RESEARCH AND DEVELOPMENT NEEDS FOR THE FUTURE

HTTR Steam Reforming System

- Need to Establish Design of Commercial Plant
- HTTR Out-of-Pile Test
  (1) Development of a dynamic simulation computer code including the reactor dynamics
  (2) Establishment of normal start-up and shut-down operation technology
  (3) Establishment of emergency shutdown operation technology, considering issues such as structural integrity of the reforming tube
  (4) Optimize the design of a reformer from the view point of size, thermal efficiency, economics, easier removal of the used catalyst, lower stresses of the reformer tubes, etc. based on the HTTR out-of-pile test and the EVA-ADAM project
  (5) Optimization of feedgas composition (CH_4, H_2O, and $C0_2$) for methanol production
- Component Tests
  (1) Evaluation of the mechanism for permeation of the hydrogen isotope through the IHX and SR tubes
  (2) Development of an analytical code for tritium and/or hydrogen transport
  (3) Obtaining corrosion data of the reforming tubes

Commercial HTGR Process Heat Application System

- First Generation Plant (Steam Reforming System)
  (1) Compact Heat Exchanger with High Temperature and High Thermal Efficiency
  (2) High Temperature Isolation Valve
  (3) Material Development for Reforming Tube (High Thermal and High Pressure Resistance)
- Future Advanced Plant
  (1) IS Process
    1). a) Development of closed-cycle operation techniques under efficient process conditions of the Bunsen reaction
    b) Establishment of the HI process scheme
    c) Obtain corrosion database of the construction materials for the Bench-scale experiment
    2) a) Bench-scale experiment
    b) Materials of construction for the Pilot-scale experiments
    3) Pilot-Scale experiment by He gas heating
    4) Demonstration by nuclear heat
  (2) Development of New Processes
    • Co-production of Hydrogen and Electricity
      - Fuel cell type reactor
      - Partial oxidation of methane
    • New Thermo-chemical Process for Hydrogen Production
    • Effective Utilization of Carbon in Fossil Fuels

- Advanced Components
  - Heat Storage with High Temperature
  - Enhancement of Heat Transfer

Further R&D for Consideration Utilizing the HTTR CO_2 Reforming System

- Development and modification of the catalyst system to meet specific feedstock like Natuna gas, biogas, etc.
- Purification of the feed gas.
- Development of startup and shutdown procedures which may different for the various feedstock (e.g. if addition of steam is needed)
- Reducing the operating pressure in the reformer.
- Increasing the operating temperature of the reformer.
- Developing of an isothermal reformer.
- Developing of a buffer thermal storage to smooth the coupling of the chemical plant and the HTTR.
- Definition, design and demonstration of the coupling of the reformer with the end-user (gas-turbine, methanol plant, etc.)
- Demonstration of a "small" size HTTR coupled with CO_2 reformer for biogas feedstock for inherently safe, zero CO_2 emission nuclear plant.