



Next Generation Nuclear Plant for Hydrogen Production

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March 12, 2009

Next Generation Nuclear Plant

The Energy Policy Act of 2005 (EPAAct), Public Law 109-58, mandates the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) to develop jointly a licensing strategy for the Next Generation Nuclear plant (NGNP).

The NGNP is very high temperature gas-cooled reactor (VHTR) (maximum exit Helium temperature ~950C) for generating electricity and co-generating hydrogen using the process heat from the reactor.

The anticipated FY09 funding for the NGNP R&D is about 185 Million

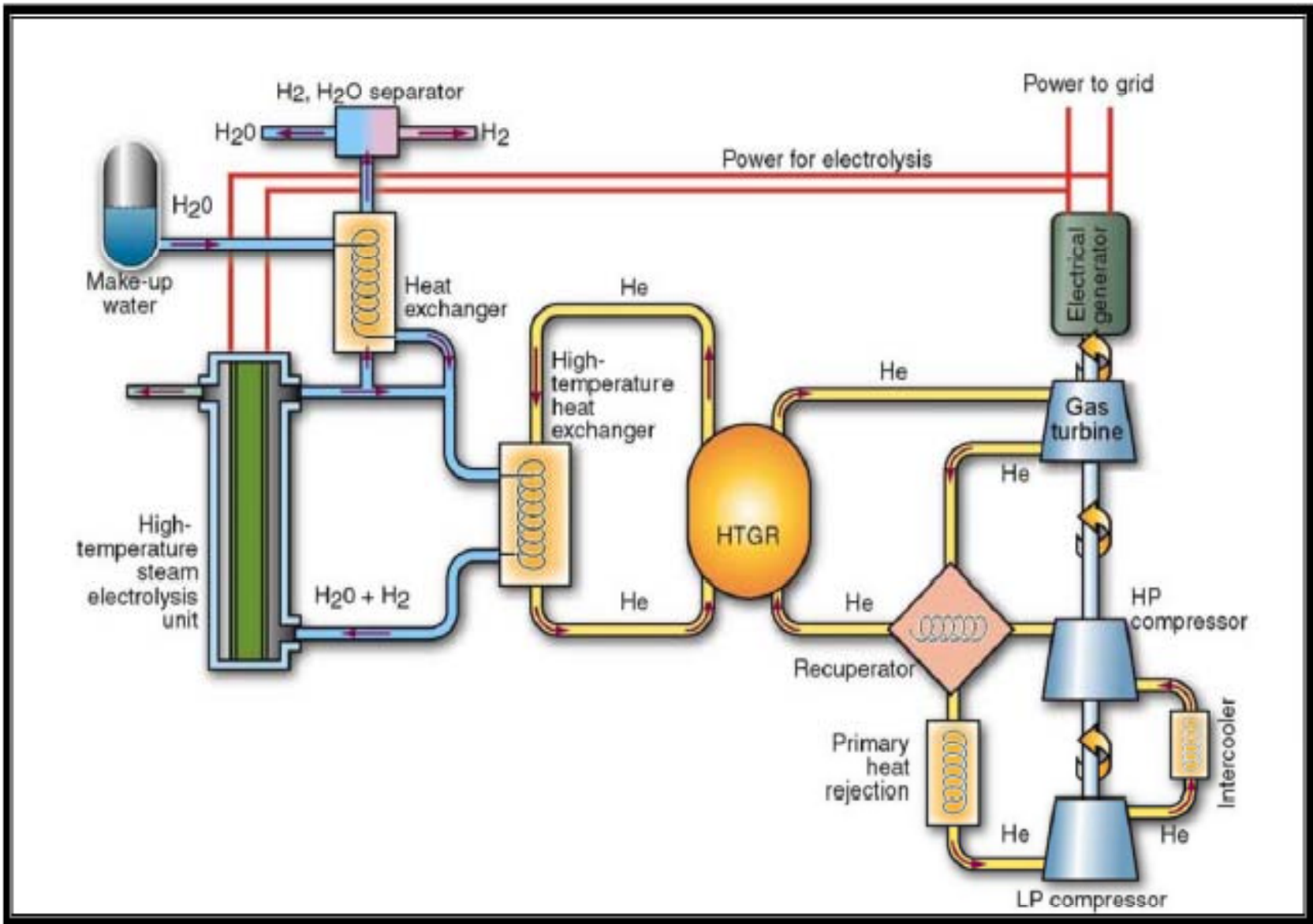


Fig. 1. Representative schematic of the NGNP.

