HTTR test program towards coupling with the IS process

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Japan Atomic Energy Agency (JAEA)
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2. HTTR test program towards the HTTR-IS system
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   ● Simulation test of abnormal transients
     - characteristics test of nuclear heat utilization system

3. Summary
Major Objective of the HTTR project

1. Establishment of HTGR technology
   - Accumulation of long-term operation data
   - Demonstration of inherent safety feature

2. Establishment of heat utilization technology
   - Demonstration of hydrogen production system
## Major Specification of the HTTR

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td>Thermal power</td>
<td>30 MW</td>
</tr>
<tr>
<td>Outlet coolant temperature</td>
<td>850 °C / 950 °C</td>
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<tr>
<td>Inlet coolant temperature</td>
<td>395 °C</td>
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<tr>
<td>Primary coolant pressure</td>
<td>4 MPa</td>
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<td>Core component</td>
<td>Graphite</td>
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<td>Core height / diameter</td>
<td>2.9 m / 2.3 m</td>
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<td>Uranium enrichment</td>
<td>3 – 10% (Ave. 6%)</td>
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</table>
Bird’s-eye View of the HTTR Reactor Building

- Air cooler
- Secondary Pressurized Water Cooler
- Intermediate Heat exchanger
- Primary Pressurized Water Cooler
- Reactor Pressure Vessel
- Reactor Containment Vessel
Block Type Fuel of the HTTR

- Fuel kernel, 600 μm
- High density PyC
- Low density PyC
- SiC
- Coated fuel particle
- Fuel compact
- Fuel rod
- Fuel assembly
- Fuel handing hole
- Dowel pin
- Graphite sleeve
- Plug
- Dowel socket, 360 mm
- 580 mm
## Construction, Test and Operation Schedule of the HTTR

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- **Construction decided**
  - Long-term Program for Research, Development and Utilization of Nuclear Energy

- **First criticality**
  - (Nov 10)

- **Construction start**

- **30 MW, 850°C**
  - (Dec 7)

- **Fuel fabrication**

- **Fuel loading**

- **Commissioning test**

- **Criticality test**

- **Power-up test**

- **Rated power operation**

- **Safety Demonstration Test**

- **950°C**
  - (Apr 19)
HTTR Reached 950°C in Parallel Loaded Operation
Performance of heat exchangers in the MCS

- Rated operation (850°C operation)
- High-temp. test operation (950°C operation)

Heat transfer coefficient \( \times \) Heat transfer area (kW/K)

- PT-3
- RS-2
- RS-5
- PT-5

Reactor-inlet coolant temperature (°C)
Power coefficients of reactivity

Reactor power (MW)

Power coefficients of reactivity (%Dk/k/MW)

- High-temp. test operation up to 30MW
- High-temp. test operation up to 20MW (single loaded)
- High-temp. test operation up to 20MW (parallel loaded)
- Rated operation
Behavior of fission product

Rated/Single loaded
Rated/Parallel loaded
High-temp./Single loaded
High-temp/Parallel loaded

Fractional release of $^{88}$Kr [-]

Reactor power [%]
Future test program using the HTTR

Simulation tests of abnormal transients caused by the nuclear heat utilization system

- Secondary coolant reduction test
- Loss of final heat sink test, etc.

Test results will be utilized for validation of analytical code as well as both of the HTTR-IS system design and the future VHTR design.
Plan of the HTTR-IS system

- Concentric hot gas duct
- High-temperature valve
- Intermediate heat exchanger
Major objective of the HTTR-IS system

The HTTR-IS system aims to:
- establish procedures on safety design and evaluation,

- add to experience of construction, operation, and maintenances,

- establish the control technology for both of IS process and reactor,

- establish the technology on key high-temperature components, such as high-temperature valves, and

- verify analysis codes.
Summary

- HTTR achieved 950 °C of outlet coolant temperature successfully in 2004
- Simulation tests of abnormal transients caused by the nuclear heat utilization system are planned.
- Development of IS process heat application technology have been performed. In near future, IS process hydrogen production system will be coupled to the HTTR.
Thank you for your attention.