File : febble Bed Reactor

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PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

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By:

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Part of High Technology Program Funded by Ministry of Education

- 550 Staff & 200 Graduate Students
- 2 MW Pool Reactor
- 5 MW District Heating Reactor
- 10 MWt HTGR

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HTGR Program

HTRE 10 MWt
1992 - Site Agreement
1993 - PSAR
1994 - CP
1998 - FSAR
~Nov. 2000 - Fuel Load License
2001 - Revised FSAR
2001 - OL

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HR - 200 MWt
1993 - Site Agreement
1994 - PSAR
1996 - CP
FSAR
Fuel Load License
Revised FSAR

- OL

Reactor Design:

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- Reactor Thermal Power 10 MWt
- Core Diameter 1.8 m
- Core Height 1.97 m
- Average Power Density 2 MW/m³
- He Coolant (Forced Circulation-Down Flow)

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- He Temperature (Normal Operation) Inlet: 250 - 300 °C Outlet: 700 - 900 °C
- He Pressure ~80 bar (~1200 psig)
- One Steam Generator/Heat Exchanger
- Single Loop with a Concentric Hot-Leg and Cold-Leg Configuration
- Passive Residual Heat Removal

Fuel:

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- 6 cm-diameter "Pebbles" or "Balls"
- 5 cm-diameter of UO₂ Fuel Particles
 0.5 cm-thickness Graphite Layer
 - Fuel Details not Provided
 - Appears Very Similar to Modular Pebble Bed Reactor (MPBR)...German Design

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- 27,000 Fuel Balls in Reactor Core Average
- Burnup Target 80,000 MWD/MT
- Fuel Enrichment 17% U235
 (200 MWt Design Expected to Have Lower Enrichment)

HTRE - Fuel Handling:

- 125 Balls Cycled Each Day
- 100 Recycled, 25 Added, 25 Discharged
- Balls Pass 5 Times Through the Core Before Being Discharged
- Fuel Separator Based on Balls Rolling Smoothly on Drum (Damaged Balls Discharged)
- Balls Also Checked for Burnup Before Recycling

- "Dummy Balls" Graphite Only are Used for Initial Fuel Loading

Fuel Facility Supporting HTR (Pebble Bed Reactor Design)

- INET (Tsinghua University)
- Capacity 125 kg U/yr
- FSAR 1997 ("Special Case")
- OL 1998
- 5000-6000 Fuel Pebbles (balls) On-site

Safety Systems:

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- Control Rods in Graphite Reflector Region
- Digital Reactor Protection System
- Backup Shutdown System Small Boron Balls Over Reactor Moderator Region
- Natural Circulation Cooling
- Liner Cooling System for Decay Heat Removal

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- Containment Function
 - Fuel Barriers
 - Confinement Building

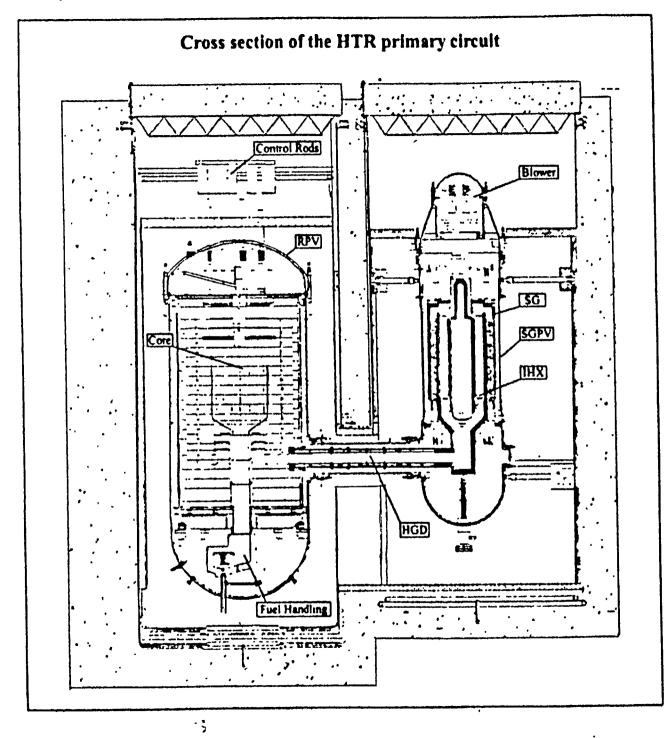
Preliminary Thoughts on Pebble Bed Reactor Issues

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- Fuel Design & Performance (Needs to be Tested Under Fluence & High Temp & Mechanical Load)
- Component Performance at High Temperature
- Fuel Handling Mechanical Equipment (Chinese Built Full Scale Mockup and Tested "Dummy" Balls)
- Reactivity Control Based on Ability to Calculate Need to Explore Criticality (i.e., Limit Excess Reactivity to 1% <Greater or Less)

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- Potential for Natural Circulation Flow Blockage
- Maintainability of Components (Ability or Inability to Offload Fuel)





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