From: Amy Cubbage
To: Akstulewicz, Frank; Ashar, Hansraj; Caruso, Ralph; Chatterton, Margaret; Cheng, Thomas; Grubelich, Frank; Imbro, Gene; Li, Hulbert; Marinos, Evangelos; Orechwa, Yuri; Scarbrough, Thomas; Shoop, Undine; Terao, David; Trehan, Narinder
Date: Mon, Jul 16, 2001 3:41 PM
Subject: Fwd: Exelon Non-Proprietary Handouts for July 17-18 Meeting

FYI

Please see attached agenda and slides from Exelon for the July 17/18 meeting (scroll to see all 7 files in attachment).

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Creation Date: Mon, Jul 16, 2001 3:41 PM
From: Amy Cubbage

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HCL (Hulbert Li)
HGA (Hansraj Ashar)
MSC1 (Margaret Chatterton)
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RXC (Ralph Caruso)
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TMC (Thomas Cheng)
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Files	Size	Date & Time
Fuel Q A 7-13 non-proprietary version.doc	34304	Monday, July 16, 2001 1:23 PM
PBMR Fuel Irradiation Program presentation non-proprietary.ppt	84992	Monday, July 16, 2001 1:21 PM
PBMR DESIGN CODES STANDARDS presentation.ppt	448512	Monday, July 16, 2001 1:21 PM
LBE PBMR Pre-Application Meeting 7-17-01.ppt	2764288	Monday, July 16, 2001 1:24 PM
Leftside Screening Approach 07-17-01.ppt	135168	Monday, July 16, 2001 1:24 PM
PBMR Pre-Application Meeting presentation.ppt	61952	Monday, July 16, 2001 1.24 PM
Jul 17_18 Agenda REV.wpd	13355	Monday, July 16, 2001 11:41 AM
MESSAGE	1268	Monday, July 16, 2001 3:15 PM

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PBMR Response to NRC Questions
From June 13, 2001 Meeting

Note: Proprietary information has been deleted as indicated by blank or ellipsis.

1. How do the fuel packing fractions compare – German vs. RSA?
The PBMR packing is particles per sphere, the same as the German proof test of spheres manufactured and tested in 1988. The packing fraction is well within the envelope of all the fuel the Germans tested successfully, which ranged from particles per sphere to particles per sphere.

2. Do you look for damage to the kernels during the "packing" portion of the fuel manufacturing process?
Yes.
Each uranium dioxide kernel is coated with four layers:
(1) a porous carbon buffer
(2) a pyrolytic carbon layer
(3) a silicon carbide layer and
(4) a final pyrolytic carbon layer.
After coating, they are now referred to as coated particles.
The coated particles … lot.

3. Referencing the graph showing free uranium content in fuel, what drove the improvements for the HTR-10 fuel (Chinese experience)?
As far as we know the Chinese used a similar process to that used in Germany. The improvement after initial batches with higher free uranium fraction is due to a learning process of mainly the pressing step in the manufacturing process. The same is expected to happen with the PBMR process during the production of initial fuel batches.

4. What are the reasons for the differences in the maximum fuel temperatures between PBMR and the Germans Phase I and AVR fuel temperatures?
PBMR will inquire whether any reports on the matter of the unexpected high temperatures encountered in the AVR are available in Germany. (OPEN ITEM)

5. How many pebbles do you load before seeing coolant activity?
Coolant activity is not expected until operation at power is sustained.

6. Will radial variations in coolant temperature be able to be monitored?
PBMR is not planning to place any thermocouples inside the reactor core. PBMR is considering placing thermo-couples and neutron detectors in the demonstration plant's graphite reflectors. This will detect radial (azimuthal) imbalances in power distribution.

7. With regard to pebble flow experiments, how were temperature effects accounted for?
As far as we know no tests were performed with helium at operating temperature. The Germans did perform many flow experiments with spherical balls of different materials having different friction factors. PBMR will review the German records. (OPEN ITEM)

8. Did the Germans ever find higher burn-up levels than predicted by modeling?
During operation, the burnup of each sphere is measured as it is removed from the core, prior to re-insertion. Fuel spheres that would exceed the limit if re-inserted for an additional cycle were permanently discharged. PBMR will inquire whether there was any fuel that exceeded the burnup limit, including fuel that was in the reactor at the time the AVR was shut down. However, fuel has been irradiated to burnups higher than planned for PBMR. (OPEN ITEM)

9. What confidence do you have that pebbles don't actually get "hung up" in the core? Any insights from AVR?
The Germans had some fuel spheres restrained from movement by the graphite reflector. PBMR is reviewing this issue with the Germans although it has a different graphite reflector design based on this experience. (OPEN ITEM)

10. It was noted that the presentation had been focused on German experience. What are the plans for this (PBMR) fuel?
PBMR fuel plans will be presented to NRC on July 18, 2001. (OPEN ITEM)

11. NRC noted the need for Quality and Acceptance Testing details.
In the proprietary session following the public session PBMR presented the fuel product specifications, source of fuel materials and characteristics to be measured for QC checks.

12. Did AVR testing simulate load following (temperature/power transient issue)?
Not that we are currently aware of.

13. NRC questioned the appropriateness of using the Poisson distribution for modeling (failure fraction vs. temperature).
The heading of the slide on page 28 of the presentation on June 13, 2001 was in error. The slide in fact shows results using a binomial distribution and not a Poisson distribution.

14. Referencing page 32 of handout, if the test results are for various fuel batches (rather than for the reference AVR 21-2 fuel), what is the significance of the results?
This slide demonstrates that....

15. Will the burn-up measurement system be digital?
Yes.
The system will measure Cesium-137 activity. Major components of the system are its collimator, Germanium detector and amplifier/signal processor/computer assembly. The burn-up measurement system operates in an automated manner. Controls to the system and measurement results from the system are interfaced to the Fuel Handling and Storage System operational control system via input and output signals. A local operator interface display and keypad panel is provided at the system's electronic enclosure for calibration, troubleshooting and maintenance activities. Testing, validation and proving the equipment performance are planned.

16. What is the asterisk on the anisotropy values?
It refers to the fact that ….

17. How does the drop strength test height ( ) compare with actual drop height?
The actual drop….

18. How does the number of drops in test ( ) compare with expected number of drops in operation?
A fuel sphere is expected to be recycled in the core….

19. What is the source of the corrosion limit ?
It came from German material graphite standard.

20. On page 17 with regard to these QC checks, were these German tests or will they be the QC checks done for PBMR?
They were the tests done in Germany and will be the QC checks for PBMR.

