Joint ICTP-IAEA Workshop on Nuclear Reaction Data for Advanced Reactor Technologies

19 - 30 May 2008


J.M. Kendall

Global Virtual LLC
Prescott
USA
IAEA-ICTP Workshop on Nuclear Reaction Data for Advanced Reactor Technologies

ICTP – Trieste, Italy, 18-30 May 2008

Gas-Cooled Reactors – Technology Options, Operating Research Reactors and Demonstration Plant Project Initiatives

J. M. Kendall
Global Virtual LLC
# Gas Cooled Reactor Operating History

<table>
<thead>
<tr>
<th>Country</th>
<th>Reactor</th>
<th>Operation Period</th>
<th>Power Output</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>Dragon</td>
<td>1964-1976</td>
<td>20 MWt</td>
<td>350-750°C</td>
</tr>
<tr>
<td>USA</td>
<td>Peach Bottom I</td>
<td>1966-1974</td>
<td>115 MWt</td>
<td>344-728°C</td>
</tr>
<tr>
<td>USA</td>
<td>Fort St. Vrain</td>
<td>1977-1989</td>
<td>842 MWt</td>
<td>406-785°C</td>
</tr>
<tr>
<td>Germany</td>
<td>AVR</td>
<td>1966-1988</td>
<td>46 MWt</td>
<td>275-950°C</td>
</tr>
<tr>
<td>Germany</td>
<td>THTR</td>
<td>1985-1989</td>
<td>750 MWt</td>
<td>250-750°C</td>
</tr>
</tbody>
</table>
Major Technology Options

Pebble Bed

Prismatic Block
Technology Option
Pebble Bed

Fuel Sphere
Dia. 60 mm

Half Section
5mm Graphite layer
Coated particles imbedded
in Graphite Matrix
Pyrolytic Carbon
Silicon Carbide
Pyrolytic Carbon
Porous Carbon Buffer

Coated Particle
Dia. 0,92 mm
Pyrolytic Carbon
Uranium Dioxide

Fuel Kernel
Dia. 0,5 mm

PBMR Pty presentations to US Nuclear Regulatory Commission, Meeting on
PBMR Safety and Design Familiarization, 28 February – 2 March 2006.
Technology Option
Pebble Bed

PBMR Pty presentations to US Nuclear Regulatory Commission, Meeting on PBMR Safety and Design Familiarization, 28 February – 2 March 2006.
Technology Option
Pebble Bed

PBMR Pty presentations to US Nuclear Regulatory Commission, Meeting on
PBMR Safety and Design Familiarization, 28 February – 2 March 2006.
Technology Option
Prismatic Block

Pyrolytic Carbon
Silicon Carbide
Porous Carbon Buffer
Uranium Oxycarbide

PARTICLES
COMPACTS
FUEL ELEMENTS

Technology Option
Prismatic Block

Technology Option
Prismatic Block

Operating Research Reactors

HTR-10
Pebble Bed
China

HTTR
Prismatic Block
Japan
Operating Research Reactors
HTR-10 (China)

Operating Research Reactors
HTR-10 (China)

Initial Criticality December 2000
Operating Research Reactors
HTTR (Japan)

30 MWt

Operating Research Reactors
HTTR (Japan)

Operating Research Reactors
HTTR (Japan)
Operating Research Reactors
HTTR (Japan)

Initial Criticality November 1998
Demonstration Projects
Pebble Bed and Prismatic Block

Ongoing Projects
• Pebble Bed
  • China – HTR-PM
  • South Africa – PBMR
• Prismatic Block or Pebble Bed
  • USA - NGNP

Initiatives (Prismatic Block)
• US/Russia – GT-MHR Pu
• Japan – GTHTR 300
Demonstration Projects
HTR-PM (China)

Demonstration Projects
HTR-PM (China)

- Pebble Bed
- 2 Reactor/Steam Generator units at 250 MWt each
- Steam Turbine-Generator output 200 Mwe
- Scheduled Completion ~2013
Demonstration Projects
HTR-PM (China)

-22-
Demonstration Projects
PBMR DPP (South Africa)

Demonstration Projects
PBMR DPP (South Africa)

- Pebble Bed
- Annular reactor core 400 MWt
- Direct cycle gas turbine ~175 MWe
- Scheduled Completion ~2013

Demonstration Projects
PBMR DPP (South Africa)

Demonstration Projects
PBMR DPP (South Africa)

Demonstration Projects
NGNP (USA)
Demonstration Projects
NGNP (USA)

- Three competing design organizations
  - Westinghouse
  - AREVA
  - General Atomics
- Pebble Bed or Prismatic
- 500-600 MWt
- Combined Electricity and Hydrogen Production
- Scheduled Completion ~2018
Demonstration Projects
NGNP (USA)

- Westinghouse
- Pebble Bed
- Hydrogen production topping cycle
- Steam turbine bottoming cycle
Demonstration Projects
NGNP (USA)

- AREVA
- Prismatic
- Parallel Hydrogen production cycle
- Parallel gas turbine with steam turbine bottoming cycle
Demonstration Projects
NGNP (USA)

- General Atomics - Prismatic
- Direct cycle gas turbine
- Parallel Hydrogen production cycle

Demonstration Projects
NGNP (USA)

Westinghouse
Pebble Bed

AREVA
Prismatic

General Atomics
Prismatic

INL/EXT-07-12967, Next Generation Nuclear Plant Pre-Conceptual Design
Report, September 2007