

January 30, 2002

MEMORANDUM TO: Jack E. Rosenthal, Chief
Safety Margins and Systems Analysis Branch
Division of Safety Analysis and Regulatory Effectiveness

John H. Flack, Chief
Regulatory Effectiveness Assessment and Human Factors Branch
Division of Safety Analysis and Regulatory Effectiveness

FROM: Farouk Eltawila, Director */RAI/*
Division of Safety Analysis and Regulatory Effectiveness
Office of Nuclear Regulatory Research

SUBJECT: REVIEW OF INFORMATION FROM EXELON GENERATION
COMPANY FOR THE PEBBLE BED MODULAR REACTOR (PBMR)
PRE-APPLICATION REVIEW: NUCLEAR FUEL, PBMR DESIGN AND
HEAT REMOVAL, ANALYTICAL CODES AND METHODS AND PBMR
OPERATIONAL MODES AND STATES

The NRC's objectives for the PBMR pre-application review are to obtain information from Exelon Generation Company (Exelon) on the PBMR design and its technical basis in order to (1) identify significant technical issues, safety issues, and policy issues and (2) identify a path for resolution of the issues. Achieving these objectives is expected to enhance the effectiveness and efficiency of the staff's review of an actual license application and to provide guidance to Exelon that is useful in the preparation of an application.

Since June 2001, the NRC staff has held monthly meetings with Exelon and the Department of Energy (DOE) to receive presentations and information on a range of technical and programmatic topics supporting the PBMR pre-application review. These monthly meetings have provided a starting point for obtaining information from Exelon on the PBMR design and its technical basis and to begin to identify significant issues for which resolution guidance will need to be identified. Table 1 in Attachment 1 provides the topics that Exelon has presented, to date, in these meetings. Table 2 documents the Exelon-requested outputs for the staff's review of each topic.

The purpose of this memorandum is to request: (1) REAHFB to coordinate the NRC's review of the Exelon white paper on "PBMR Nuclear Fuel" (Topic 1, proprietary) provided in Attachment 2, (2) SMSAB to coordinate the review of the Exelon white papers on "PBMR Analytical (computer) Codes Data Tables" (Topic 4, non-proprietary), "PBMR Design and Heat Removal Preliminary Description" (Topic 6, proprietary) and "PBMR Operational Modes and States" (Topic 11, proprietary) provided in Attachment 3 and (3) REAHFB and SMSAB to develop and document appropriate requests for additional information (RAIs) on the assigned topics. It is requested that the RAIs be provided by March 29, 2002, for transmittal to Exelon.

To date, Exelon has presented 12 technical and programmatic topics as shown by Attachment 2, Table 1. REAHFB and SMSAB have the lead review responsibility for selected topics and a supporting review responsibility for other topics. Early in the pre-application review, RES requested Exelon to formally document and submit for RES review the information that had been informally presented in these meetings. Exelon agreed to this request and has begun to submit the requested documents as technical "white papers" for each presentation topic. In addition to the purposes stated by Exelon for presenting each topic (see Attachment 1, Table 2), Exelon has also requested feedback, where appropriate, on the staff's technical, safety, or policy issues, including questions associated with each of these topical papers and related presentations. Exelon has also indicated that, where possible, they would respond to these issues and questions during the pre-application review, or subsequently, as part of an actual application. Issues and questions that they can be responsive to during the pre-application review phase will also allow Exelon to revise and re-submit the associated white paper to incorporate the substance of their response. The white papers, including any updates and formal responses to staff identified issues and questions, will provide the primary basis upon which the staff's pre-application review findings, conclusions, positions, and guidance will be based. In this regard, it should be noted that because of the nature of Topic 11, Exelon made no specific request to NRC with respect to either the presentation or the associated white paper. Accordingly, it may be found that Topic 11 will result in no RAIs for transmittal to Exelon.

A request for additional information or questions on the white papers provides a formal process for the staff to identify and communicate its preliminary questions related to potentially significant technical, safety, and policy issues on each topic. An Exelon response could also provide important input for the development of staff guidance for resolving the identified significant issues and questions. It should be understood that Exelon does not plan to provide a preliminary design document for the PBMR for the staff's pre-application review. Accordingly, RAIs should not be used simply to compile a more complete PBMR design description or safety analysis description. RAIs should probe and draw attention to the key technical, safety, or policy issues that will need to be addressed during a license application review. By the (limited) scope and depth of the PBMR pre-application documentation provided in these white papers, the pre-application review will not be able to identify all significant technical or safety issues that may be identified during a review of an actual application when a detailed FSAR is provided. The objective now is to apply NRC's best efforts to identify the key issues associated with each white paper, to the extent that the information in these documents (together with other available reference information) allow.

