

PBMR CORE DESIGN

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PBMR, Pty

16 August 2001

Aug 01

Attachment 3-d¹

Objective

- Inform and educate NRC regarding key safety design features
- Describe application of analytical codes used by PBMR Pty.
- Reach agreement on what constitutes sufficient design information and analytical methodologies to support a US license application

Topics

- Physical Layout
- Pebble Flow Overview
- Core Calculations
- Conclusions

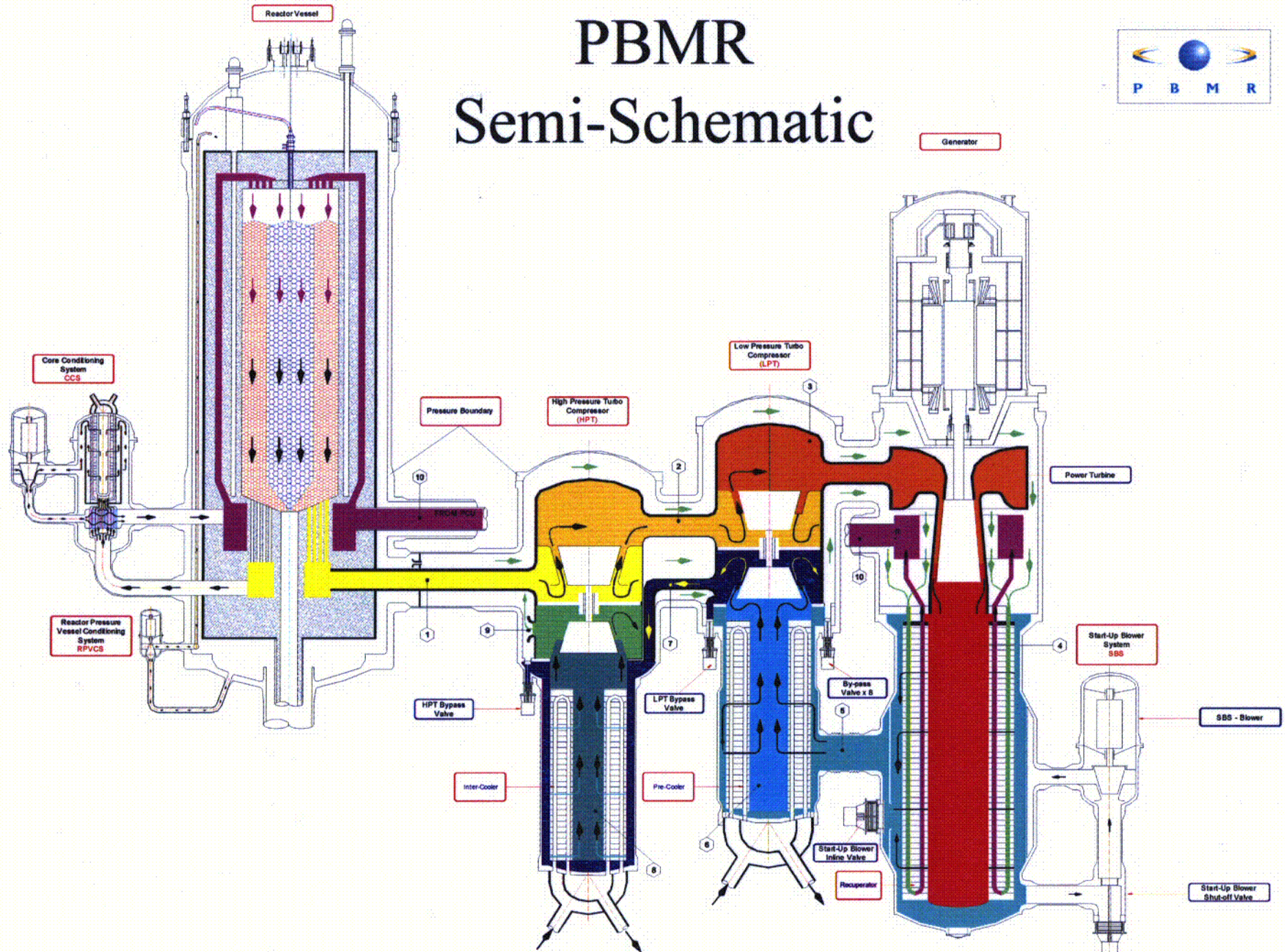
Introduction



- Safety characteristics as basis for design
- HTR-MODUL Reactor Unit (RU) design as reference
 - Control elements in reflector only
 - H/D ratio increased 1:1 to 3:1
- Introduction of “graphite column” as central reflector

