



P B M R

# NRC Commissioner Briefing on PBMR

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C/S



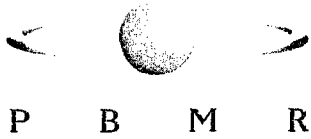
# Discussion Topics

- Substantial PBMR Progress
- US Interests in PBMR
- PBMR US Design Certification Program Objectives
- Other Topics Related to PBMR

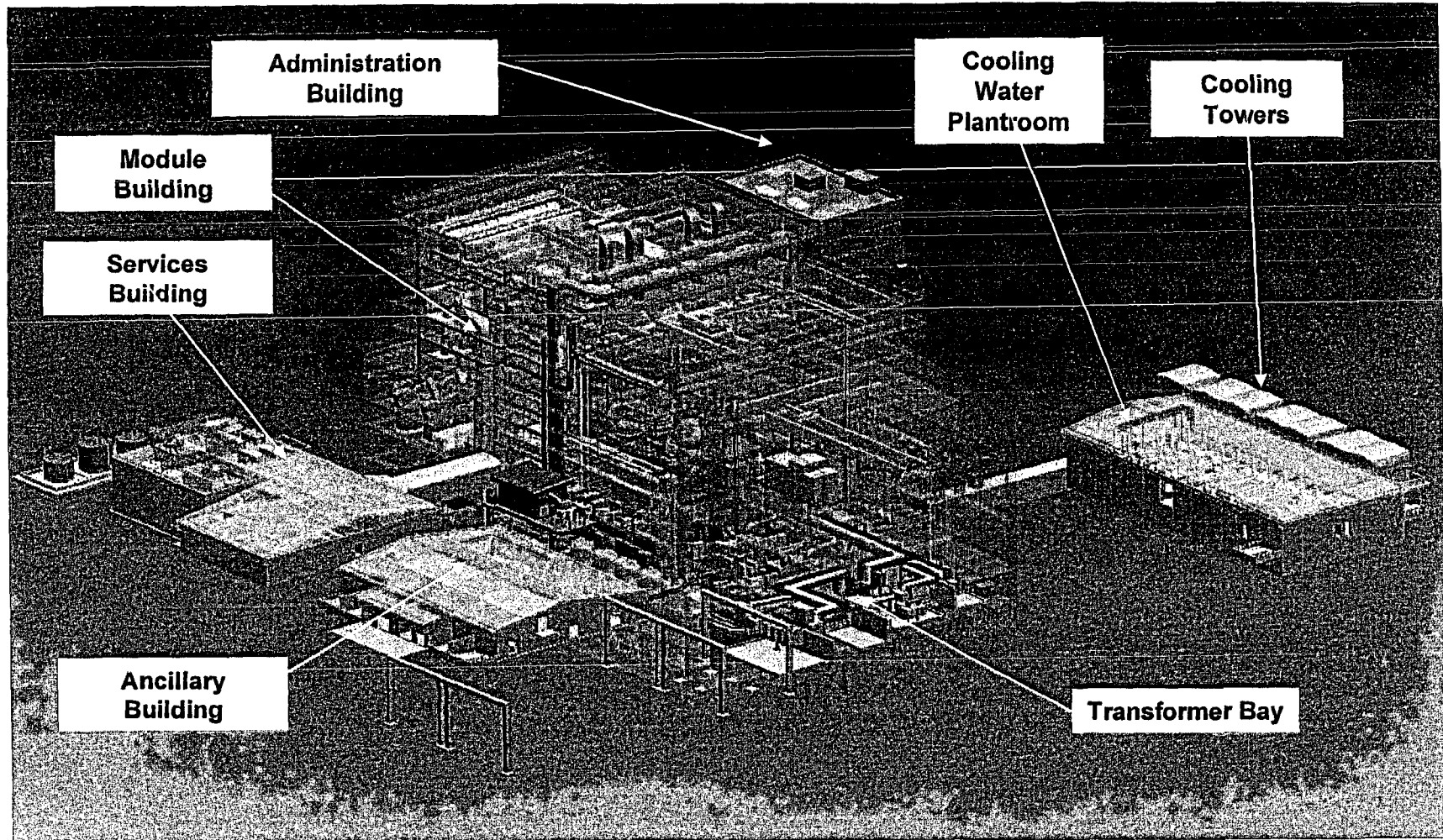


# “It is a real project!”

- RSA government has increased its public backing of the project
  - National Strategic Project reaffirmed; funding assured
  - Goal of 4000+MWe from PBMR in long range electricity supply plan
  - 1<sup>st</sup> International Supplier Conference held; 14 countries present
  - Major commitment to build supporting capacity of human capital at all levels
  - Increasingly a topic in state to state discussions
  - Expect RSA-USA agreements on nuclear energy cooperation this year
- Project Schedules for RSA Demonstration Unit at Koeberg
  - Currently about 700 people full time working on project world-wide
  - Fuel Load in 2010; commercial handover in 2011
    - SAR submittal in April 2006 to NNR; NRC RG 1.70 format / modified content for HTGRs;
    - Long lead equipment orders beginning in Dec. 2006
    - Revised EAI Record of Decision December 2006
    - NNR construction release in April 2007
    - Site excavation starts January 2007; Permanent construction beginning in May 2007
    - Fuel plant construction in 2006; early fuel for testing late 2006