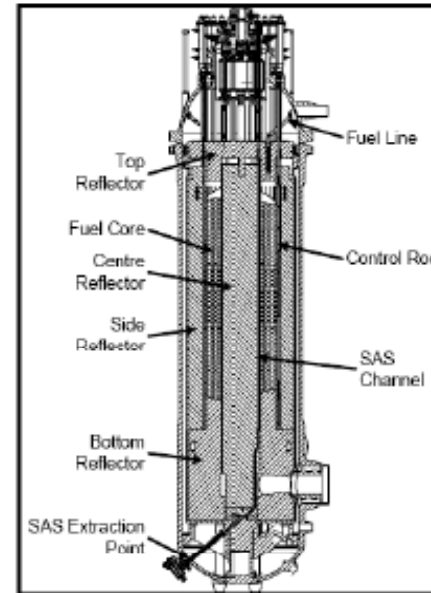
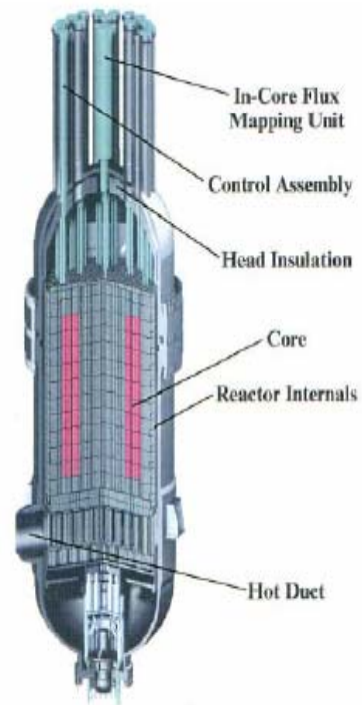


Fig. 2. NGNP prismatic core option.

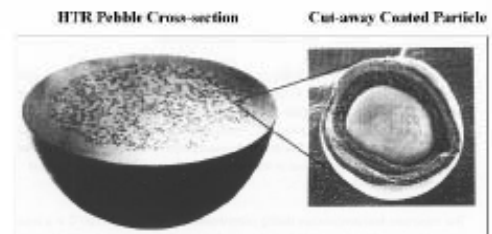


Fig. 3. NGNP pebble bed core option.

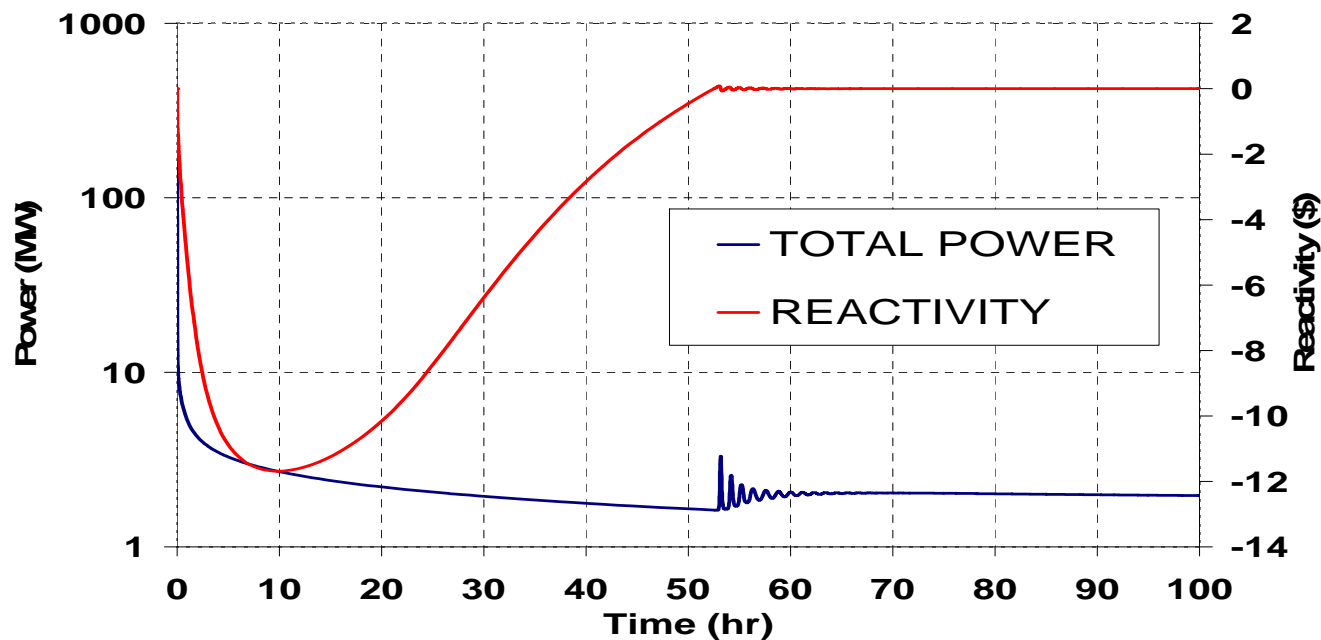
NGNP Safety Analysis

For off-normal and accident situations, the following categorizations of three major event-frequency based regimes (with typical ranges assigned to the frequency of occurrence) were used.