21. On page 20, are the methods specified new, or the same as the Germans?
The same as the Germans.

22. On page 26, within the test designation numbers, what do K and P mean?
K refers to a sphere, P to a particle.

23. On Page 27, what was method of heat-up?
Heat-up was done via oven testing. Zero failures observed.

24. What is definition of failure fraction?
PBMR distinguishes fuel anomalies as:
1. Fuel manufacturing defects as measured by the free uranium fraction which includes tramp uranium (failed particle fraction – the fraction of coated particles that have been damaged in manufacture).
2. Fuel mechanical failures as measured by broken or cracked spheres as a result of

drops, handling damage etc.

3. Fuel failures in the reactor is measured by Krypton-85 level in the coolant above the level than can be expected from manufacturing defects.

25. On Page 32, how is a fast neutron defined?
Neutrons with energies greater than 0.1 Mev.

26. NRC noted that it would need to help establish acceptance criteria – Safety Limits, Operating limits, etc.
Another meeting will be planned with the NRC discussing Safety analysis, Design basis accidents, operating limits, etc., at the appropriate time.

27. What are PBMR's nuclear material control and accountability plans?
PBMR has developed a conceptual plan that has been endorsed by IAEA. The issue of material accountability will be addressed at a future meeting. (OPEN ITEM)

28. NRC requested more detail about source term projections, analysis, testing plans, etc. Expected release in terms of time and temperature and the uncertainty related to the release projection.
A separate presentation to the NRC will be made on the radiological effects during steady state, transient and accident conditions at the appropriate time.
(OPEN ITEM)

Exelon

PBMR
Fuel Irradiation Program

July 18, 2001

Robert R.Calabro
Consultant

PBMR Fuel Irradiation Program

- Purpose of presentation
  - Define the purpose of the PBMR fuel irradiation program
  - Describe the program plan and schedule
  - Describe the irradiation measurements to be taken
  - Describe the PBMR proposed joint international irradiation program

Purpose of PBMR Fuel Irradiation Program

- To confirm that the PBMR fuel, manufactured at the Pelindaba plant with modern processes and equipment to German specifications and quality control standards, will perform within the envelope of German measured irradiation data.

- To provide irradiation data for the steady state and transient operating conditions, as closely as possible, to those expected in the Demonstration Plant.

PBMR Irradiation Program

- Test Program in the RSA Safari Reactor
- Test Program in Russian IVV-2M Reactor

Fuel Baseline Program

Proprietary information not shown

Fuel Baseline Program

Proprietary information not shown

Proposed Test Program in the Safari Reactor

- Phase I

Proprietary information not shown

Proposed Test Program in the Safari Reactor, Cont'd

- Phase II

Proprietary information not shown

Proposed Test Program in Russian IVV-2M Reactor

- Test Process

Proprietary information not shown

- Coated Fuel Particle Tests

Proprietary information not shown

Proposed Test Program in Russian IVV-2M Reactor, Cont'd

- Fuel Element Tests

Proprietary information not shown

Proposed Test Program in Russian IVV-2M Reactor, Cont'd

Proprietary information not shown

Conclusion

RSA Safari and Russian IVV-2M tests will confirm that fuel manufactured at Pelindaba will perform as successfully as previously tested German fuel under PBM reactor conditions.

Exelon

PBMR Design Codes And Standards

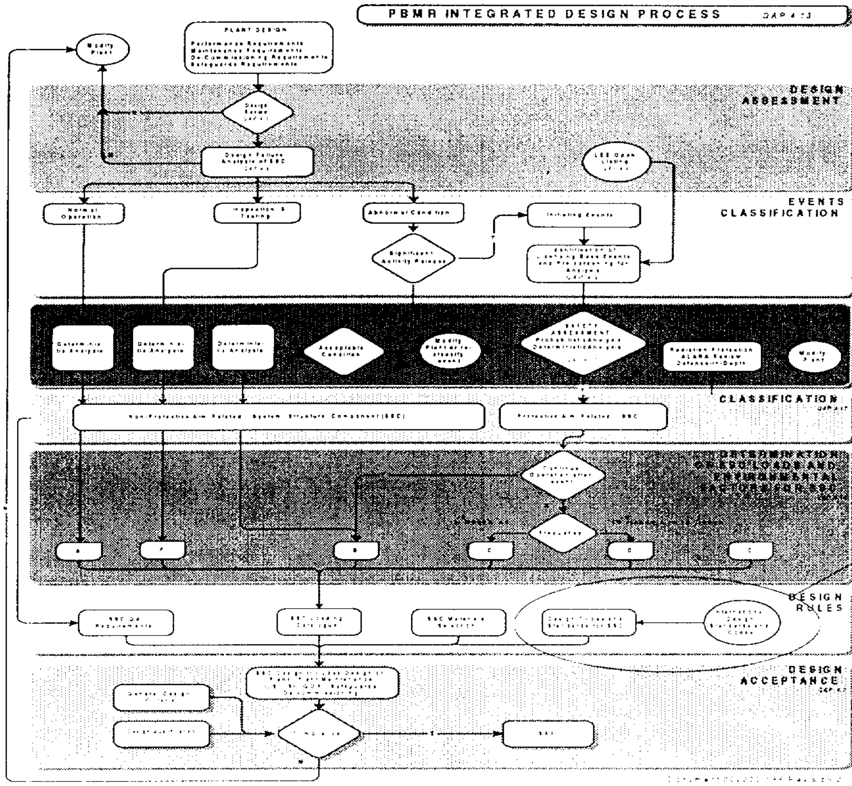
Vijay Nilekani
Manager, Technology Transfer
Exelon Generation

July 18, 2001

PBMR Design Codes & Standards
Scope Of Presentation

- PBMR Integrated Design Process/Codes & Standards
- Civil, Structural and Seismic
- RPV, Primary Pressure Boundary
- Electrical and Instrumentation & Control
- Fire Protection

PBMR Integrated Design Process Codes & Standards



Codes & Standards

PBMR Integrated Design Process
Codes & Standards, Cont'd

Codes and Standards selection philosophy

- Established internationally recognized design and construction rules will be followed
- Applicability is demonstrated
- Compatible with the PBMR design and safety requirements
- Differing requirements will be resolved by following the most conservative requirement

Civil, Structural and Seismic

- Civil
  - Primary code used is ACI 349-97

    "Code Requirements for Nuclear Safety Related Concrete Structures"

    Subsidiary reference codes also used
  - Guidance – Draft Reg Guide DG-1098

    "Safety-Related Concrete Structures for Nuclear Power Plants (other than reactor vessels and containments)"

- Structural
  - Primary code used is ANSI/AISC N690 – 1994

    "American National Standard Specification for the Design, Fabrication and Erection of Steel Safety- Related Structures for Nuclear Facilities"

Civil, Structural and Seismic Cont'd

- ASME Code Section III 1998 is also used
  "Boiler and Pressure Vessel Code, Div 1, Subsection NF, Supports"
- The following Reference Codes are used for determining Design Envelope Loadings
  - ASCE 7-8, "Minimum Design Loads for Buildings and Other Structures"
  - US DOE STD-1020-94, "Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities"
  - SABS 0160 – 1989, "South African Standard, Code of Practice: General Procedures and Loads to be adopted in the design of Buildings"

Civil, Structural and Seismic Cont'd

- Seismic
  - US NRC guidance (NUREG 0800, RG's 1.122, 1.165, 1.60, etc.)
  - US DOE guidance (DOE STD 1020-94, etc.)
  - IAEA guidance (50-SG-S2, etc.)
  - Design for tornado and other natural hazards as well as protection from missiles, aircraft crashes, etc. are addressed in some of the guidance above.