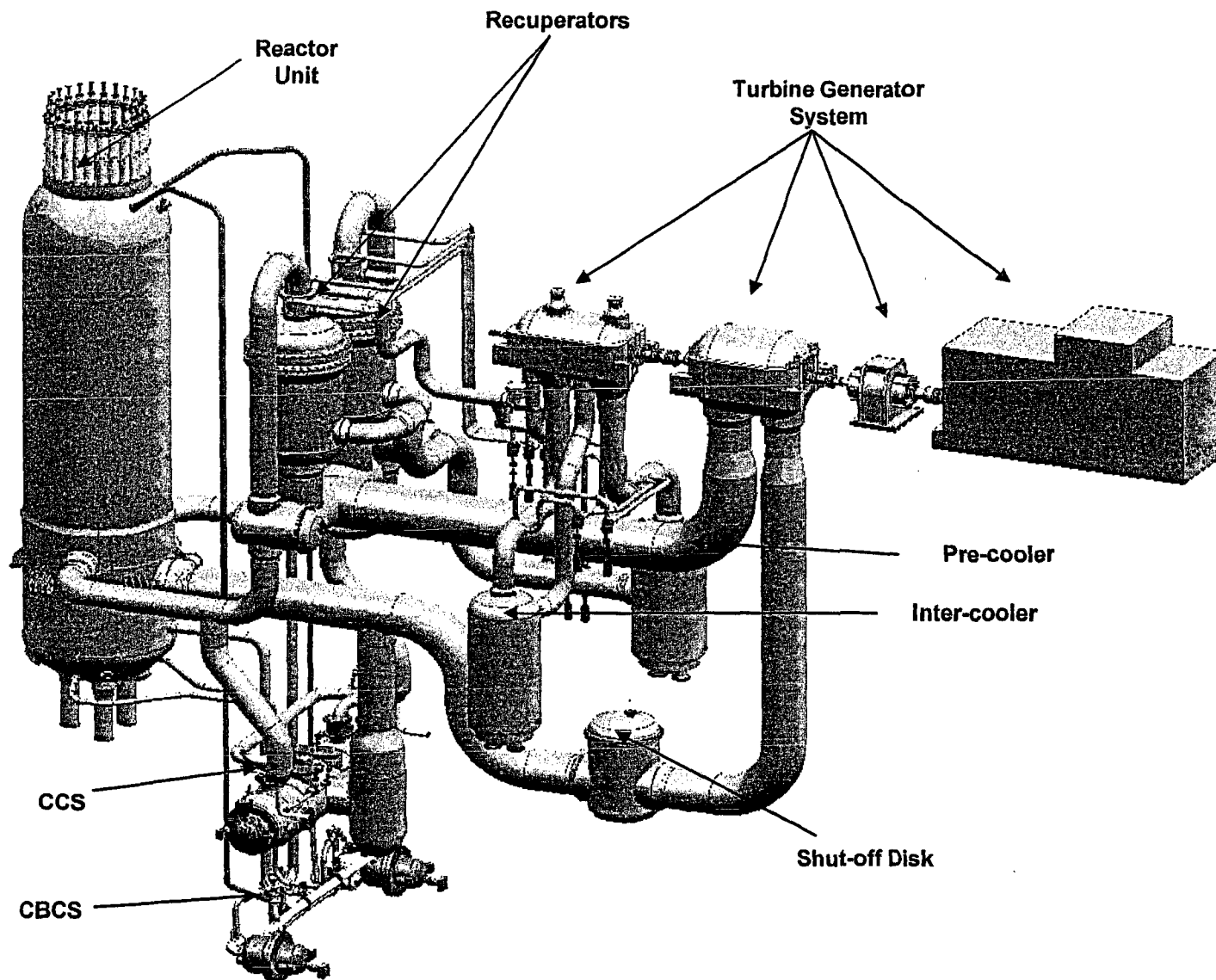


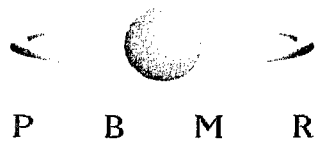
# PBMR Demonstration Plant



P B M R

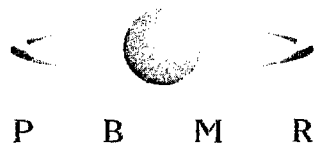
# PBMR Main Power System





# Key Suppliers In A Global Effort

- |                                       |                       |
|---------------------------------------|-----------------------|
| • Mitsubishi Heavy Industries (Japan) | Turbo-Machinery/CBA   |
| • IVV-2M (Russia)                     | Fuel Testing          |
| • PBMR Fuel Co. (RSA)                 | Fuel Supply           |
| • NUKEM / Uhde                        | Pilot Fuel Plant EPCM |
| • SGL (Germany)                       | Reflector Graphite    |
| • Heatric (UK)                        | Recuperator           |
| • GEA (RSA)                           | Pre-/Intercoolers     |
| • IST Nuclear (RSA)                   | Nuclear Auxiliaries   |
| • Westinghouse (USA)                  | Instrumentation       |
| • ENSA (Spain)                        | Pressure Boundary     |
| • Hydra (RSA)                         | Gas Cycle Valves      |
| • Gammametric (USA)                   | Radiation Monitoring  |
| • SNC Lavalin/M&R Joint Venture       | Demo EPCM             |



