



FACSIMILE TRANSMISSION

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PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

December 20, 2000

By:

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Ward-

These are briefing notes based on a recent trip to China. NRR contacted the Chinese and got the OK to release the information provided during the plant tour. We have no way to verify the accuracy of the information attached, as it was recorded based on discussions during the plant tour.

Sincerely

Bruce

PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

- Tsinghua University
Institute for Nuclear Energy Technology
Contact: Prof. Xue Dazhi

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

PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

HTGR Program

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

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

PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

Reactor Design:

- 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)
- 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

PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

Fuel:

- 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
- 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)

PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

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

PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

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

PEOPLE'S REPUBLIC OF CHINA Pebble Bed Reactor Program

Safety Systems:

- 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
- Containment Function
 - Fuel Barriers
 - Confinement Building

PEOPLE'S REPUBLIC OF CHINA

Pebble Bed Reactor Program

Preliminary Thoughts on Pebble Bed Reactor Issues

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