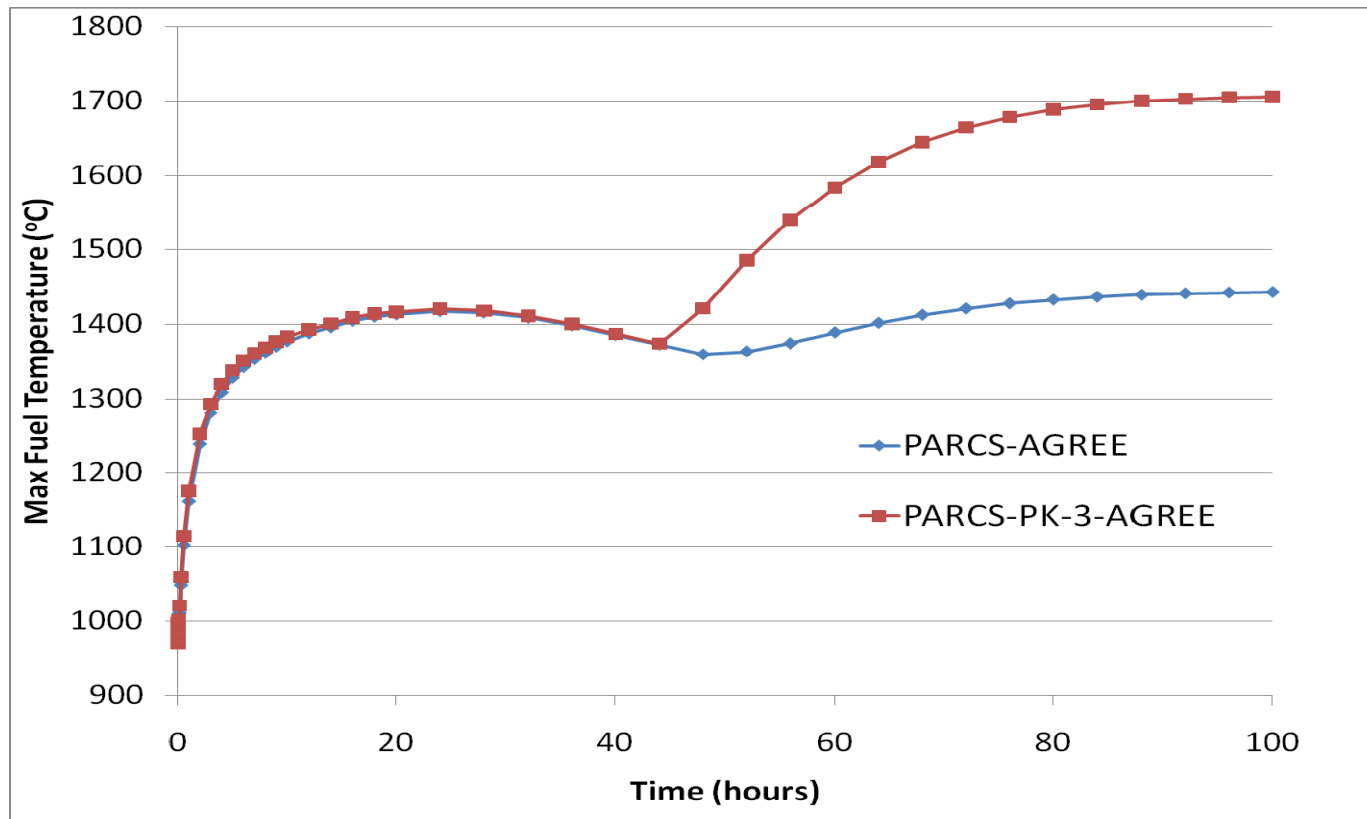
- *Anticipated Operational Occurrence (AOO): An AOO is a frequent event with an expected*
mean frequency of occurrence of 10⁻² per plant-year or higher.
- *Design Basis Accident (DBA): A DBA is an infrequent event that might occur once during the* collective lifetimes of a large number of plants. However, the plant is specifically designed to mitigate the event using only equipment classified as safety grade. DBAs are typically associated with events having a mean frequency between 10⁻² and 10⁻⁴ per plant-year.
- *Beyond Design Basis Accident (BDBA): A BDBA is a very low-probability event not*
expected to occur within the collective lifetimes of a large number of similar plants. BDBAs typically have a mean frequency between 10⁻⁴ and 5 × 10⁻⁷ per plant-year.

(DLOFC) Depressurized Loss of Flow without Scram

- Sequence of Events
 - 0 – 13 sec : Reduction in mass flow rate from 192.7 to 0.2 kg/s.
 - 0 – 13 sec : Reduction in helium outlet pressure from 90 to 1 bar.
 - 13-360000 sec: Transient completed



DLOFC - Maximum Fuel Temperature: Comparison of Different Fidelity Calculations PK (Point Kinetics) = Low Fidelity



*Fission Gas Release Begins to Occur at 1600C

Summary

The NGNP will be a very high temperature gas-cooled reactor (VHTR) for generating electricity and co-generating hydrogen using the process heat from the reactor.

There appears to be bipartisan support for Consistent Funding of the NGNP in Congress

One of the significant R&D challenges will be high fidelity multi-physics modeling to predict the maximum temperatures in the reactor after design basis accidents

We are looking for collaborators in computational fluid dynamics and high end computing to improve the efficiency and accuracy of NGNP safety analysis