

Evolution of Small Reactor Design - Advanced 4S Concept -

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INTRODYCTION

The concept of 4S (Super Safe, Small and Simple) Reactor was proposed for the application to creation of green belts in desertification area^{1,2}. 4S Reactor has the following distinct features; greater simplicity, easy to maintain, inspect and operate, less influence of human factors, highly reliability, and improved availability and capacity. The original design of 4S Reactor, however, has a rather high building due to the vertical arrangement of the components of the primary heat transfer circuit, and a steam generator (SG) arranged separately from the reactor vessel might enlarge the volume of the building.

The purpose of this paper is to described a highly compact small reactor concept, Advanced 4S Reactor, to meet global energy demand.

ADVANCED 4S CONCEPT

Advanced 4S Reactor, shown in Fig. 1, is conceived from the innovative reactor designs, 4S Reactor and Modular Double Pool Reactor (MDP)^{3,4}, which have been studied in CRIEPI.

The reactor assembly consists of two vessels, a primary vessel and a secondary vessel. Core and primary circuit are installed in the primary vessel, while heat transfer tubes for steam generating and secondary circuit are located in the annular space formed between the primary vessel and the secondary vessel. Electrical power output is set to be 5 MWe based on the world demand survey by IAEA.

The enriched U-Zr fueled core is designed so as to extend the life to as long as thirty years without fuel refueling, by using burnable poison (ZrH-Gd) to compensate the reactivity loss. The reactivity control system is the same as the original 4S Reactor; the reactivity is controlled only by the vertical movement of the annular reflector during plant startup, shutdown and power generation.

The primary coolant flow is induced by natural circulation during rated operation. The simple flow configuration in the primary vessel and integrated fuel pin concept without wrapper tubes reduces the friction loss⁵.