# Major Testing Program / Facilities

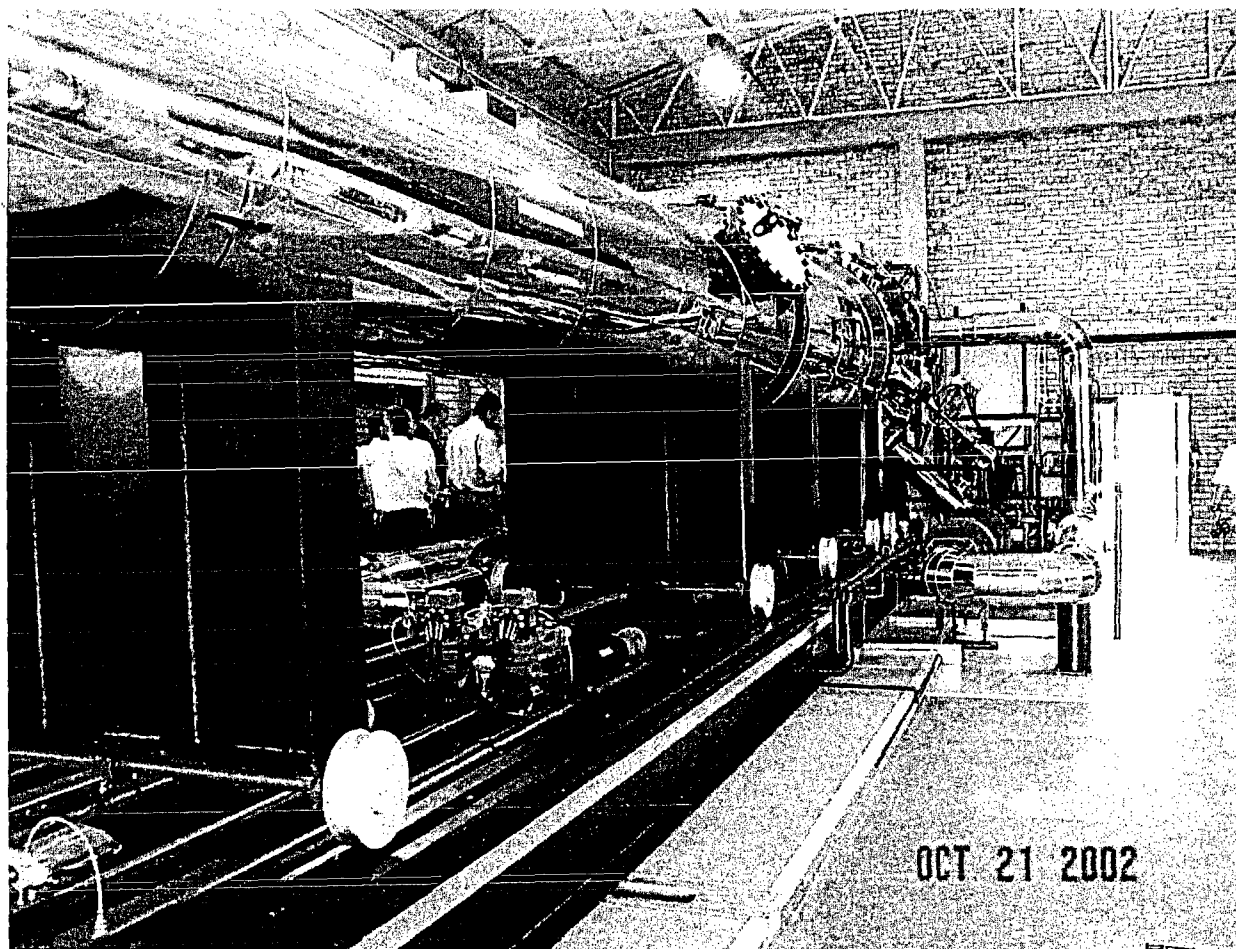
## Making Significant Progress

Testing to validate all critical assumptions of equipment performance or for code validation to manage risks

- PBMR 'Micro-model' - complete
  - Brayton system model for code V&V and control system logic
- Helium Test Facility – in construction
  - Full size components at full design conditions
  - Component reliability / maintainability / dynamic performance
- Heat Transfer Test Facility – in design
  - Full temperature core conditions
- Other separate effects or component tests
  - Air Ingress – in progress
  - Component manufacturability / reliability / optimization - complete
- Fuel and graphite irradiation testing – in design
  - Fuel design performance validation
  - Fuel manufacturing assurance
  - Graphite lifetime performance validation

