



*United States
Nuclear Regulatory Commission*

Office of Nuclear Regulatory Research
Advanced Reactors Activities
June 4, 2001

D-2

John H. Flack
Stuart D. Rubin

TAB C13

Introduction

- Historical role of RES in preapplication reviews
- Preapplication review of advanced reactors
- Current role of RES in advanced reactor reviews
- Advanced reactor group in Division of Systems Analysis and Regulatory Effectiveness (RES)

Advanced Reactor Activities

- Advanced reactors have greater reliance on new technology and safety features.
- Preapplication interactions and reviews will help NRC prepare for licensing application
- NRR has lead with RES support for LWR advanced reactor preapplication initiatives and licensing application reviews
- NMSS has lead for fuel cycle, transportation and safeguards
- RES has lead for non-LWR advanced reactor preapplication initiatives and longer-range new technology initiatives
- Recent industry requests for preapplication interactions:
 - Westinghouse: AP1000 (5/4/00)
 - Exelon: Pebble Bed Modular Reactor (12/5/00)
 - General Atomics: Gas Turbine-Modular Helium Reactor (3/22/01)
 - Westinghouse: International Reactor Innovative and Secure (4/06/01)
- NEI Risk-Informed framework for Advanced Reactor Licensing

RES Advanced Reactors Activities

- PBMR:

- Request for pre-application interactions received from Exelon
- NRC response
- Plan developed (SECY-01-0070)
- Pre-application work underway (FY2001-2002)
- Objective - identify issues, infrastructure needs and framework for PBMR licensing
- Develop nucleus of staff familiar with HTGR technology

- GT-MHR

- Request for pre-application interactions received from General Atomic
- NRC Response

RES Advanced Reactors Activities (cont.)

- IRIS

- Developed under DOE-NERI program
- Initial meeting on 05/07/01

- Generation IV - WESTINGHOUSE

- International activity coordinated by DOE
- Longer term
- NRC participating as an observer

- Generic Framework: ? ESBWR - GE

- NEI developing proposal
- Need for NRC to establish an effective and efficient risk-informed, and where appropriate, performance-based licensing framework

Significant Technology Issues:

- Unique, First of a Kind Major Components
- Fuel Design, Performance, Qualification, & Manufacture
- Source Term
- Thermal-Fluid Flow Design
- Hi-Temperature Performance
- Containment
- Fuel Cycle Safety & Safeguards
- Prototype Testing and Experiments
- Human Performance and I&C
- Probabilistic Risk Assessment Methodology and Data
- Emergency Planning
- Regulations Framework
 - design basis accident selection
 - safety classification
 - acceptance criteria
 - GDC,
 - use of PRA
 - Safety Goals

PBMR Pre-Application Review Objectives

- To develop guidance on the regulatory process, regulations framework and the technology-basis expectations for licensing a PBMR, including identifying significant technology, design, safety, licensing and policy issues that would need to be addressed in licensing a PBMR.
- To develop a core infrastructure of analytical tools, contractor support, staff training and NRC staff expertise needed for NRC to fully achieve the capacity and the capability to review a modular HTGR license application.

PBMR Pre-Application Review Guidance

- Commission Advanced Reactor Policy Statement
- NUREG-1226 on the Development And Utilization of the Policy Statement
- Previous Experience with MHTGR Pre-Application Review
- Identify Safety, Technology, Research, Regulatory & Policy Issues

PBMR Pre-Application Review Scope

Selected Design, Technology and Regulatory Review Areas:

- Fuel Design, Performance and Qualification
- Nuclear Design
- Thermal-Fluid Design
- Hi-Temp Materials Performance
- Source Term
- Containment Design
- PBMR Regulatory Framework
- Human Performance and Digital I&C
- Prototype Testing Program
- Probabilistic Risk Assessment
- Postulated Licensing-Basis Events
- Fuel Cycle Safety
- Emergency Planning
- SSC Safety Classifications

PBMR Pre-Application Review Process

- **Conduct Periodic Public Meetings on Selected Topics:**
 - Process Issues, Legal & Financial Issues, Regulatory Framework (4/30)
 - Fuel Performance and Qualification (6/12-13)
 - Traditional Engineering Design (e.g., Nuclear, Thermal-Fluid, Materials)
 - Fuel Cycle Safety Areas
 - PRA, SSC Safety Classification
 - PBMR Prototype Testing
- **NRC Identifies Additional Information Following Topical Meetings**
- **Exelon/DOE Formally Documents and Submits Topical Information**
- **NRC Develops Preliminary Assessment and Drafts Documented Response**
- **Obtain Stakeholder Input and Comments at a Public Workshop**
- **Discuss Preliminary Assessments With ACRS and ACNW**
- **Commission Papers Provide Staff Positions and Recommend Policy Decisions**
- **Commission Provides Policy Guidance and Decisions**
- **NRC Staff Formally Responds to Exelon with Positions and Policy Decisions**

PBMR Pre-Application Review Sources of Expertise

- RES, NRR, NMSS, OGC Technical Expertise and Regulatory Experience
- Contractor Support From National Labs and Design/Technology Experts
- Prior NRC Modular HTGR Pre-Application Review Experience
- Design, Operating and Safety Review Experience for Fort St. Vrain HTGR
- International HTGR Experience: IAEA, Japan, China, Germany, UK
- Exelon and DOE Design, Technology and Safety Assessments
- External Stakeholder Comments
- ACRS and ACNW Advice and Insights

PBMR Safety Significant Review Issues/Topics

- Fuel Performance and Qualification
- High Temperature Material Issues
- Passive Design and Safety Characteristics
- Accident Source Term and Basis*
- Postulated Licensing Basis Events*
- Prototype Testing Scope and Regulatory Credit
- Containment Functional Design Basis*
- Emergency Planning Basis*
- Risk-Informed Regulatory Framework*
- Probabilistic Risk Assessment

* Commission Policy Decision Likely Is Needed

PBMR Pre-Application Review Schedule

- About 18 months to Complete
- Monthly Public Meetings To Discuss Topics
- Feedback on Legal, Financial and Licensing Process Issues (~9/01)
- Feedback on Regulatory Framework (~12/01)
- Feedback on Design, Safety, Technology & Research Issues (~6/02)
- Feedback on Policy Issues (~10/02)

Regulatory Infrastructure Development Needs

- Staff Training Course for HTGR Technology
- Analytical Codes and Methods for Advanced Reactor Licensing Reviews
- Regulatory Framework for Advanced Reactor Licensing Reviews
- Core Staff Capabilities for Advanced Reactor Licensing Reviews
- Contractor Technical Support Capabilities
- Possible RES Confirmatory Testing and Experiments
- Possible Codes and Standards for Advanced Reactor Design and Technology