RPV, Primary Pressure Boundary

- RPV
  - ASME Section III Class 1, Sub-Section NB 1998
  - ASME approved Code Case N-499 (1994) has been used to address higher temperatures experienced during Pressurized Loss of Forced Coolant (PLOFC) and Depressurized Loss of Forced Coolant (DLOFC) DBE's (420 deg. C and 480 deg. C). The code case permits temperatures up to 538 deg. C for certain pressures and for a certain time that envelope the PBMR DBE's

    This code case needs NRC review and approval.

RPV, Primary Pressure Boundary Cont'd

- RPV Internal Core Barrel
  - Designed to ASME Section III, Division 1, Sub-section NG 1998
  - ASME approved Code Case N-201 (1994) has been used to address higher temperatures experienced during PLOFC and DLOFC DBE's (720 deg. C). The code case permits temperatures up to 816 deg. C for certain levels of stress and for a certain time that envelope the PBMR DBE's

    This code case needs NRC review and approval.

RPV, Primary Pressure Boundary Cont'd

- Primary Pressure Boundary
  - ASME Section III, Division 1, Sub-Section NC 1998
  - ASME Section XI guidance will be used for the Inservice Inspection Program. Inspectability is one of the design considerations

Electrical and Instrumentation & Control

- Nuclear Safety Related Systems
  - Reactor Protection System (RPS), Post-Event Instrumentation (PEI), Associated Neutronic Instrumentation, RPS & PEI Human Machine Interfaces (HMI)
    - IEEE Std 603 1998 and IEEE Std 7-4.3.2 1993 are the primary standards
    - Applicable IEEE sub references of the above (e.g. IEEE 308, IEEE 344, IEEE 577, IEEE 1023 only for RPS/PEI HMI)
    - NUREG 0800, Chapter 7

Electrical and Instrumentation & Control Cont'd

- Non-Safety Related I & C Systems
  - Equipment Protection System
    - ANSI/ISA S84.01 1996
  - Operational Control Systems
    - IEC Standards are being used. (International Electrotechnical Commission, based in Geneva, Switzerland. IEC is affiliated with ISO and endorsed by 14 countries, including the US, UK, Germany.)

Electrical and Instrumentation & Control Cont'd

- HMI in the Control Room (excluding RPS & PEI HMI)
  - Detailed design is in preliminary stage
  - NUREG 0800, Chapters 13 and 18
  - NUREG 0700, "Human System Interface Review Guidelines" is the primary input to the HMI and control room design. NUREG 0700 refers to:
    - NUREG 0711, "Human Factor Engineering Program Review Model"
    - NUREG CR 5908, "Advanced Human System Interface Design Review Guidelines"
    - NUREG CR 6105, "Human Factors Engineering Guidance for the Review of Advanced Alarm Systems"
    - NUREG CR 6146, "Local Control Station: Human Engineering Issues and Insights"

Electrical and Instrumentation & Control Cont'd

- Radiological Monitoring System, Seismic Monitoring System, etc. are in preliminary design stage.
    - Appropriate Regulatory guidance (e.g. NUREG 0737) will be used.
- Electrical Systems
    - IEC Standards is being used for "50 Hz design"
    - IEEE Standards will be used for "60 Hz design"

Fire Protection

- The design of this is in preliminary design stage
- Guidance from the following sources is under consideration
  - NFPA, (e.g. NFPA 80, Fire Doors; NFPA 101, Life Safety)
  - NUREG 0800, Section 9.5.1, Fire Protection Program
  - USNRC (Appropriate Secy's, RG's, and other guidance documents)
  - IAEA Safety Standard Series

Exelon

Process for Selection of Licensing Basis Events for the PBMR

Fred Silady, PhD
Consultant for
Exelon Generation

07/17/01

Presentation Purpose

- To describe the risk-informed process for selection of licensing bases events
- To illustrate the method with examples from the application of the similar process utilized for the MHTGR in the mid-80's
- To provide insights for regulatory document review

Presentation Outline

- Use of Top Level Regulatory Criteria
- Use of PRA
- Process for Selection of Licensing Basis Events
  - Anticipated Operational Occurrences (AOO)
  - Design Basis Events (DBE)
  - Emergency Planning Basis Events (EPBE)
- Risk Insights for Regulatory Document Review

Relation of Risk-Informed Licensing Bases

- Top Level Regulatory Criteria (TLRC) provide *what* must be achieved
- Licensing Basis Events (LBE) provide *when* the TLRC must be met
- Regulatory design criteria (RDC) and equipment safety-related classification provide *how* it will be assured that the TLRC are met
- Requirements (special treatment) for the safety-related Systems, Structures, and Components (SSC) provide *how well* the TLRC are assured

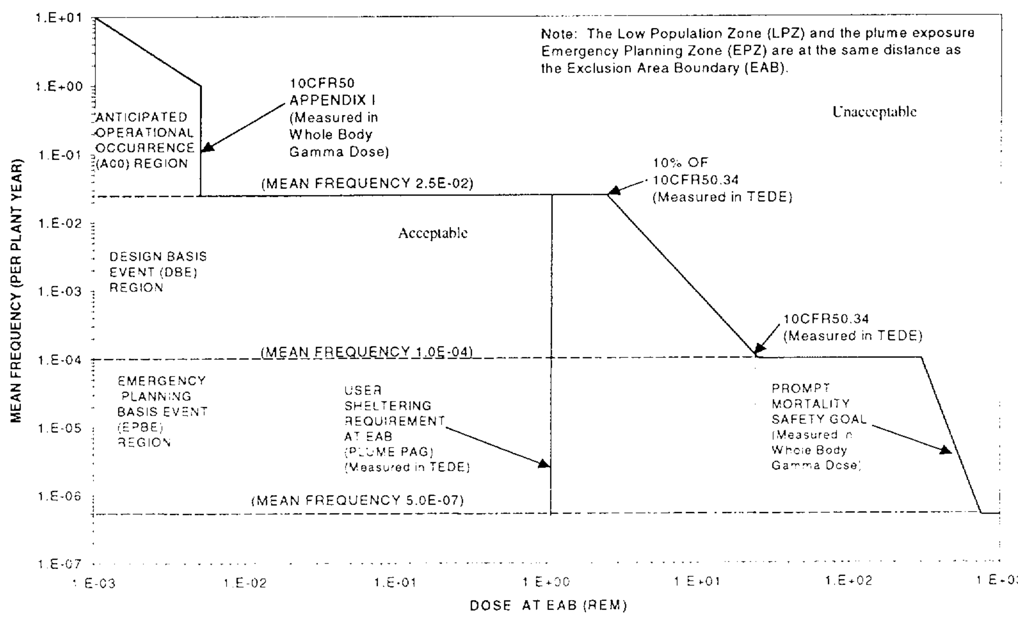
Bases for Top Level Regulatory Criteria

- Direct statements of acceptable health and safety as measured by risks of radiological consequences to the public or the environment
- Quantifiable
- Independent of reactor type and site