In a letter dated November 15, 2001, Exelon informed the NRC of its revised plans for submitting the most safety significant PBMR pre-application review topics (Attachment 4). The revised schedule will result in a four month extension of the pre-application review period. It is now expected that the results of the pre-application review of the PBMR design and associated technical basis, including the identified staff issues and guidance for resolution, will be documented in a Commission paper submitted in April 2003. The Commission paper will include the significant technical issues, safety issues, and programmatic issues that were identified by the staff, and the staff's guidance for resolution of these issues as part of an actual application. The paper will also include the significant public health and safety issues requiring Commission policy guidance (e.g., containment functional requirements, licensing basis events, source term calculation and use, and emergency planning requirements). For Commission policy level issues, the paper is expected to include the staff's policy guidance options and the staff's bases for any recommended guidance.

As stated earlier, the pre-application review information provided by Exelon, including their response to staff questions, comments, and issues, will provide the principle basis for the staff's assessment of each topical area including the identification of key issues and guidance (on further information and actions) needed for resolution. However, as mentioned above, it is expected that the staff will utilize other relevant PBMR-specific and HTGR-generic information, resources, and perspectives to conduct its review of Exelon's white papers and presentation information. Such other information includes (1) "Introduction to the Pebble Bed Modular Reactor (PBMR)" submitted by Exelon; (2) the modular HTGR course (and course materials) presented by the Department of Energy in September and October 2001; (3) the IAEA HTGR technical documents (TECDOCS) available on CD (see Chester Gingrich); (4) staff technical review documents and Commission policy documents (compiled and available for reference in the NRC library) associated with previous staff reviews of modular HTGRs (see Raji Tripathi); (5) significant modular HTGR design, technology and safety assessment reference documents and information obtained from foreign organizations in connection with recent NRC staff and Commission visits to South Africa, the UK, Germany, China and Japan (translations and copies in progress (see Peggy Bennett); (6) DOE laboratory specialized contractor input and information (e.g., modular HTGR accident analysis, and coated particle fuel irradiation testing), and (7) the October 2001 HTGR Safety Issues and Research Workshop (see Raji Tripathi) .

As noted earlier, the letter from Exelon, dated November 15, 2001, summarizes Exelon's proposed schedule for providing additional technical white papers on additional safety significant pre-application review topics (beyond those listed in Attachment 1, Table1) during CY2002 and CY2003. However, based on discussions with Exelon, NRC has determined that the PBMR pre-application review will only encompass topics that can be presented and documented by Exelon through the end of CY 2003. Accordingly, Attachment 4 should be viewed as an interim reference on additional technical and programmatic pre-application review topics for which REAHFB and SMSAB resources and support will be needed during FY 2002 and early FY 2003.

Finally, Attachment 5 contains the handouts provided by Exelon for the presentations on "Fuel Overview - Design, Manufacturing, QC and Qualification" (proprietary) given at the June 13, 2001 meeting, "Analytical Codes and Software Design" (non-proprietary) and "PBMR Core Design" (proprietary) and "PBMR Heat Removal" (proprietary) given at the August 16, 2001 meeting and "PBMR Operational Modes and States" (non-proprietary) given at the November 30, 2001 meeting.

If you or your staff have any questions on this request or require additional information, please contact me (415-7499) or the RES project manager for the PBMR pre-application review, Stuart Rubin (415-7480).

ADAMS Package ML020350210
ADAMS Memo ML020350155

Attachments: As stated

ADAMS Accession Numbers:

Attachment 2, Topic 1	ML020310239	Attachment 5	ML020310197
Attachment 2, Topic 4	ML013050065	Attachment 5	ML020310241
Attachment 3, Topic 6	ML020310222	Attachment 5	ML020310247
Attachment 3, Topic 11	ML020310208	Attachment 5	ML020310249
Attachment 4	ML013480132	Attachment 5	ML020310265

J. Rosenthal, J. Flack

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cc: See Attached List

Memorandum dated January 30, 2002

SUBJECT: REVIEW OF INFORMATION FROM EXELON GENERATION COMPANY FOR
THE PEBBLE BED MODULAR REACTOR (PBMR) PRE-APPLICATION
REVIEW: NUCLEAR FUEL, PBMR DESIGN AND HEAT REMOVAL,
ANALYTICAL CODES AND METHODS AND PBMR OPERATIONAL MODES
AND STATES

cc w/atts.:

