

PBMR Pre-Application Meeting

Presented to the U.S. Nuclear Regulatory
Commission

June 12 & 13, 2001

Pre-Application Meeting Topics

– June 12 and 13, 2001

- **Licensing Approach**
 - NRC Views Regarding Application; Top-Level Requirements; Frequency-Consequence Diagram
- **NRC Views Regarding Legal and Regulatory Issues**
- **NRC Views Regarding Proposed PBMR Part 52 Plan**
- **PBMR Fuel Performance and Quality Program Overview**

Pre-Application Meeting Topics

– July 17 and 18, 2001

- Continue Licensing Approach
 - Method to Determine Licensing Basis Events
 - Method to Identify Design Principals
 - Procedure to Compare Design with Current Regulations
 - » Trial PBMR Method using MHTGR Examples
- Continue Fuel Performance and Qualification
- Overview of Codes and Standards Used by PBMR Pty.
 - Identification of any Lead Times Issues, Tools, or Resource Requirements

*July 19, 2001 – NRC Staff Meeting with Commission
Exelon Request to Participate as Panelist*

Pre-Application Meeting Topics

– August 14 and 15, 2001

- **Continue PBMR Licensing Approach**
 - SSCs Selection Methodology
 - PBMR Methods / MHTGR Examples
- **Continue Fuel Performance and Qualification**
 - Transportation and Safeguards
- **Continuation of Codes and Standards Used by PBMR Pty.**
- **Overview of Analytical Codes Used by PBMR Pty.**
 - Identification of Lead Times, Tools, Resource Requirements, or Verification & Validation Assessment Needs

– September 19 and 20, 2001

- **Closure of Licensing Approach**
 - Other Uses during Application: SAR Format, TS, ITAAC
- **Continue Fuel Performance Discussions**
 - Proposed Performance Testing Logistics
- **Continuation of Analytical Codes Used by PBMR Pty.**
- **Specific Issue Discussions**

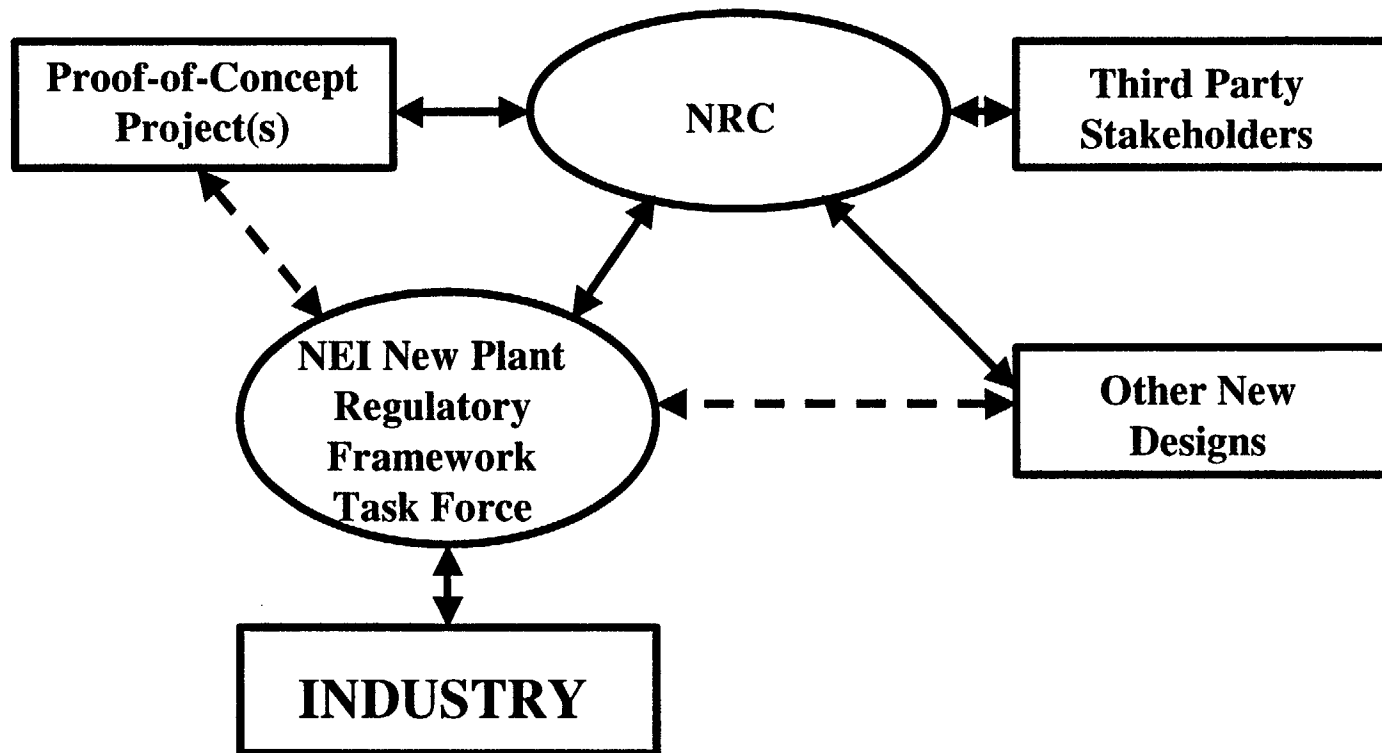
Reconcile PBMR Licensing Approach and NEI Industry Framework Initiative

