: FINAL REVIEW OF THE EXELON GENERATION COMPANY, LLC, APPLICATION FOR EARLY SITE PERMIT AND THE ASSOCIATED NRC STAFF'S FINAL SAFETY EVALUATION REPORT

Dear Chairman Diaz:

During the 530th meeting of the Advisory Committee on Reactor Safeguards, March 9-11, 2006, we completed our review of the early site permit application for the Clinton site and the associated final Safety Evaluation Report (SER) prepared by the NRC staff. We reviewed the application and the final SER to fulfill the requirement of 10 CFR 52.23 that the ACRS report on those portions of an early site permit application that concern safety. We issued an interim letter on this application and the associated draft SER on September 22, 2005. This matter was also discussed during our Subcommittee meeting on March 8, 2006. During these reviews, we had the benefit of discussions with representatives of the NRC staff and Exelon Generation Company, LLC (Exelon). We also had the benefit of the documents referenced.

CONCLUSIONS AND RECOMMENDATIONS

- The early site permit application and the staff's final SER show that the proposed nuclear power plant site adjacent to the existing Clinton Nuclear Power Station is an acceptable site for nuclear power plants that meet the plant parameter envelope proposed by the applicant.
- The staff has thoroughly reviewed a performance-based method proposed by the applicant for determining the safe shutdown earthquake (SSE) ground motion. This method is an attractive alternative to methods endorsed in current regulatory guides.
- The staff should consider development of a regulatory guide dealing with the alternative, performance-based, method for assessing the seismic hazard of a site.

DISCUSSION

Exelon has applied for an early site permit for locating nuclear power plants or modules having a total power generation rate of 2400 to 6800 MWt on a site adjacent to the currently operating Clinton plant, which is a BWR 6 within a Mark III containment. The early site permit application is based on the now familiar "plant parameter envelope" approach since the applicant has not identified the particular reactor technology that will be adopted. The plant parameter envelope is based on the characteristics of certified designs such as the AP1000 and Advanced Boiling

Water Reactor (ABWR) as well as other designs such as the International Reactor Innovative and Secure (IRIS), Economic Simplified Boiling Water Reactor (ESBWR), Gas-Turbine Modular Helium Reactor (GT-MHR), and Pebble Bed Modular Reactor (PBMR).

The staff's review of this application included a detailed review of the alternative, performance-based method proposed by the applicant for determining the SSE ground motion spectrum. The staff identified six permit conditions for the proposed site. The staff has used technically sound, objective criteria for identifying these permit conditions. The staff and the applicant have agreed to 32 combined license (COL) action items. The action items for the proposed Clinton site can be compared to 30 action items for the North Anna early site permit and 26 action items for the Grand Gulf early site permit.

Nature of the Site

The proposed site is located in a rural setting in central Illinois. The terrain is essentially flat with some rolling hills. Nearby populations centers with populations in excess of 25,000 include Springfield (74 km), Peoria (75 km), Champaign (49 km), Urbana (66 km), Decatur (36 km), and Bloomington (36 km). Near the site (<16 km) are the small towns Clinton (population 7,000), as well as DeWitt, Weldon, and Wapella each with a population of less than 1,000.

Population trends in the larger cities near the site have been estimated based on census data. Modest growth in population is anticipated in these cities over the next 60 years. Interestingly, data obtained from other sources led the applicant to anticipate that populations in the rural regions around the site will decline modestly over the next 60 years.

Weather

Weather at the proposed site is well characterized in recent years as would be expected for a site with an operating nuclear power plant. The weather is marked by rather warm summer periods and harsh winters. Weather extreme characteristics of the site have been based on historical data. Neither the applicant nor the staff has considered the potential for cycles in weather that may complicate the prediction of future weather extremes based on historical records. Nevertheless, we believe that the applicant has adequately characterized the site weather for the purposes of an early site permit.

Seismicity

The proposed site is affected by the New Madrid seismic zone and the Wabash Valley seismic zone. Since the nuclear power plant at the Clinton site was licensed, the estimated frequency of major earthquakes at the New Madrid seismic zone has been increased. The estimate of the maximum potential magnitude of earthquakes at the Wabash Valley seismic zone has also been increased. There is a background seismicity of the site represented by the Springfield earthquake estimated to have occurred at a location about 70 km from the site, approximately 6,000 years ago and to have had a magnitude of 6.2 to 6.8 on the Richter scale.

In other applications for early site permits, the applicants have adopted the methods recommended in Regulatory Guide 1.165 to estimate the SSE ground motion spectrum. Exelon has adopted an alternative method. This alternative is based on an industry standard (ASCE 43-05) that itself is based on work done by the Department of Energy for assessing the seismic safety of its nuclear facilities. The alternative is considered "performance based" because it uses a target probability for the maximum acceptable facility damage from an earthquake.

Exelon has selected the frequency of 10^{-5}/yr for the onset of significant inelastic deformation of systems, structures, and components. This target provides a rather substantial margin to core damage and containment failure.

The staff has reviewed thoroughly the proposed alternative method for estimating the seismic hazard at the proposed site. The staff's review included examination of the credibility of parametric quantities in the models and an independent assessment of the analysis results by direct integration of the seismic risk equation. Also, the staff has reviewed carefully the applicant's assessment of the local seismic hazard. We concur with the staff that the alternative approach adopted by Exelon for this application provides a high level of safety. The seismic core damage frequency that can be inferred from the proposed ground motion spectrum (~$2x10^{-6}$/yr) is significantly less than the median found in seismic probabilistic risk assessments for 29 existing nuclear power plants. The performance-based alternative method yields results that are in concert with the Commission's expectation that advanced reactors will provide enhanced margins of safety and/or utilize simplified, inherent, passive, or other innovative means to accomplish their safety functions.

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. The staff may want to consider developing a regulatory guide on the use of the alternative methodology. Certainly, the detailed review of the method conducted by the staff for this early site permit would provide a substantial technical basis for the development of such a regulatory guide.

Sincerely,

/RA/

Graham B. Wallis
Chairman

References:

1. Exelon Generation Company, LLC, Early Site Permit Application, September 23, 2003.
2. ACRS Interim Letter, Exelon Generation Company, LLC, Application for Early Site Permit and the Associated NRC Staff's Draft Safety Evaluation Report, dated September 22, 2005.
3. EDO response to ACRS Interim Letter, "Interim Letter: Exelon Generation Company, LLC, Application for Early Site Permit and the Associated NRC Staff's Draft Safety Evaluation Report on the Clinton Early Site Permit Site," dated October 26, 2005.
4. Final Safety Evaluation Report for Exelon Early Site Permit Application, dated February 17, 2006.
5. Exelon Generation Company, LLC, letter to the U.S. Nuclear Regulatory Commission Subject: "Seismic Risk (Performance Goal) Based Approach Primer Revision," dated January 14, 2005.
6. NRC Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," March 1997.
7. American Society of Civil Engineers, Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities, ASCE/SEI 43-05 (ASCE Standard 43-05), 2005.

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