Top Level Regulatory Criteria for the PBMR

- 10CFR50 Appendix I annualized offsite dose guidelines
  - 5 mrem/yr whole body
- 10CFR100/50.34 accident offsite doses
  - 25 rem total effective dose equivalent
- EPA-400-R-92-001 protective action guideline doses
  - 1 rem total effective dose equivalent
- 51FR130 individual acute and latent fatality risks
  - 5×10^{-7}/yr and 2×10^{-6}/yr, respectively

PBMR Risk Criteria Chart with Top Level Regulatory Criteria



PBMR PRA Objectives

- Confirm design meets the TLRC
- Support identification of LBE
- Provide insights and a basis for development of RDC

PBMR PRA Scope Requirements

- Comprehensive treatment of end states and initiating events for robust risk assessment
- PBMR design characteristics support use of single event tree structure from initiating events to end states for accident family consequences and frequencies with uncertainties
- PBMR PRA needs to address all modes of operation and shutdown and internal and external events
- Includes operating experience from power industry including LWR, Magnox, AGR, and HTGR
- Provides framework for evaluation of deterministically selected events

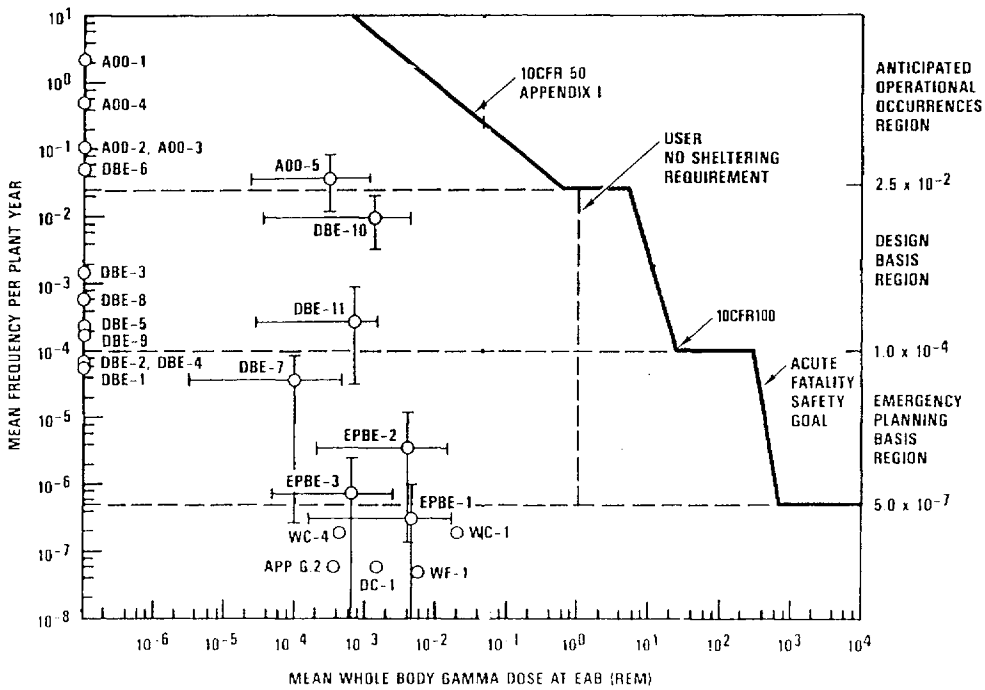
Applicability of LWR PRA Standards

- General principles of LWR PRA standards applicable to PBMR
- LWR risk metrics such as CDF and LERF will be replaced by representative set of PBMR accident family consequences and frequencies
- Slow evolution of PBMR transients results in time-dependent source terms and potential for mitigative actions
- Tools and method for physics, thermal hydraulics, and fission product transport must be specific to PBMR conditions
- Need to address multiple modules and sites with LWRs

Licensing Basis Events

- Off-normal or accident events used for demonstrating design compliance with the Top Level Regulatory Criteria
- Collectively, analyzed in PRA for demonstrating compliance with the safety goal
- Encompass following event categories
  - Anticipated Operational Occurrences
  - Design Basis Events
  - Emergency Planning Basis Events
- Example of selection process provided for MHTGR pre-application submittals

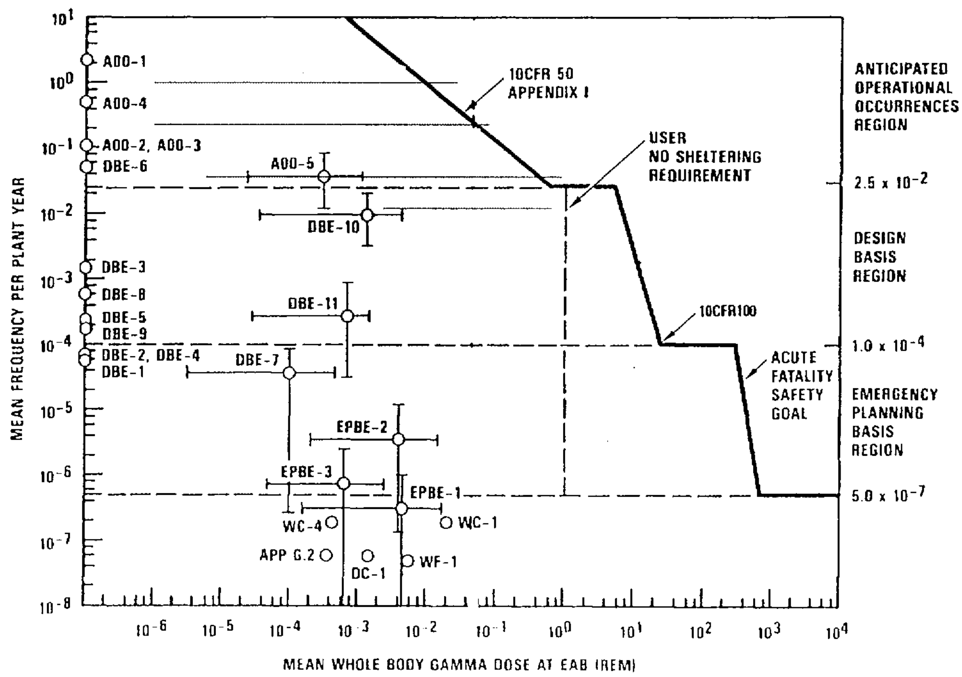
MHTGR Licensing Basis Events



Anticipated Operational Occurrences

- Events expected once or more in the plant lifetime
  - a plant lifetime of 40 years assumed
  - lower frequency of .025/plant year ($\leq$10 modules for PBMR)
- Identified as families of events in AOO region that could exceed Appendix I of 10CFR50 *if certain equipment or design features had not been selected*
- Consequences realistically analyzed for compliance with 10CFR50 Appendix I