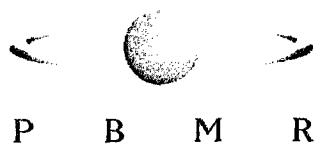


# Major PBMR Test Facilities

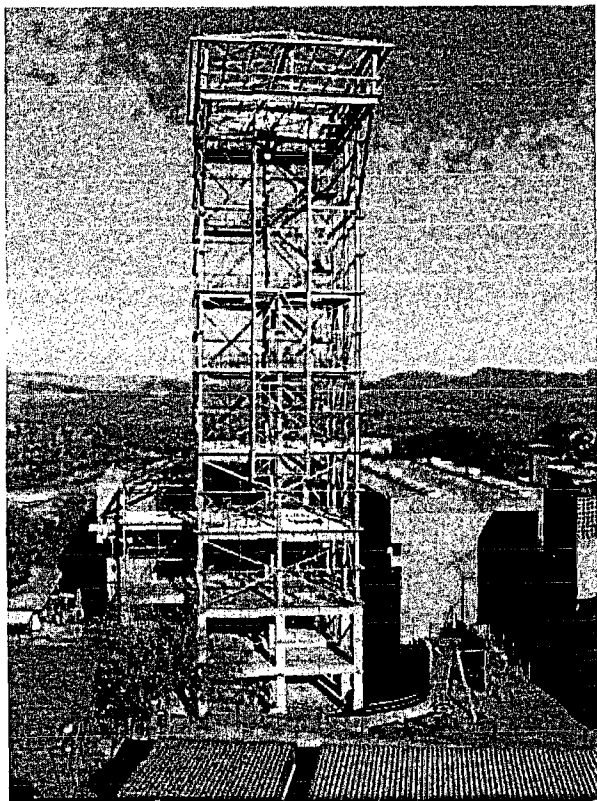


**Micro Model demonstrated operation of closed cycle recuperative Brayton Cycle**

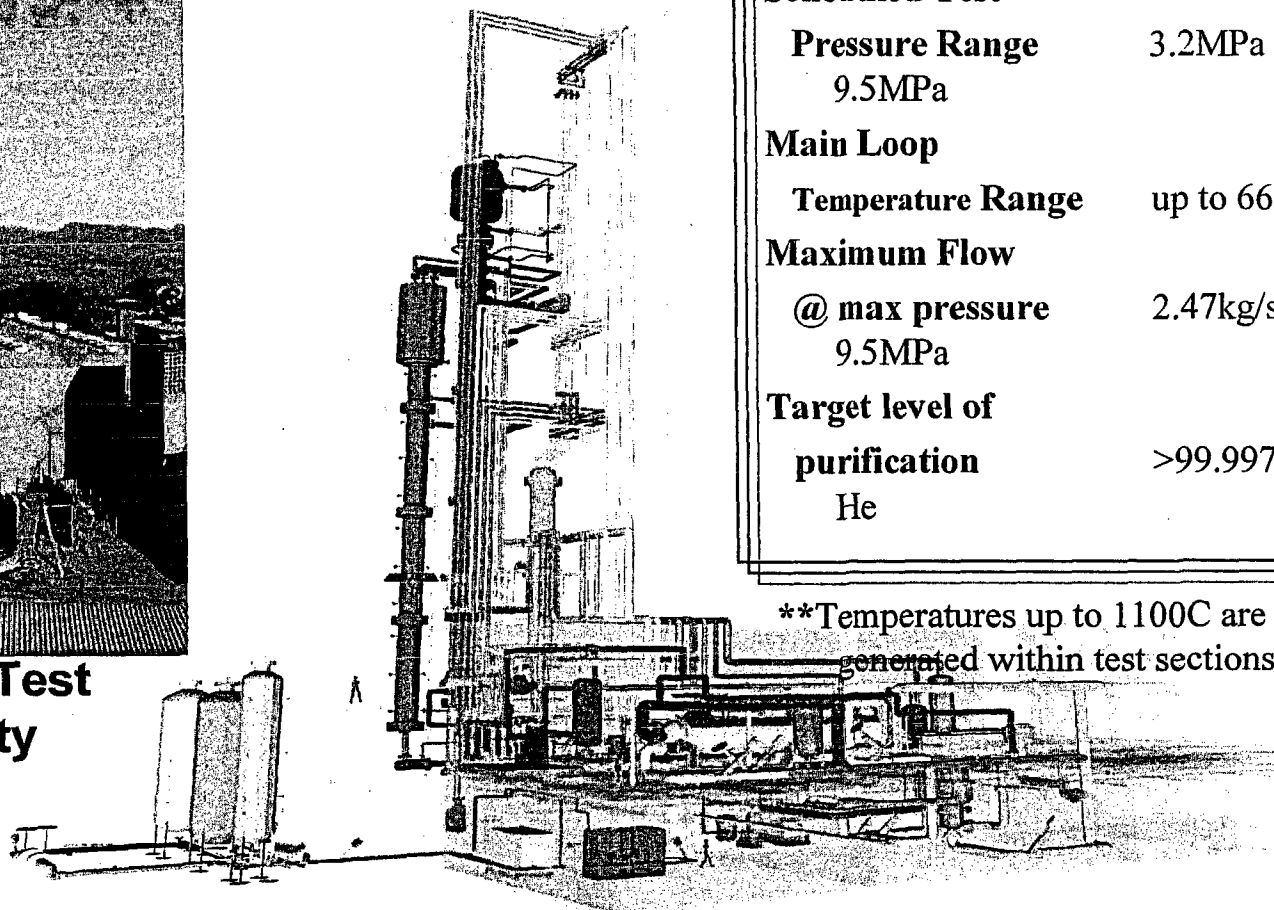




# Major PBMR Test Facilities (cont'd)



**Helium Test  
Facility**



## **Main Loop Characteristics**

### **Scheduled Test**

**Pressure Range** 3.2MPa to  
9.5MPa

### **Main Loop**

**Temperature Range** up to 660°C\*\*

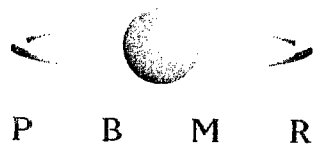
### **Maximum Flow**

**@ max pressure** 2.47kg/s @  
9.5MPa

**Target level of  
purification**  
He

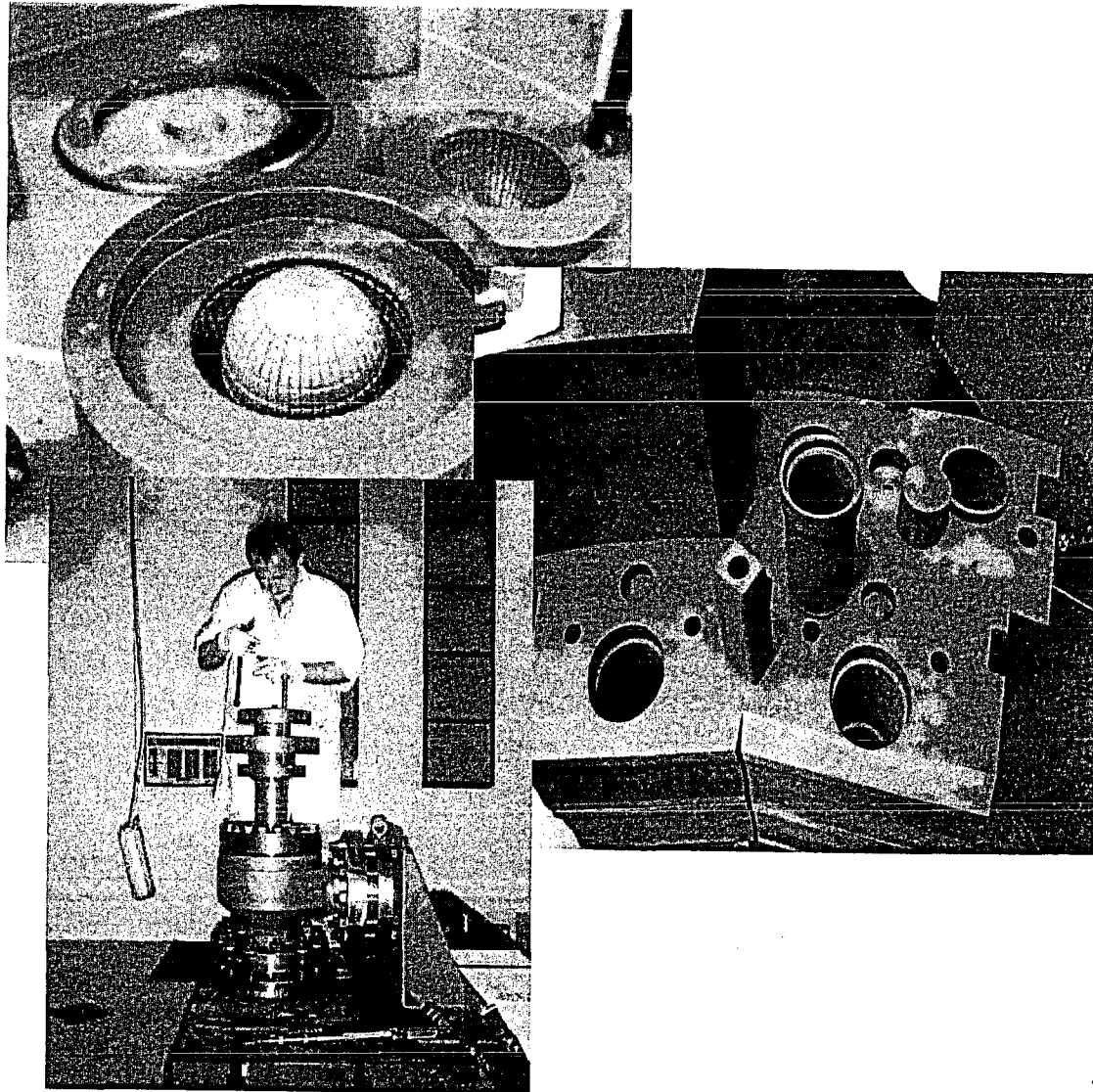
>99.997% pure

\*\*Temperatures up to 1100C are  
generated within test sections



# Manufacturing of Pre-Production Components Already Started

- Fuel
- Graphite Structures
- Gas Cycle Valves





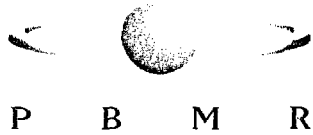
# US Interests in PBMR

- **Utility Interest**
  - PBMR can satisfy special situations
    - Alternate choices for small or constrained sites
    - Economic options with smaller capital increments
    - Transmission system optimizations