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Top-Down, Risk Informed Approaches

- PBMR Licensing Approach
 - Navigate within Existing Regulations
 - Near Term
 - PBMR Specific
 - Proof-of-Concept
- NEI Framework Initiative
 - Redefine Existing Regulations Through Rulemaking
 - Longer Term
 - Applicable to All Designs
 - Extract Experience from Proof-of-Concept and other Industry Experience

NEI New Plant Regulatory Framework Interface



DRAFT

COMPARISON OF PBMR LICENSING APPROACH AND NRC RISK INFORMED POLICIES

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Issues Addressed

- How does the proposed PBMR licensing approach address
 - NRC Advanced Reactor Policy Statement
 - Use of safety goals and risk metrics
 - Current options for risk informing 10CFR50
 - Principles of risk informed regulation

NRC ADVANCED REACTOR POLICY STATEMENT

- PBMR inherent and engineered features correlate well with policy definition of an “advanced reactor”
 - Long time constants due to high thermal capacity/low power density
 - Simplified safety system design due to inert, low enthalpy gas coolant, and capability to cool core in a manner independent from any forced or natural circulation or operation of any active engineered systems
 - low excess reactivity; negative temperature coefficient of reactivity
 - inherently low and slowly developing radiological exposures from accidents
- Current series of meetings is in response to the policy’s invitation to encourage “earliest possible interaction” to facilitate NRCs “timely comment” on licensing implications

USE OF SAFETY GOALS AND RISK METRICS

- NRC safety goals are reactor independent and have been used appropriately in the proposed licensing approach.
- Traditional LWR risk metrics such as CDF and LERF, etc. are not meaningful to PBMRs due to ceramic fuel particles, graphite moderator, and helium coolant
- Frequencies and consequences of PBMR specific event sequence families are analogues to LWR risk metrics
- Two-dimensional frequency-consequence diagram consistent with MHTGR approach and with Farmer's approach to evaluate suitability of siting early graphite moderated gas-cooled reactors (Magnox, AGRs) in the U.K.

USE OF LWR RISK INFORMED REGULATION PRINCIPLES

- Meet current regulations
 - need to sort out which regulations are applicable to PBMRs; proposed license approach (Exelon 6-1-01 letter to NRC)
- Maintain defense in depth and safety margins
 - greater reliance on inherent and passive vs. active and engineered features
 - explicit treatment of uncertainties in PRA framework
- Address NRC safety goals
 - fundamental aspect of proposed licensing approach
 - significant decrease in potential risk levels expected
- Monitoring in place to assure safety protection
 - addressed via fuel manufacturing quality assurance, monitoring of circulating activity, and continuous on-line monitoring of fuel elements

Conclusions

- PBMR design features consistent with NRC definition of advanced reactor per policy statement
- Proposed PBMR licensing approach consistent with NRC principles of risk informed regulation
- PBMR specific risk metrics to be defined
- PBMR approach to defense-in-depth and application of safety margins places more reliance on inherent and passive vs. active and engineered safety features