MHTGR Example for Selection of AOO



AOO Examples from MHTGR

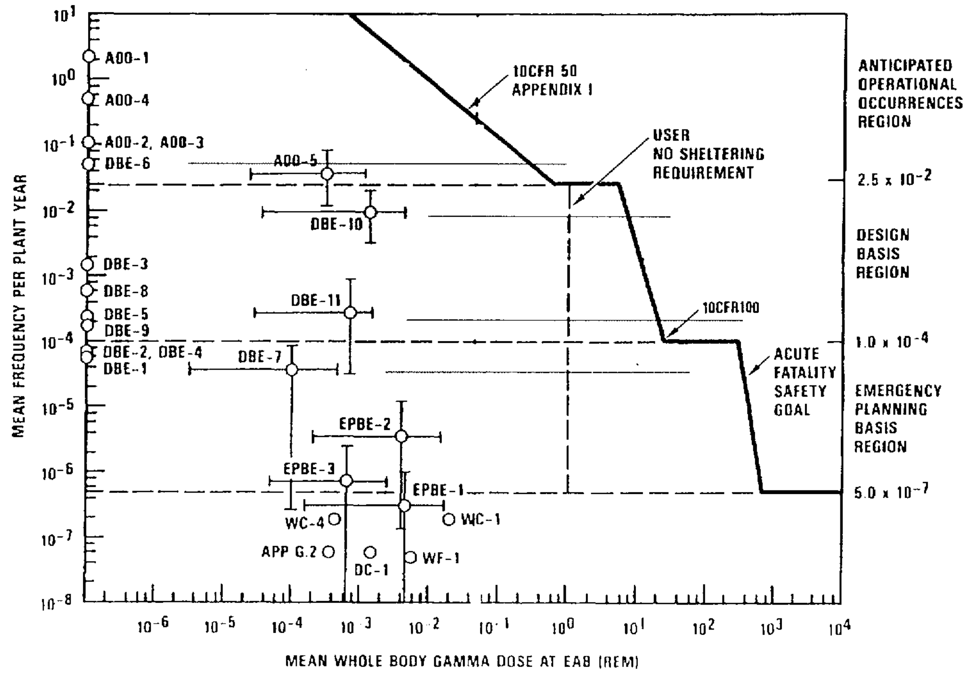
AOO Designation	Anticipated Operational Occurrences
AOO-1	Main loop transient with forced cooling
AOO-2	Loss of main and shutdown cooling loops
AOO-3	Control rod group withdrawal w/ control rod trip
AOO-4	Small steam generator leak
AOO-5	Small primary coolant leak

Shaded LBE not expected for PBMR

Design Basis Events

- Events of lower frequency than AOOs, not expected to occur in the lifetime of the plant
  - for a plant lifetime of 40 years, less than 1% chance
  - lower frequency of 10^{-4}/plant year
- Identified as families of events in (or close to) DBE region that could exceed 10CFR100 *if certain equipment or design features had not been selected*
- Mean values and uncertainty range of consequences are evaluated to provide high confidence of compliance with and safety margin to 10CFR100

MHTGR Example for Selection of DBE

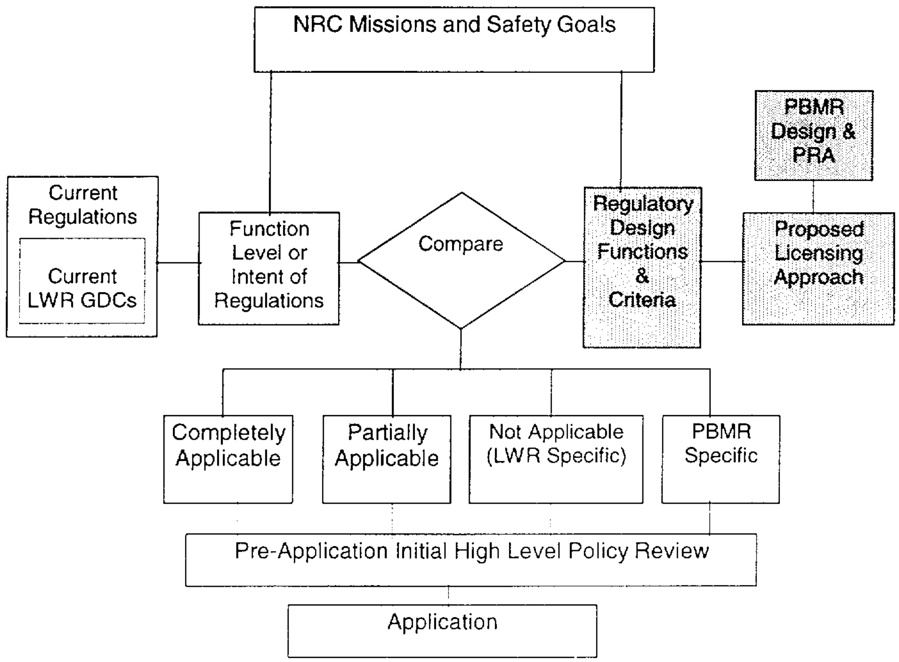


DBE Examples from MHTGR

Designation	Design Basis Events
DBE-1	Loss of main loop and shutdown forced cooling
DBE-2	Main loop transient w/o control rod trip
DBE-3	Control rod withdrawal w/o main loop cooling
DBE-4	Control rod withdrawal w/o forced cooling
DBE-5	Earthquake
DBE-6	Moisture inleakage
DBE-7	Moisture inleakage without forced cooling
DBE-8	Moisture inleakage with moisture monitor failure
DBE-9	Moisture inleakage w/ steam generator dump failure
DBE-10	Moderate primary coolant leak w/o forced cooling
DBE-11	Small primary coolant leak w/o forced cooling