  - Merchant operations for process heat industries
  - Hydrogen production
  - Utility Advisory Group formed and active
- **Government Interest**
  - Energy Bill NGNP Licensing Task
    - “ Sec 644 (b) Licensing Strategy.-Not later than 3 years after the date of enactment of this Act, the Secretary and the Chairman of the Nuclear Regulatory Commission shall jointly submit to the appropriate committees of the Senate and the House of Representatives a licensing strategy for the prototype nuclear reactor, ... “
  - Longer term National Lab programs; Gen IV VHTR
- **Non-utility Interest**
  - Carbon; water; reject heat restrictions limit US expansion
  - Insecure supply and unstable cost of fossil feedstocks
  - Access to new technologies like Coal-To-Liquid and Gas-To-Liquid



# PBMR NRC Design Certification Rationale

- Supports utility long-term electricity planning needs
- Opens the door for other applications
  - NGNP Licensing Task in Energy Bill
  - Process Heat Plant applications
    - Hydrogen
    - Coal-to-Liquid; Gas-to-Liquid
    - Desalination by-products
    - Petroleum refining / extraction
- Advanced non-LWR ideal for testing Risk-Informed, Technology-Neutral Regulatory process
  - Should not be restricted to ALWRs
  - Requires a real design for effective process / regulatory analysis
  - Prepares NRC Staff for non-LWR regulation in the future
  - Provides an ideal test case for implementing Safety Goal, Risk, and Advanced Reactor Policies in integrated manner



# PBMR NRC Design Certification

- DC Approach
  - Detailed planning; minimizes resources early
  - Limited technical issues, but tough ones
  - Define the requirements for a non-LWR DC application
  - DC application only following completion of key milestones in RSA on Demonstration Plant / Multi-module design and satisfactory completion of NRC pre-application review
- DC Schedule
  - Planning complete December 2005
  - Pre-Application technical exchanges 2006-7
  - DC Application submittal late 2007-early 2008
    - Contributes to/capitalizes on DOE-NRC deliberations on NGNP licensing
    - Demonstrates new risk-informed, performance-based licensing process for HTGR reactors
  - Certification in 2011-2012



# Pre-Application Topics

- Licensing Bases Event determination
- SSC Classification and Defense in Depth
- Fuel Design and Qualification
- Materials Selection and Codes & Standards
- Analytical Code V&V
- Single v. Multi-module Certification
- Physical Security Optimization for new DBT



## Other Issues

- Pebble Bed Reactors will be built in South Africa and China as a minimum
- NRC increasingly taking lead on broader international community efforts for effective nuclear regulation
- Sustaining NRC's leadership role in global nuclear regulation
- NRC preparation for non-LWR regulation requires some time and a real design to be effective



# Summary

- PBMR is a real project that will lead the global development of high temperature gas reactors
- NRC Design Certification is well timed:
  - Pre-application will assure regulatory preparedness for advanced HTGRs
  - Pre-application work will substantially advance the development of a RI T-N regulatory process
  - Pre-application work directly supports NRC – DOE licensing plan for NGNP
  - NRC resource demand for pre-application are modest
- There is growing client interest in PBMR for longer term electric and process heat applications