MEMORANDUM TO: Joseph W. Shea, Chief
Regional Operations and Program Management Staff
Office of the Executive Director for Operations

FROM: Joseph M. Sebrosky, Acting Deputy Director
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

SUBJECT: VISIT BY EXELON NUCLEAR (EXELON) EXECUTIVE WITH COMMISSIONERS DIAZ, MCGAFFIGAN AND MERRIFIELD

On April 16, 2002, Mr. Oliver D. Kingsley will meet with Commissioner Diaz at 10:00 a.m., Commissioner Merrifield at 11:00 a.m., and Commissioner McGaffigan at 2:00 p.m.

This meeting is to discuss the status of the Pebble Bed Modular Reactor (PBMR) project. Attached is a background briefing package in preparation for the meeting to include:

- Briefing Sheet
- PBMR Fact Sheet
- Resume of Mr. Kingsley

Should you require any additional information, please contact Amy Cubbage at 415-2875.

Attachments: As stated

cc w/atts: S. Collins/J. Johnson
W. Borchardt
J. Lyons
M. Case
A. Mendiola
F. Eltawila
J. Flack

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EXELON NUCLEAR

Visiting Official: Oliver D. Kingsley, President
and Chief Nuclear Officer
Exelon Nuclear
Exelon Generation Company, LLC

Date of Visit: April 16, 2001

Project: Pebble Bed Modular Reactor

BACKGROUND

In a letter dated December 5, 2000, Exelon Generation Company (Exelon) requested early interactions with the staff on the feasibility of licensing the pebble bed modular reactor (PBMR) in the United States (U.S.). The Office of Research (RES) has taken the lead for PBMR pre-application activities with support from the Office of Nuclear Reactor Regulation (NRR), the Office of Nuclear Materials Safety and Safeguards (NMSS), and the Office of the General Counsel (OGC). The staff's plan for pre-application activities on the PBMR was provided in SECY-01-0070, "Plan for Pre-Application Activities on the Pebble Bed Modular Reactor (PBMR)," dated April 25, 2001. The PBMR pre-application review started on April 30, 2001. Since then, monthly meetings have been held with Exelon, the Department of Energy (DOE), and other interested stakeholders to discuss the PBMR pre-application review efforts. These efforts are focused in three areas: (1) Exelon's proposals related to nine legal and financial issues including Price Anderson, annual fees, and antitrust review requirements; (2) Exelon's proposed licensing approach for the PBMR; and (3) identifying key technical and policy issues related to the PBMR design.

EXPECTED TOPICS FOR DISCUSSION ON APRIL 16, 2001

- A status report on Exelon's plans for licensing the PBMR in the U.S.

CURRENT ISSUES:

1. Legal and Financial Issues:

In SECY-01-0207, "Legal and Financial Issues Related to Exelon's Pebble Bed Modular Reactor (PBMR)," dated November 20, 2001, the staff's preliminary position on operator staffing, fuel cycle impacts, financial qualifications, decommissioning funding, minimum decommissioning costs, antitrust review, number of licenses, annual fees, financial protection,

and testing requirements for a combined license (COL) were given. On March 27, 2002, the staff held a public workshop to discuss the positions presented in this paper with Exelon and other stakeholders. Based on these discussions, the staff will revise its positions, as necessary, and make recommendations on policy issues related to the legal and financial matters for Commission approval in June 2002.

2. Exelon's Licensing Approach:

The staff has completed its preliminary assessment of Exelon's proposed licensing approach for the PBMR. Exelon's approach is to conform with the current regulations while recognizing that many of the current regulatory requirements are based on light water reactor (LWR) technology. A risk-informed process would be used to define events for which the plant is to be designed, acceptance criteria, and a classification process whereby design requirements are specified for structures, systems, and components. The staff has concluded that the licensing approach proposed by Exelon, if adequately implemented, is a reasonable process for ensuring that the Commission's regulations are met and for identifying PBMR-specific regulatory requirements.

Implementation of Exelon's proposed licensing approach requires additional design and probabilistic risk assessment (PRA) information that has not yet been provided. A detailed PRA is required for implementation of Exelon's proposed risk-informed regulatory approach. Furthermore, the degree to which the staff may be able to rely on PRA information for the PBMR will be a consideration due to the more limited operating experience for such designs. In its preliminary evaluation, dated March 26, 2002, the staff informed Exelon that while the PRA confirms risk insights for a design, licensing activities will be a mix of "deterministic" analyses supplemented with risk insights. The lack of operational data for some of the unique PBMR structures, systems and components makes reliance on PRA difficult. Therefore, the staff will continue to assess issues such as treatment of uncertainties, margins of safety, and defense-in-depth.

3. Pre-application Technology/Design Review:

Exelon has informed the staff that the detailed design phase for the PBMR has been delayed in order to resolve a number of key technical issues. Exelon indicated that information requested by the staff would be provided over a 24-month period from January 2002 to December 2003. Subsequent discussions between Exelon and the staff have resulted in an agreement to provide critical technical information in 2002. This information will provide the basis for the scope and content of the staff's pre-application review.

The current PBMR pre-application review is mostly limited to summarized technical information presented at meetings and high level "white papers" submitted by Exelon documenting those presentations. Exelon has informed the staff that neither a PBMR preliminary design document nor a probabilistic risk assessment (PRA) will be available during the pre-application review because of the changing status of the PBMR design. Detailed information will become

available to Exelon, and subsequently the NRC, when an application is submitted for a PBMR combined license. These constraints have impacted the scope and level of the staff review.