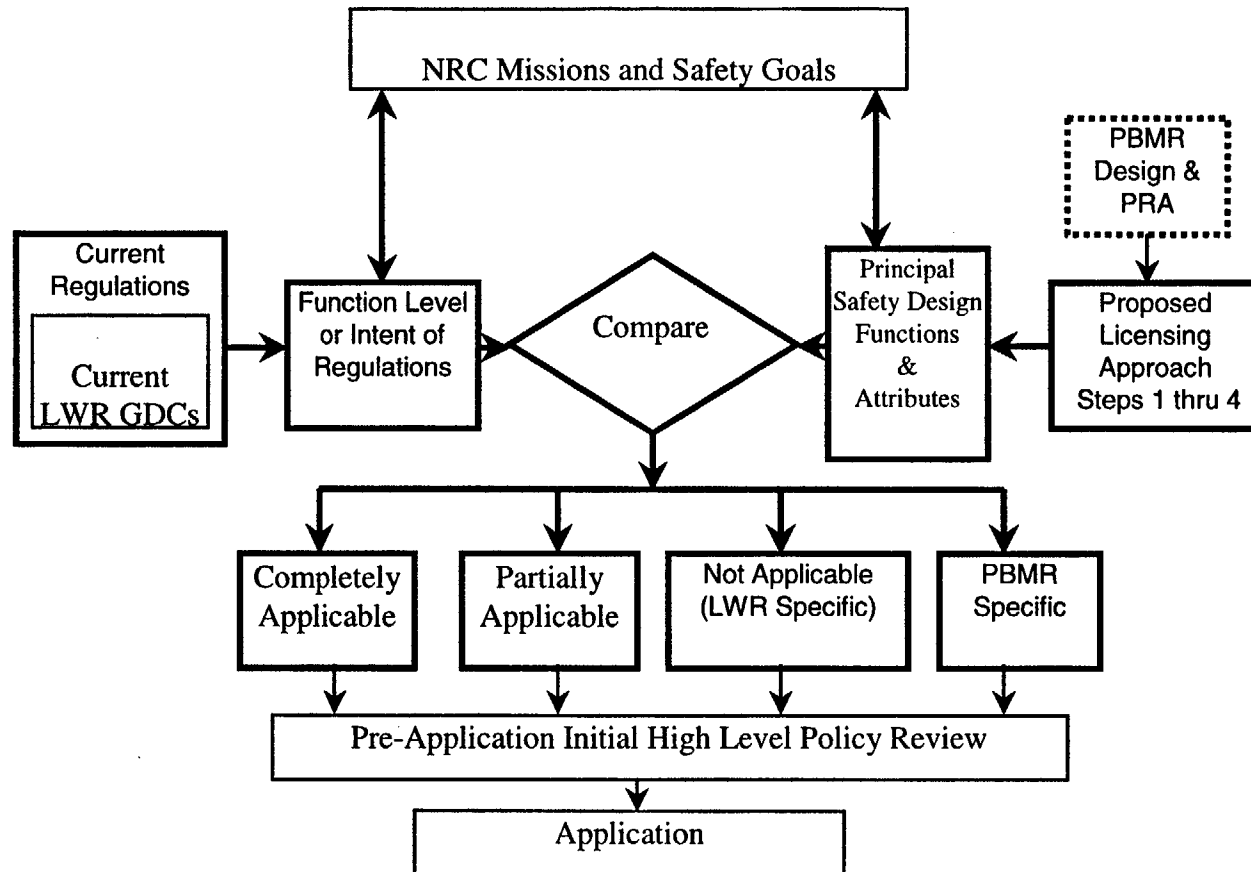
PBMR Licensing Approach: Identify and Define Licensing Requirements

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PBMR Licensing Approach

- 1) Determine the design independent and site independent top-level quantitative criteria that define the NRC mission and safety goals
- 2) Determine the design-specific licensing bases events (LBE) by means of the plant specific PRA
- 3) Determine the PBMR's applicable principal design safety criteria (GDCs) by examining the functions and features that prevent the criteria in step 1 from being exceeded (step 2 and step 3 are iterative steps)
- 4) Classify the systems, structures, and components (SSCs) that provide the safety related functions determined above and ensure the level of regulatory treatment assigned to these SSCs is commensurate with its safety significance.

PBMR Method



Top-Level Regulatory Criteria

Development of PBMR Working Paper

- Contemporary Insights
- Verification of Quantitative Regulations
- Discussion of Plant Security Top-Level Requirements

Requested NRC Views

- Are the regulatory mission linkages presented appropriate and acceptable for a PBMR design?
- Are the top-level regulatory criteria presented acceptable and can they remain valid through final design approval of a PBMR design?
- Can the relationship between criteria and acceptable ranges, as presented, provide the acceptance goals for PBMR approval?

Preparation for Next PBMR Licensing Approach Meeting

- LBE Selection Method Using PRA
- Method to Identify Primary Design Principals
- *Is the methodology for proceeding from the top-level regulatory criteria through risk assessment to the deterministic licensing basis acceptable and can it remain valid through final design approval?*