

# **PBMR Pre-Application Meeting**

Presented to the U.S. Nuclear Regulatory  
Commission

June 12 & 13, 2001

E/14

# **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. (S Almas Co)
  - 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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June 12, 2001

# Top-Down, Risk Informed Approaches

## • PBMR Licensing Approach

- Navigate within Existing Regulations
- Near Term
- PBMR Specific
- Proof-of-Concept

- used to put together licensing application later this year & early next year

## • NEI Framework Initiative

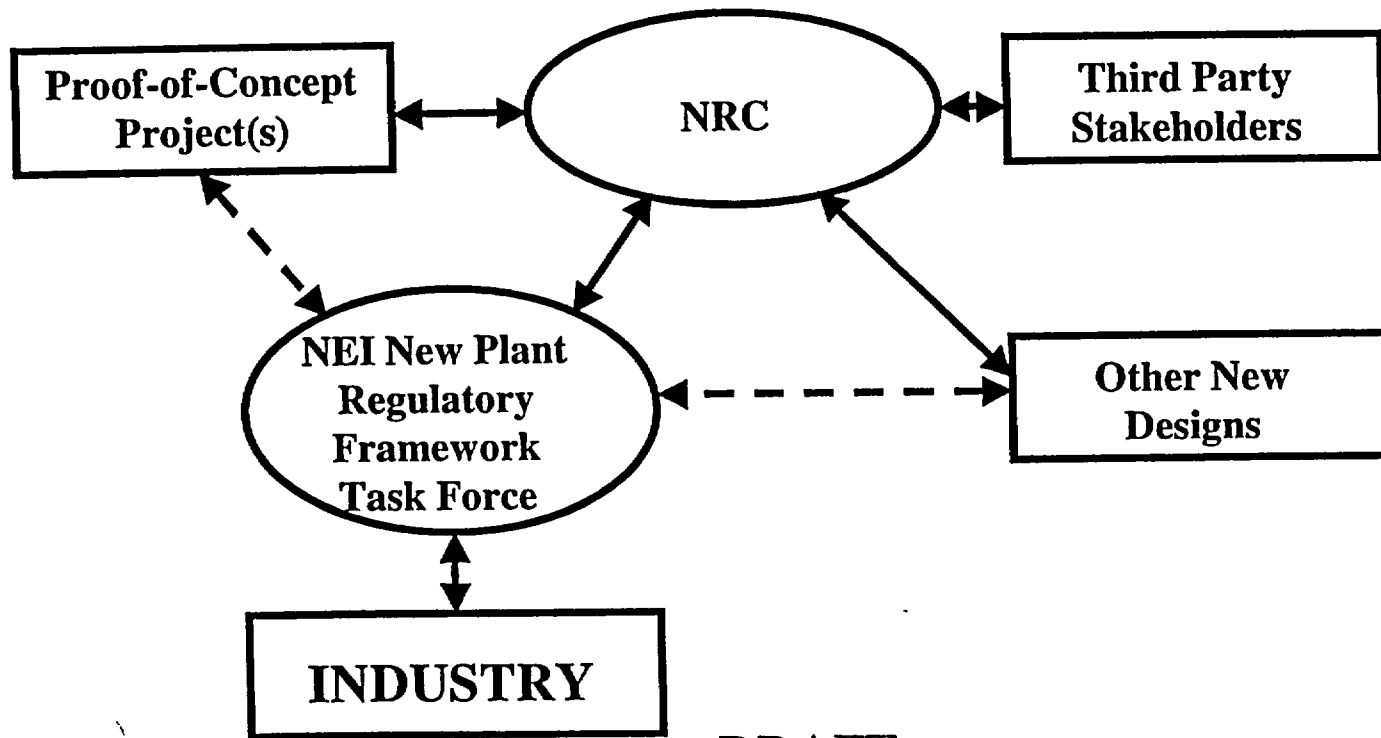
- Redefine Existing Regulations Through Rulemaking
- Longer Term
- Applicable to All Designs
- Extract Experience from Proof-of-Concept and other Industry Experience

\* Facing a new task force  
- potential licensees  
- increased number suppliers of technologies

\* current structure is based around LWR → need a new regulatory structure building on what is going on in early regulatory activities

\* anticipate while paper early next year as preliminary to ANPR

# NEI New Plant Regulatory Framework Interface



# **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 <sup>(adequate time to respond in event of accident)</sup> 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 *also reduce need for operator action*
  - 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<sup>core damage frequency</sup> 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.

similar to PSA analysis but need new metrics to describe those consequences

# USE OF LWR RISK INFORMED REGULATION PRINCIPLES

Reg Guide 1.174

- Meet current regulations
  - need to sort out which regulations are applicable to PBMRs; proposed license approach (Exelon 6-1-01 letter to NRC) *less some reg but not losing the defense in depth afforded by these reg - looking at whether of reg.*
- 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  
(in helium)