As discussed in SECY-01-0070, areas that are likely to lead to policy issues include proposed licensing-basis accidents, the need for containment versus confinement, application of a mechanistic source term, and reduced emergency planning zones. Defense-in-depth principles and a risk-informed approach that is supported by a sound technical basis will be used to address these issues. The staff plans to prepare a SECY paper and to engage the Commission on these potential policy issues this summer. The staff continues to encourage Exelon to provide information related to potential policy issues on an expedited schedule.

The staff plans to provide a Commission paper in the Fall of 2002 on the PBMR licensing basis events. This schedule allows time for the staff to complete and document its review and to interact with the Advisory Committee on Reactor Safeguards (ACRS) before submitting the paper. Another paper scheduled for June 2003 will address other technical, safety, and policy issues that stem from the pre-application review of the PBMR. These schedules are dependent on Exelon's ability to provide the white papers for the previously presented technical topics, to meet its revised schedule, and to provide timely responses to staff questions.

CONGRESSIONAL INTEREST:

Price Anderson Act:

Legislation has been passed by the House (H.R. 2983) that would amend Section 170 to allow a combination of two or more modular reactors (each rated 100 -300 MWe) with a combined rated capacity of not more than 1300 MWe to be considered one facility. Legislation is under consideration by the Senate (S. 517) which contains the same provision.

PBMR FACT SHEET

Pebble Bed Modular Reactor

Vendor/Applicant: Exelon Generation

Reactor type: Modular high-temperature gas-cooled reactor with pebble-type fuel

Power output: 110 - 140 Mwe per module

Features: Up to 10 modules linked per control room
TRISO coated, UO_2, 7.8 - 8.5% enriched pebbles
closed-cycle helium cooled reactor and vertical Brayton-cycle turbine
core: 330,000 fuel pebbles; 110,000 graphite pebbles for central reflector
multi-pass, continuous on-line reload
passive decay heat removal

The PBMR is a modular high temperature gas-cooled reactor. Each module will be up to 140 MWe. On one site, up to 10 modules could be linked by one control room.

The reactor core contains approx. 330,000 fuel pebbles and approx. 110,000 graphite-only pebbles. The pebble is 60 mm in diameter (about the size of a cue ball or racquetball). The graphite pebbles create a central reflector column in the core. This shifts the peak power outward radially and enables higher power production. The core is 8.44 m in height and 3.5 m in diameter. The pebbles are loaded from 8 positions around the periphery of the core, through the top reflector. There are top, bottom, side reflectors, and the center graphite balls act as a reflector. The average helium temperature entering the reactor is 500°C. The average exit temperature is 900°C.

Refueling is performed on-line continuously (daily). Each pebble is expected to pass through the core approximately 10 times. Burnup for each pebble will be 80,000 MWD/MTU.

The helium gas is in a closed cycle from the reactor to the turbine-generator. Each module will have its own turbine-generator, which are a vertical design. The turbine will work on the Brayton cycle.

Prevention of radiation release: The TRISO coated particle is designed to withstand 1600°C that will retain the radionuclides under all accident conditions. Due to a strong negative temperature coefficient, the reactor will shut itself down if helium is lost. The pressure boundary includes the reactor unit pressure vessel and power conversion unit pressure vessel (turbine/generator). The "confinement" building is vented and non-pressure retaining.

During normal operations, changes in power are made by adjusting the pressure and mass flow rate of the helium. The design also includes the reactivity control and shutdown system (RCSS) consisting of two independent systems: the reactivity control system (RCS) which consists of 18 control rod systems and the reserve shutdown system (RSS) which consists of 17 small absorber sphere (SAS) shutdown systems.

The reactor cavity cooling system (RCCS) dissipates the heat from the reactor vessel during normal operation, including shutdown. The system also removes decay heat during the loss of heat transfer functions of the power conversion unit (loss of forced cooling). The RCCS includes three independent units each providing 100% cooling capacity for several days. The RCCS is not relied upon to protect the nuclear fuel from exceeding its design temperature. Heat transport through the concrete structures is sufficient to ensure the maximum core temperature is not exceeded.

Exelon Target Dates:

PBMR Pre-Application: Ongoing
Early Site Permit (ESP) Application: June 2003
Combine License (COL) Application: Early CY 2004

OLIVER D. KINGSLEY, JR.

President, Chief Nuclear Officer

EXPERIENCE:

- **Exelon Nuclear**

Dec. 2000 - Pres. President and Chief Nuclear Officer

- **Commonwealth Edison Company**

1997 - Dec. 2000 President, Chief Nuclear Officer, Nuclear Generation Group

- **Tennessee Valley Authority**

1997 - 1988 Senior Vice President, Nuclear Power (SNE)
President, Generating Group
President, TVA Nuclear and Chief Nuclear Officer (SNE)

- **Middle South Utilities**

1988 - 1985 Vice President, Nuclear Operations (Grand Gulf Nuclear Plant)

- **The Southern Company**

1984 - 1971 Assistant Plant Manager, Farley Nuclear Plant
Plant Manager, Farley Nuclear Plant
Assistant Manager, Nuclear Generation
Manager, Nuclear Engineering & Technical Support

- **Military Branch**

1971 - 1966 United States Navy Nuclear Submarine Force

EDUCATION:

- BS - Engineering Physics with Honor - Auburn University, 1966

OTHER QUALIFICATIONS:

- NRC Senior Reactor Operator, Farley Nuclear Plant, 1977
- Received ANS Zinn Award for outstanding contributions in nuclear power, June 2000

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ORIGINATOR: **A. Cubbage**

SECRETARY: **C. Nagel**

DATE: **November 25, 2002**

●●● ROUTING LIST ●●●

	NAME	DATE
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