Shaded LBE not expected for PBMR

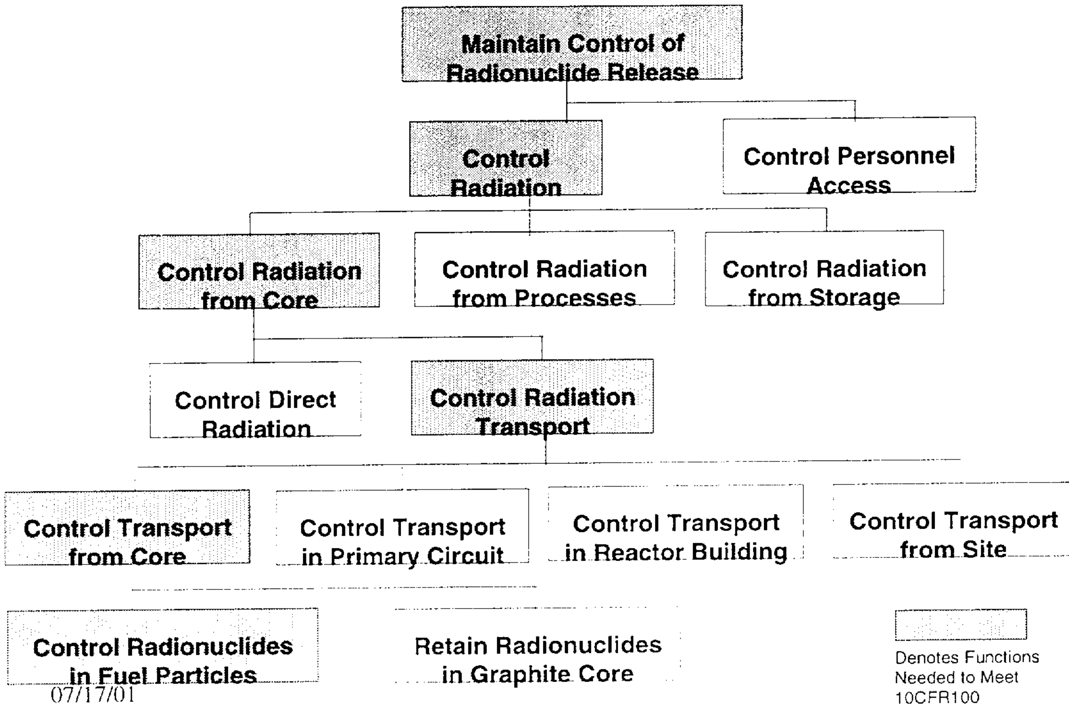
Use of PRA Insights for Regulatory Document Review



Required Safety Functions

- Required safety functions developed from review of LBE versus TLRC
- PBMR required safety functions will be similar to those for the MHTGR
  - For compliance with 10CFR100/50.34:
    - radionuclide retention within fuel particles
      - control of heat generation
      - core heat removal
      - control of chemical attack
- Defense-in-depth provided in both process and barrier sense for radionuclide retention and sub-functions

MHTGR Example of Radionuclide Retention Functions



Unique PBMR Characteristics Relative to LWR

- PBMR primary pressure boundary provides following safety functions
  - Retain radionuclides
  - Maintain core geometry (by reactor vessel for core heat removal and control of heat generation)
- The following functions are NOT required
  - Prevent core melt---ceramic particles and graphite do not melt
  - Prevent loss of coolant----can't lose coolant, always there to some extent, thus, LOCA does not apply
  - Prevent fuel failure----core materials and geometry selected for heat transfer by conduction and radiation, convection not required
- Other differences include no need for containment heat removal---low enthalpy of helium

MHTGR Example of Design Criteria

Conduct Heat from Core to Vessel Wall:

The reactor core design and configuration shall ensure sufficient heat transfer by conduction, radiation, and convection to the reactor vessel wall to maintain fuel temperatures within acceptable limits following a loss of forced cooling. The materials which transfer the heat shall be chosen to withstand the elevated temperatures experienced during this passive mode of heat removal. This criterion shall be met with the primary coolant system both pressurized and depressurized.

Linkages to Other PBMR Licensing Bases

- Required safety functions during DBE help shape RDC and review of existing regulatory documents
- Method for classification and requirements for safety related SSC is the subject of the next meeting.

Outcome Objectives from NRC to Exelon

- Comments and feedback on the process for selection of the LBE
- Agreement on the use of risk-informed LBE as key foundation of licensing approach

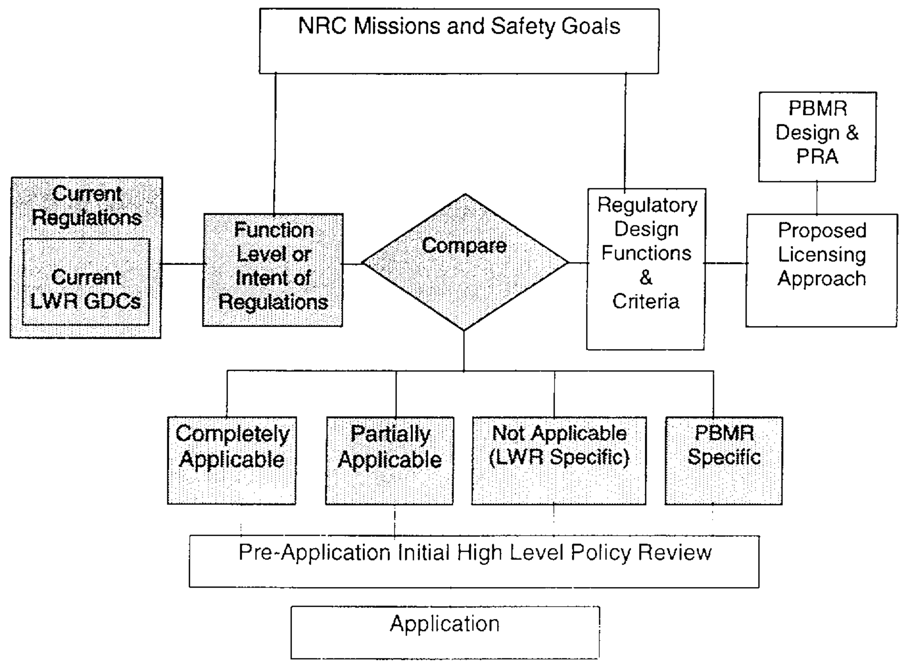
Exelon

Preliminary Screening of Regulations

Ed Wallace
Project Manager
Exelon Generation

07/17/01

Licensing Approach



Deterministic Evaluation of Regulatory Applicability

***Purpose*:**

- To conduct a pilot project that will develop an initial categorization of a large sample of regulations that apply to the licensing of the PBMR in the US.
- Also provide: A greater sense of the number of exemptions that could be required in the process of reviewing the PBMR design;
- A greater sense of what the key questions and logic for making decisions regarding applicability of current regulatory guidance documents,
- A beginning point for applying risk-informed insights to help shape the changes or interpretations that will be needed to address partially applicable regulations, and
- Confidence that a logical, repeatable, reliable and defendable decision process can be defined for addressing the remaining set of regulatory guidance in existence today.