PBMR

Semi-Schematic



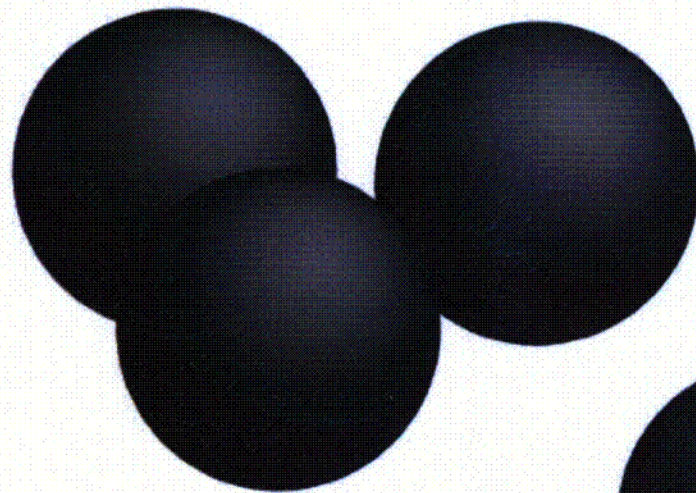
PBMR RPV Layout

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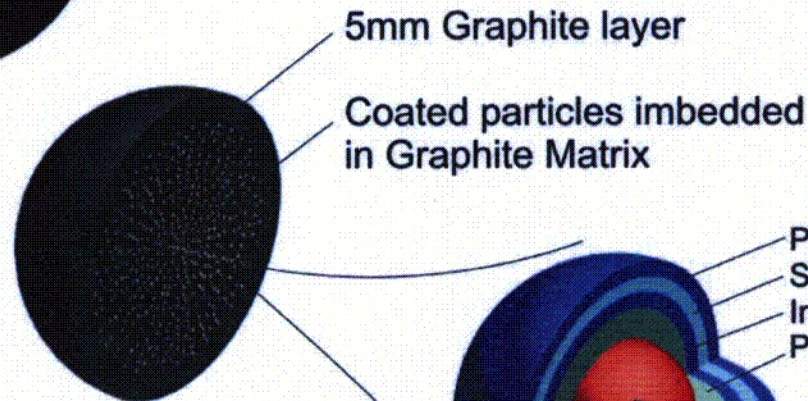
PBMR
FHSS
Schematic

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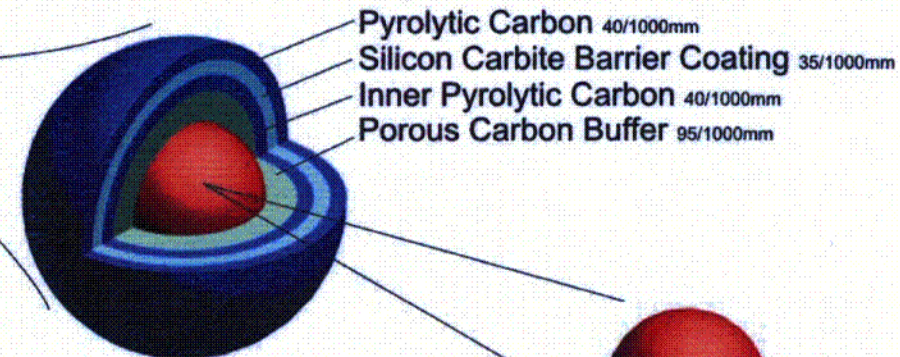
Fuel Sphere Design



Dia. 60mm
Fuel Sphere



Half Section



Dia. 0,92mm
Coated Particle



Geometry

- Pebble Flow Experiments
 - R&D Final Report by Siemens
- Computer Simulation
 - Model development at FZJ
- Select Benchmark Experiment
 - Compare experiment and computer model
- Verify VSOP pebble flow model

PFC-3D code

- The *PFC^{3D}* code used for PBMR analysis is divided into two parts:
 - Analysis of the top of the core in a cylindrical vessel
 - Analysis of the pebble flow through the core

Filling the Vessel

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Core Sphere Flow Analysis

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Core Sphere Flow Analysis

Core Sphere Flow

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Flow Lines

Local Distribution vs. Core Radius

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Computational Approach

- Prepare input models for:
 - Fuel
 - Geometry
 - Pebble flow
 - Core compositions
- Perform equilibrium and/or initial core calculations
- RU status is preserved for later restart

Comments on Pebble Flow Experiments



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Flow of Pebbles

- Model Description:
 - Parallel flow in the upper part of the pebble bed
 - Effect of cone and discharge tube in the bottom region
 - Transition from parallel flow to flow pattern via interpolation

VSOP Implementation

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VSOP RU Model

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Temperature Coefficients



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Radial Fast Flux Distribution at Various Axial Positions

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Radial Thermal Flux Distribution from Top of Core

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RCSS Position: Inserted

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RCSS

Characteristics

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Reactivity Balance

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Xenon Transient

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Benchmarking using PBMR

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