September 26, 2001

Mr. James Muntz, Vice President
Nuclear Products, Exelon Generation
300 Exelon Way
Kennett Square, PA 19348

Dear Mr. Muntz:

Since April 2001 Exelon Generation Company and the U.S. Nuclear Regulatory Commission have been having a series of preapplication meetings on the Pebble Bed Modular Reactor (PBMR). The purpose of and expectations for these meetings are to facilitate early identification of safety issues and a path to their resolution, thus enhancing the effectiveness and efficiency of future staff reviews as well as providing guidance useful to Exelon in preparation of an actual application. The scope and schedule envisioned for the preapplication review was described in SECY-01-0070, "Plan for Preapplication Activities on the Pebble Bed Modular Reactor (PBMR)," dated April 25, 2001, As discussed in SECY-01-0070, we intend to prepare a summary paper for Commission review in approximately April 2002 describing the safety issues and their potential resolution. As we had discussed previously, in order to achieve this, we need input from Exelon by December 2001, so as to allow time for preparation of the paper, review by the Advisory Committee on Reactor Safeguards, and NRC management review.

The results of our meetings have led to a greater understanding of the PBMR program; however, the scope of the information provided at the meetings to date and subsequent follow up submittals, may not be sufficient to achieve our original expectations. Accordingly, we have prepared a summary, by technical area, of the major technical issues which we would like to address during the PBMR preapplication phase, and the information we believe is necessary to review the issues and facilitate development of a plan for the generation of information that can lead to their resolution. This summary is enclosed to this letter.

It is requested that you review the enclosed summary and respond as to whether or not the desired information can be provided by December 2001 and, if not, what alternative you propose. Please contact me if you have any questions.

Sincerely,

/RA/ *Thomas L. King*

Thomas L. King, Director
Division of Systems Analysis and Regulatory Effectiveness
Office of Nuclear Regulatory Research

Enclosure: As stated

cc w/encl.: William D. Magwood, IV, U.S. DOE

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Pebble Bed Modular Reactor Preapplication Review – Outcomes Expected

Based upon the plan for the Pebble Bed Modular Reactor (PBMR) preapplication review, as described in SECY-01-0070, "Plan for Preapplication Activities on the Pebble Bed Modular Reactor (PBMR)," April 25, 2001, the staff had envisioned that sufficient discussion and documentation would be provided to allow identification of the major safety issues associated with the PBMR and agreement on paths to their resolution. Listed below, by technical area, is a summary of the major technical issues which we would like to address during the preapplication phase and the information necessary to allow NRC to provide feedback in sufficient detail to define the scope and approach for their resolution.

A) PBMR Design Basis

- Issue 1: what are the events the PBMR will be designed for?
  - Information needed: description of the off-normal events for which the PBMR is to be designed, the approach and criteria for their selection, their acceptance criteria, and the role of probabilistic risk assessment in the design and safety assessment. (It is recognized that on August 31, 2001, Exelon submitted a document describing their proposed approach and criteria for selecting events to be considered in the design).

- Issue 2: what systems, structures, and components will be considered "safety grade" and what requirements will be imposed as a result of this classification?
  - Information needed: list of "safety grade" structures, systems, and components (SSCs), how they were selected, and their key requirements (e.g., seismic, quality assurance (QA), environmental qualification (EQ), etc.)

- Issue 3: what is the basis for the source terms assumed in safety analysis?
  - Information needed: a description of the source terms used in the safety analysis (quantity, chemical form, and timing of release) and their technical bases for:
    - normal operation, including anticipated operational occurrences
    - design basis accidents, including any air and moisture ingress
    - beyond design basis accidents, including air and moisture ingress

    The contributions from graphite, graphite dust and its impurities should be included as well as fission products.

- Issue 4: what are the automated control features of the PBMR, including staffing plans and control room design features?