M. MMayfield, RES

cc w/o atts.:

A. Thadani, RES, R. Zimmerman, RES

S. Newberry, RES

C. Ader, RES

G. Holahan, NRR

J. Strosmider, NRR

J. Lyons, NRR

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Memorandum dated January 30, 2002

SUBJECT: REVIEW OF INFORMATION FROM EXELON GENERATION COMPANY FOR THE PEBBLE BED MODULAR REACTOR (PBMR) PRE-APPLICATION REVIEW: NUCLEAR FUEL, PBMR DESIGN AND HEAT REMOVAL, ANALYTICAL CODES AND METHODS AND PBMR OPERATIONAL MODES AND STATES

cc w/atts.:

M. MMayfield, RES

cc w/o atts.:

A. Thadani, RES, R. Zimmerman, RES

S. Newberry, RES

C. Ader, RES

G. Holahan, NRR

J. Strosnider, NRR

J. Lyons, NRR

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Table 1 PBMR Pre-Application Review Technical and Programmatic Topics Presented and Documented by Exelon

Meeting Date	Topic Num	Meeting Presentation Technical Topic	White Paper Date	Lead Review Organization
Jun 12-13	1	Fuel Overview -Design, Manufacturing, QC and Qualification	11/16/01	<u>REAHFB</u> SMSAB DET
Jul 17-18	2	Design Codes and Standards	10/30/01 12/17/01	DET
	3	Fuel Irradiation Program	TBD	<u>REAHFB</u> SMSAB
Aug 15-16	4	<u>Analytical Codes and Software Control</u> 1. Engineering Analysis 2. Reactor Analysis 3. Radiation Analysis 4. Fuel Design & Performance Analysis 5. Risk and Consequence Analysis	10/30/01	<u>SMSAB</u> SMSAB & DET SMSAB & REAHFB SMSAB & RPERWMB SMSAB REAHFB DRAA
	5	Fuel Design Logic	TBD	<u>REAHFB</u> SMSAB
	6a	Core Design	11/16/01	<u>SMSAB</u> REAHFB
	6b	Heat Removal	11/16/01	DET
Sept 18		None	N/A	N/A
Oct 25	7	High Temperature Materials Graphite	10/23/01	DET*
	8	Control of Chemical Attack	10/23/01	<u>DET*</u> SMSAB & REAHFB
	9	PBMR Systems Design Approach and Status	N/A	N/A
	10	High Temperature Materials	TBD	DET*
Nov 29-30	11	PBMR Operational Modes and States	11/28/01	SMSAB
	12	Testing Requirements for a COL	11/28/01	NRR

* review support available from ORNL

N/A Not Applicable

Table 2: Exelon Objectives for NRC’s Pre-application Review
by Presentation Topic

Topic No.	Exelon’s Documented or Stated Objectives for NRC Pre-application Review
1	NRC to identify potential opportunities for NRC involvement in fuel qualification process.
2	NRC to provide comments/feedback/issues/questions on the reference design codes and standards to be used in the PBMR design. [Also: NRC requested to review and approve ASME Code Cases N-499 and N-201.]
3	NRC to provide comments/feedback/issues/questions on the proposed fuel testing program and the general approach to be used in analyzing the acceptability of the fuel design.
4	NRC to identify specific list of codes and models that are needed from PBMR to become familiar with and be ready for an application.
5	NRC to provide comments/feedback/issues/questions on the proposed PBMR fuel testing program and the methodology to be used prior to a license application. [Exelon would like feedback from the NRC on the process for reaching agreement ¹ on the fuel testing and methodology.]
6 a,b	Exelon would like to obtain NRC agreement ¹ on sufficient design information and analytical methodologies to support a US license application.
7	No specific NRC action is requested by Exelon. The purpose of the presentation was to highlight the safety issues related to the use of graphite technology in HTGRs and to identify options that can lead to the successful resolution of these issues
8	NRC to provide comments/feedback/issues/questions on the approach to the control of chemical attack in a PBMR
9	No specific NRC action is requested by Exelon. (Information presentation)
10	NRC to provide comments/feedback on the use of high temperature materials in a PBMR. [Also the planned use of ASME Code Case N-201 for the core barrel is noted.]
11	No specific NRC action is requested by Exelon. (Information presentation)
12	Exelon would like NRC agreement on a decision process and issue- specific testing expectations for a COL.

¹“Agreement” is not likely to be achievable during the pre-application review. It is expected that NRC will be able to identify issues and guidance to resolve these issues.