Expert Panel Process

- Panel Members
  - Seven participants
  - Owner, regulator, designer, legal perspectives included
  - Backgrounds include experience in LWR design, operations, maintenance, construction, licensing, reactor regulation, risk assessment, and gas reactor design
- >180 years of nuclear industry experience total

Expert Panel Process (continued)

- Sample Set Selection
  - 10CFR50 including Appendices plus selected other regulations
  - 163 total regulations / GDCs reviewed
- Process
  - Vote types
    - Applies; Partially Applies; Not Applicable
  - Process Definitions
    - Specific meaning for rules / regulations developed that differ from guidance documents
      - Literal reading for rules / regulations
      - Intentions or purpose for guidance
  - Technical Definitions

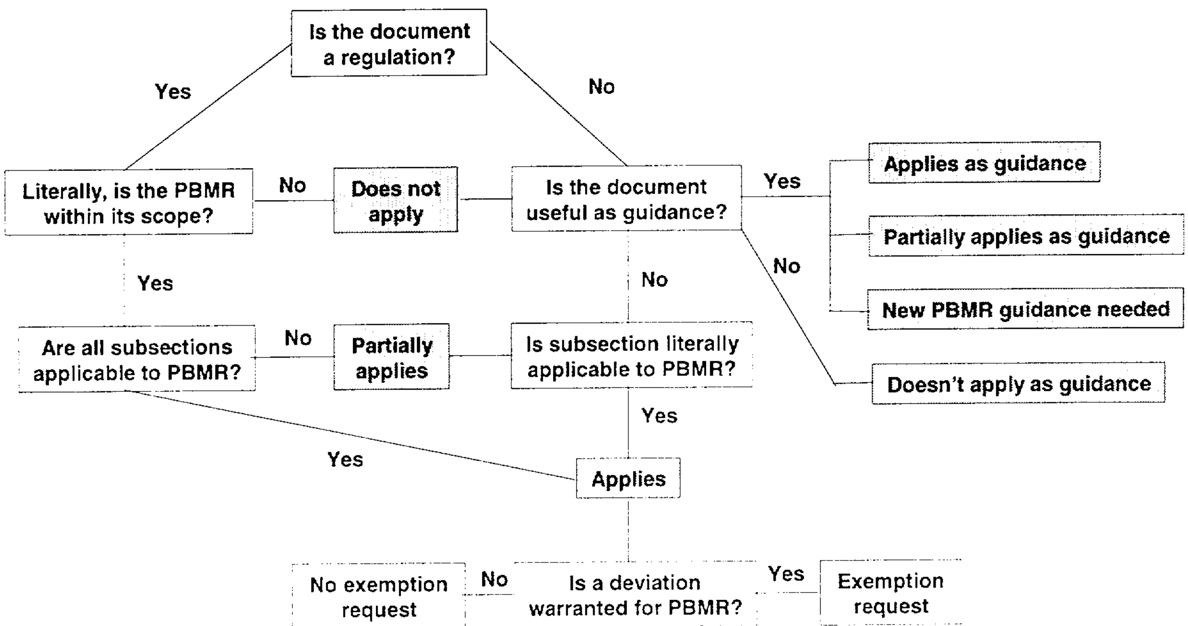
Technical Definitions

- Primary Pressure Boundary
  - Use in lieu of Reactor Coolant Pressure Boundary
  - Fission Product Retention
  - Core Geometry for Residual Heat Removal
- LOCA
  - Evaluation models and other regulatory requirements only when needed to support PBMR specific LBE and Safety Outcomes
- Containment
  - One of defense-in-depth barriers in PBMR design
  - PBMR design requirements appropriate for advanced gas reactor
    - Performance parameters driven by LBE scenarios
    - Performance parameters risk-informed
- Merchant Plant
- Modular Reactor

Results Summary

- Developed logic diagram reflecting the consensus decision-making process
- 114 Apply
- 23 Partially Apply
- 26 Not Applicable
- Key process observations
  - Common definitions of both plain English terms and key technical terms needed to reach consensus
  - Considerations of actual design and PRA insights important

Logic Chart for Regulatory Document Review



Use of Design Type and PRA Insights in Determining Applicability of Regulatory Documents

- Based on current knowledge of PBMR design
- Used early risk insights to determine LBEs
- Based on knowledge of LBEs, concluded what functional capabilities are necessary
- Compared the functional capabilities against regulatory criteria to determine level of applicability

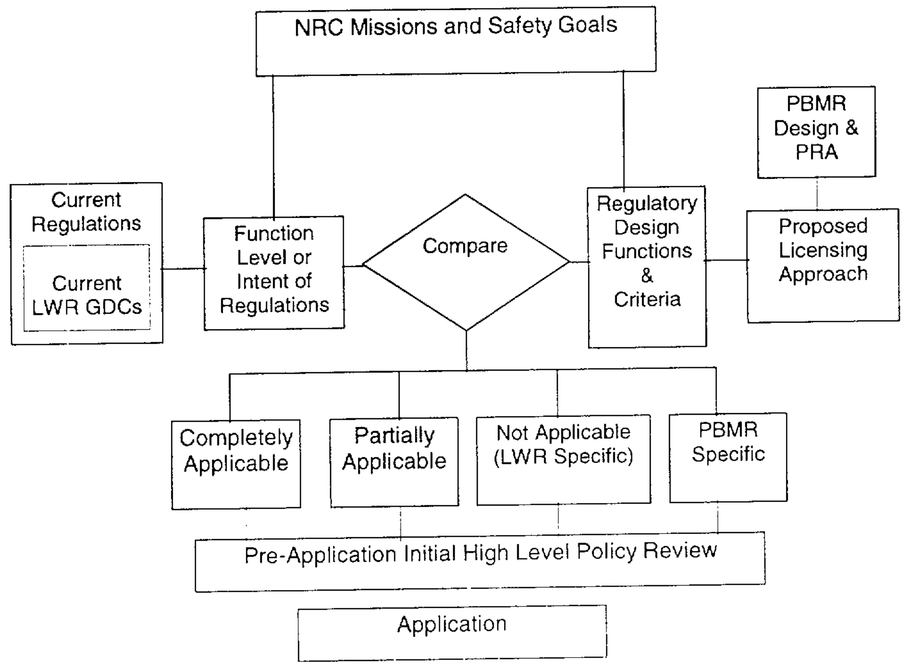
Process Example Demonstrations

- Regulations / Rules
  - Straight Forward
    - applies [50.59 "changes, tests, and experiments"]
    - partially applies [50.54(o) "primary rector containments"]
    - does not apply [50.44 "standards for combustible gas"]
  - Requires Judgement and Insight
    - applies [50.75 "recordkeeping for decommissioning"]
    - partially applies [50.49 "environmental qualification for electric equipment important to safety"]
    - does not apply [50.46 "criteria for emergency core cooling systems"]