# 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 *What will they be defined?  
What is the design process for defining these risk metrics.*
- PBMR approach to defense-in-depth and application of safety margins places more reliance on inherent and passive vs. active and engineered safety features *likely to be a handful or a dozen of different metrics that relate to each of the design basis criteria.*

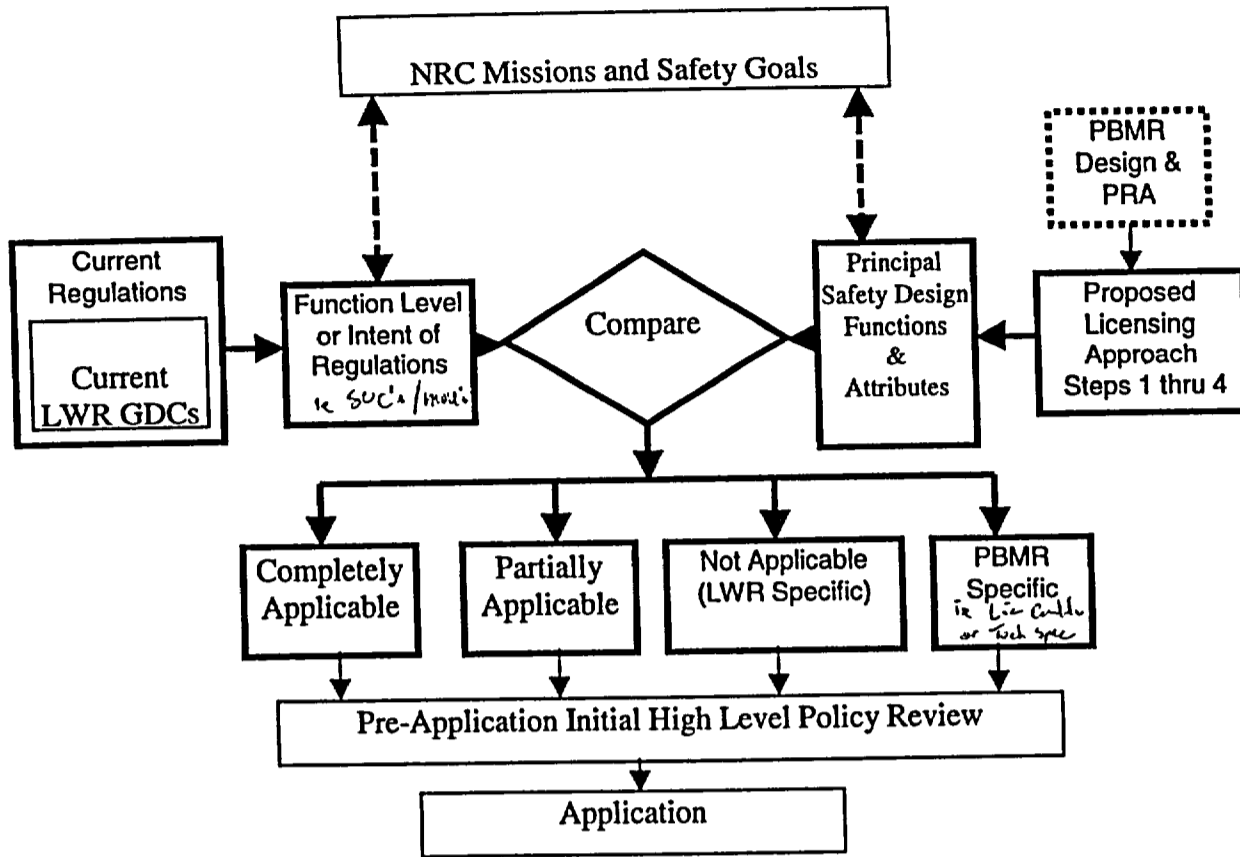
# **PBMR Licensing Approach: Identify and Define Licensing Requirements**

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# PBMR Licensing Approach

- July 1) Determine the design independent and site independent top-level quantitative criteria that define the NRC mission and safety goals
- July 2) Determine the design-specific licensing bases events (LBE) by means of the plant specific PRA
- August 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) *Go back and add these steps back into the PRA & analyze the consequences.*
- 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



see previous page  
 layout at an early level the design of  
 the plant of class required to refer to  
 determine applicability.  
 - provide repeatable format for  
 determining applicability - create  
 consistency.  
 - what is it about design that is  
 comparable & applicable to rego  
 - how to apply the concept of an  
 existing rego to a new design

This process seems more applicable to technical requirements - not as  
 applicable to process requirements ie. essential qualification; licensee  
 qualification & so. on. 16



# **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?*