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POOL-TYPE RESEARCH REACTOR

The research reactor is widely used for many purposes such as education and training, neutron activation analysis, radioisotope production, conversion effects, neutron radiography, material structure studies, neutron capture therapy [1]. Generally, the fission heat from fuel assembly is not used in a research reactor while electrical energy is produced in a commercial nuclear power plant using the fission heat of nuclear fuel.

Pool-type reactors are used in a lot of research reactors. The majority of the illustrations in the publication are of pond-style research reactors.

Pool-Type Research Reactor

Among the colorful comprehensive research reactor designs, the following types are encountered, digested according to the added performance and/ or strength of the implicit neutron flux:

A. Open-core downward flow

The fuel assemblies in this arrangement, as illustrated in fig. 1, are connected to a grid and pull the pool water down for primary cooling. This category includes the SILOE and FRG1 reactors (both of which are no longer operational). The primary circuit's reference pressure is the pool's hydrostatic pressure at the primary inlet. When the flap valves below the core are passively opened and the flow is reversed once the inertial effect of the primary pump has been spent, the core is cooled by natural convection of the pool water.

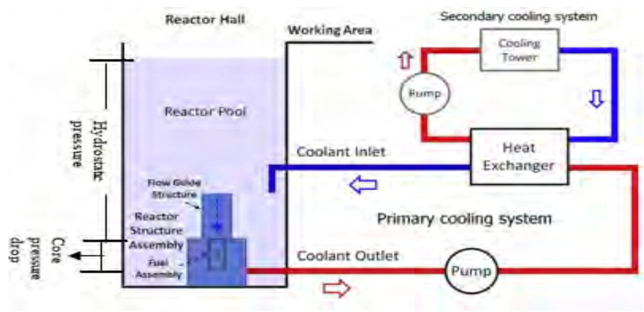

Fig. 1. Open Core Downward Flow

B. Open-core Upward flow

The primary pressure reference cooling circuit is determined by placing the core in a box with an open chimney on a trough at the primary port, as illustrated in fig.2. In terms of water flow, the design ensures continuous pond water entry into the primary circuit; the balance of the global water mass in the circuit is achieved through continuous extraction towards a purifying circuit or bypass if the purifying circuit is not available, and finally back to the pond. This group includes OSIRIS, OPAL, and HANARO. The core is cooled by natural convection of the pool water when it is closed. Once the main and natural pumps' flywheel effects have worn off, the convection flap valves located at the inlet of the primary circuit open passively.

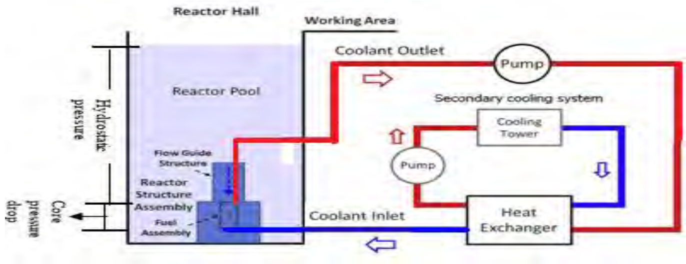

Fig. 2. Open Core Upward Flow

C. Tank-in-pool open primary circuit with pressure reference from the pool

In this design as shown in fig.3, the core is placed inside a closed tank. The primary circuit except for the tubes connecting the primary circuit (such as the pump inlet) to the accumulator is also enclosed allowing the mass within the primary circuit to be changed and the pressure reference set for the primary circuit (depending on the design the pool can be hydrostatic pressure or higher pressure when a pressure system is applied to this tube). This class of design can be applied to two possible refrigerant flow directions: ORPHEE, FRM II, and JHR descending flow. When closed, the core is cooled by forced convection for a few hours depending on the energy density of the core before The primary circuit of the pool can be opened and cooled by natural convection.

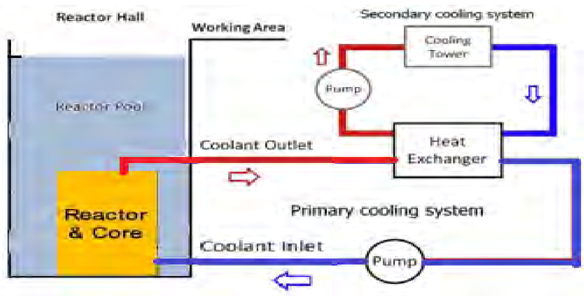

Fig. 3. Tank-in-pool open primary circuit with pressure reference from the pool

D. Tank-in-pool with an enclosed leak tight primary circuit:

In this design as shown in fig.4, the primary water is fully separated from the pool water. Tank research reactors in a heavy water cooled pond generally belong to this order (eg, HFR/ ILL Grenoble). When closed, primary cooling is generally assured by forced convection. Cooling capacity can be enforced by normal cargo but its use should be limited to the loftiest position of defense at depth due to heavy water (tritium conditioning). It's intriguing to note that some exploration reactors in this class (eg family reactors SAFARI and HFR/ Petten), which offer accessible neutron fluxes with other types of design, also live. In these cases, the design appears to have been driven by confining the radiative release to the primary circuit.

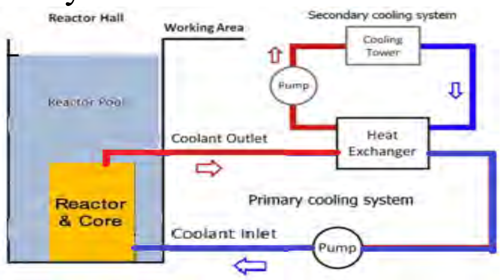

Fig. 4. Tank-in-pool with an enclosed leak tight primary circuit.

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THE DIFFERENCE BETWEEN THE POND TYPE RESEARCH REACTOR IN TERMS OF UTILIZATION

The research reactor is widely used for many purposes such as education and training, neutron activation analysis, radioisotope production, conversion effects, neutron radiography, material structure studies, neutron capture therapy [1]. Generally, the fission heat from fuel assembly is not used in a research reactor while electrical energy is produced in a commercial nuclear power plant using the fission heat of nuclear fuel.

Numerous research reactors (RR) are designed as pond- type reactors. The paper is substantially demonstrated with RR of pool type and the difference between them in terms of design and construction.

Utilization

Irradiation site configuration

To achieve the goal of irradiation and the production of radioactive isotopes that will necessarily evolve over the life of the reactor, the reactor must provide irradiation sites with a great diversity in terms of neutron fluxes and