Process Example Demonstrations

- Guidance
  - Applies [GDC 13 "Instrumentation and control"]
  - Partially Applies [Appendix A preamble; GDC 30 "Quality of reactor coolant pressure boundary"]
  - Not Applicable [GDC 55 "Reactor coolant pressure boundary penetrating containment"]

Licensing Approach



Looking Forward

- Screen the entire set of NRC regulations, not just sample
- Continue to validate the logic chart
- Begin application of PBMR specific risk-insights to applicable or partially applicable regulations
- Iterate the assessment of applicability
- Expand the effort to non-regulation regulatory documents (i.e., Regulatory Guides, Standard Review Plans)
- Provide results to NRC on on-going basis and achieve outcomes

Outcome Objectives from NRC to Exelon

- Comments and feedback on "left side" portion of approach for developing regulatory set of requirement and guidance documents
- Agreement on using the logic process developed as a decision tool for preliminary screening of the regulatory set
- Agreement on the development of key definitions for the purposes of regulatory screening effort
- Early agreement on the set of "not applicable" regulations
- Agreement on the plan for use of the screening process for the lower-tier regulatory documents.
- Development of the complete set of regulatory documents that will drive the application content during the pre-application period using this licensing approach.

Exelon

PBMR Pre-Application Meeting

Presented to the U.S. Nuclear Regulatory Commission

July 17-18, 2001

Kevin Borton
Manager, Licensing
Exelon Generation

Pre-Application Issues – NRC Staff Schedules

- Licensing Approach
  - **September, 2001**: Staff recommendations
  - **October, 2001**: ACRS recommendations
  - **December, 2001**: Commission Paper
- Technical
  - **December, 2001**: Staff recommendations
  - **January, 2002**: ACRS recommendations
  - **April, 2002**: Commission Paper
- Policy
  - **June, 2002**: Staff recommendations
  - **July, 2002**: ACRS recommendations
  - **September, 2002**: Commission Paper

Pre-Application Objectives - Exelon Licensing Approach Introductions

- ✓ Licensing Approach
  - Agreement on approach - Commission Paper
- ✓ Part 52 Process
  - Agreement on process and schedule – Commission Paper
- ✓ 9 White Papers
  - Staff positions and initiation of actions
- August 2001 - License Application
  - Agreement on format, content, resolution process

Pre-Application Objectives – Exelon Technical Topic Introductions

Common understanding of design; Identification of the level of information necessary in order to obtain license; Early identification of additional or unique requirements

✓ **June, 2001** - Fuel
✓ **July, 2001** - Codes and standards
August, 2001 - Analytical codes
- Core Design (steady/transients)
- Shut-down cooling and shut-down capability

September, 2001
- Confirmatory test program / ITAAC
- High temperature material
- Fuel handing system
- Source term

October, 2001 – Graphite chemical attack
- Security / safeguards
- Control room design / habitability

November, 2001 - Waste characteristics
- Brayton Cycle / Power conversion unit

December, 2001 - Open

Pre-Application Objectives - Exelon Policy Topic Introductions

- Review of Current Commission Policies
  - No changes, or
  - Changes noted and staff recommendations

January, 2002 - Containment
- Control room habitability / staffing

February, 2002 - Emergency preparedness
- Defense-in-depth

March, 2002 - Human factors
- Shutdown Margin
- Others

Agenda

Meeting with Exelon and DOE on PBMR
July 17, 2001 9:00 am - 3:15 pm; July 18, 2001 9:00 - 12:40
Commissioners Hearing Room O1F16

Tuesday, July 17, 2001

9:00 am - 9:10 Introductory Remarks - NRC (S. Rubin)

- PBMR Pre-Application Review Goals, Meeting Purpose and Process, and Review Status
- Administrative Items
- Meeting Agenda

9:10 am - 9:40 Overview of PBMR Pre-Application Review Technical Topics, Objectives and Schedule Exelon (K. Borton)

9:40 am -9:45 PBMR Construction: Schedule for Fabrication of Major Components (J. Sebrosky, NRC)

9:45 am - 10:30 Exelon White Papers

Additional Exelon Information, Preliminary Staff Views/Comments, and NRC/Exelon Discussion on:

- Fuel Cycle Impacts in 10 CFR Part 51 (E. Wallace, Exelon/All)
- Requirements on Annual Fees in 10 CFR Part 171 (J. Turdici, NRC/All)
- Number of Licenses -status (NRC/All)
- Requirements for Antitrust Review Under 10 CFR 50.33a: (M. Dusaniwskyj; N. St. Amour, NRC/All)
- Financial Protection Requirements in 10 CFR Part 140 (N. St. Amour, NRC/ All)

10:30 am -10:45 Break

10:45 am -12:15 Proposed PBMR Licensing Approach (Exelon, K. Borton; E. Wallace:F. Silady; Exelon Consultant, K. Fleming via Teleconference)

- Background
- PRA
- Process for Selection of Licensing Basis Events

12:15 pm -12:30 Stakeholder Comments

12:30 pm - 1:30 Lunch Break

1:30 pm - 3:00 Proposed PBMR Licensing Approach (Exelon - Continued)

- Preliminary Screening of Regulations

3:00 pm - 3:15 Stakeholder Comments

Agenda
Meeting with Exelon and DOE on PBMR
July 18, 2001 9:00 am - 12:30 pm
Commissioners Hearing Room O1F16

Wednesday, July 18, 2001

9:00 am -10:00 PBMR Codes and Standards
(Vijay Nilekani - Exelon; D. Lee, N. Broom, K. Smit, J. Van derWesthuizen, K. Van Rensburg, I. Drodskie, A. George - PBMR, Pty; and J. Hufnagel via teleconference)

- Discussion of PBMR Codes and Standards
- Requested Objective for Codes and Standards Pre-Application Review

10:00 am - 10:15 Break

10:15 am - 12:15 PBMR Fuel Irradiation Program

10:15 am - 10:45 PBMR Fuel Irradiation Program (Non-Proprietary - Open to the Public)
(Vijay Nilekani - Exelon; R. Calabro, Exelon consultant; A. George, J. Venter - PBMR Pty. and J. Hufnagel via teleconference)

- Discussion of PBMR Fuel Irradiation Program
- Requested Objective for Fuel Irradiation Program Pre-Application Review

10:45 am - 11:15 Stakeholder Comments

11:15 am - 12:45 PBMR Fuel Irradiation Program (Proprietary - Closed to the Public)
(Vijay Nilekani - Exelon; R. Calabro, Exelon consultant; A. George, J. Venter - PBMR Pty. and J. Hufnagel via teleconference)

- Review of Proprietary Answers to Questions From July 13 meeting
- Discussion of PBMR Fuel Irradiation Program

12:45 pm - 1:00 Closing Remarks and Future Meeting Schedule (NRC/Exelon)