  – Information needed: describe plans, requirements, and design criteria (e.g., standards) for safety-related PBMR I&C systems. Describe staffing plans, including how many control room operators and the control room layout, as well as the overall strategy for operation (i.e., role of the operator in normal and off-normal events)

B) PBMR Fuel

- Issue 1: what will be done to demonstrate that the PBMR production fuel will have sufficient integrity and fission product retention capability to meet project goals for limiting initial defects, and achieving the desired irradiation performance and behavior under normal and accident conditions?

  – Information needed: a description of the in-reactor and ex-reactor fuel testing to be performed, including source and quantities of fuel to be tested, test conditions, test objectives, acceptance criteria, schedule, post test examinations to be performed and documentation to be prepared. Also, the strategy and schedule for obtaining the above data as it relates to supporting the COL application should be described.

- Issue 2: what will be done to ensure that the fuel quality is maintained over the life of the plant?

  – Information needed: fuel fabrication and quality control and performance monitoring plans.

- Issue 3: how will the fuel ultimately be disposed of?

  – Information needed: –plans for packaging, transportation, and disposal of spent fuel, after on-site spent fuel storage.

  –does Exelon anticipate the need for dry cask storage? Also, address any special provisions that would be necessary to dispose of the substantially larger volume of spent fuel (on a per MWe basis) associated with large scale deployment of the PBMR in the U.S.

- Issue 4: fuel fabrication

  – Information needed: –how and where the initial PBMR fuel will be fabricated. Are there plans for fabricating PBMR fuel in the U.S. at some point in the future?

  –What special provisions might be required for transporting fresh PBMR fuel to the U.S. (e.g., due to the higher enrichment)?

- Issue 5: security and safeguards

  – Information needed: –Does the PBMR design pose any unique security or safeguards concerns?

  –Are there special provisions for material control and accounting (MC&A)?

C) PBMR Materials

- Issue 1: what graphite will be used for the reflector and other in-vessel structures and how will its physical properties (e.g., thermal conductivity, strength, dimensions, etc.) as a function of temperature and irradiation be determined?

  – Information needed: –description of the graphite to be used (e.g., fabrication standard, fabrication process, source of feed material, etc.) and the plans to obtain its physical properties as a function of temperature, time, and irradiation.

  – code, standard or acceptance criteria for analysis of integrity of graphite structures.

- Issue 2: what materials and design codes are to be used for the reactor pressure vessel and connecting piping?

  – Information needed: –grade of steel, service conditions (normal and off normal), and design codes to be employed.

  –procedures and databases for conducting fatigue and creep analyses including the effects of high-temperature helium with impurities on degradation of fatigue life, stress corrosion cracking resistance and creep properties.

  –effect of graphite particles and helium impurities on carburization and degradation of metal surfaces.

  –inservice inspection plan, including frequency and components to be inspected.

- Issue 3: what concrete and design codes are to be used for the reactor cavity.

  – Information needed: type of concrete, service conditions (normal and off normal) and design information (e.g., code).

D) PBMR Safety Analysis Tools

- Issue 1: how will analytical tools used to assess plant response to accident conditions be validated? This includes analytical tools for analysis of:

    - fuel temperature and burnup during normal and off-normal events, including accounting for uncertainties due to pebble location and residence time.

    - fission product release and transport during normal and off-normal events, including beyond design basis accidents.

    - reactor pressure vessel and connecting piping temperatures, stresses and time history during normal and off-normal events.

  – Information needed: analytical tool description, including range of applicability, scaling considerations and plans for validation of models and methods (e.g., thru comparison with experimental data, benchmarks, etc.).

- Issue 2: how will testing using the demonstration plant in South Africa be used to support an application in the U.S.?

  – Information needed: description of the tests to be performed including test objectives, schedule, acceptance criteria, test conditions, additional instrumentation and documentation.

E) PBMR Containment vs. Confinement

- Issue: what is the basis for proposing a design with a confinement building vs. a pressure retaining containment building?

  – Information needed: –the criteria and rationale for confinement, including the advantages and disadvantages of containment vs. confinement considering the potential dose to workers and offsite from factors such as:

    - routine operation
    - design basis accidents
    - beyond design basis accidents
    - acts of sabotage
    - impact on offsite response

    –the design conditions and codes and standards for the containment/confinement.