On the Basis of Coolant Used

(a) Water cooled reactors

(b) Gas cooled reactors

(c) Liquid metal cooled reactors

(d) Organic liquid cooled reactors.

Classification by Use

(a) Electricity Nuclear power plant.

(b) Propulsion (i) Nuclear marine propulsion. (ii) Various proposed forms of rocket propulsion.

(c) Other Uses of Heat

(i) Desalination

(ii) Heat for domestic and industrial heating

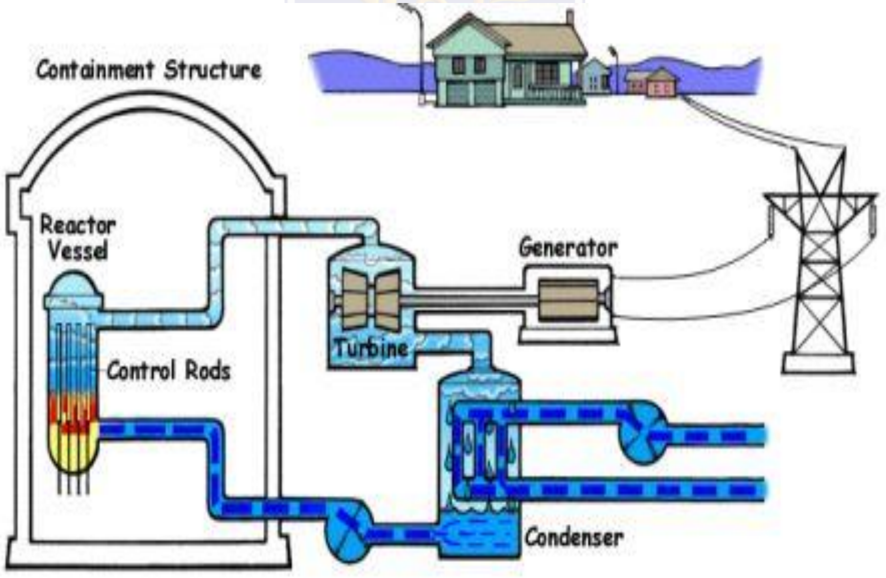
(iii) Hydrogen production for use in a hydrogen economy

(d) Production Reactors for Transmutation of Elements

BOILING WATER REACTOR (BWR)

The BWR uses demineralized water (light water) as a coolant and neutron moderator. Heat is produced by nuclear fission in the reactor core, and this causes the cooling water to boil, producing steam.

The steam is directly used to drive a turbine, after which is cooled in a condenser and converted back to liquid water. This water is then returned to the reactor core, completing the loop. The cooling water is maintained at about 75 atm (7.6 MPa) so that it boils in the core at about 285°C. In comparison, there is no significant boiling allowed in a PWR because of the high pressure maintained in its primary loop - approximately 158 atm (16 MPa, 2300 psi).



Feedwater

Steam exiting from the turbine flows into condensers located underneath the low pressure turbines where the steam is cooled and returned to the liquid state (condensate). The condensate is then pumped through feedwater heaters that raise its temperature using extraction steam from various turbine stages. Feedwater from the feedwater heaters enters the reactor pressure vessel (RPV) through nozzles high on the vessel, well above the top of the nuclear fuel assemblies (these nuclear fuel assemblies constitute the “core”) but below the water level.

Control Systems

Nuclear Power Plant Reactor power is controlled via two methods: by inserting or withdrawing control rods and by changing the water flow through the reactor core. Positioning (withdrawing or inserting) control rods is the normal method for controlling power when starting up a BWR. As control rods are withdrawn, neutron absorption decreases in the control material and increases in the fuel, so reactor power increases. As control rods are inserted, neutron absorption increases in the control material and decreases in the fuel, so reactor power decreases. Some early BWRs and the proposed ESBWR (Economic Simplified BWR) designs use only natural circulation with control rod positioning to control power from zero to 100% because they do not have reactor recirculation systems. Fine reactivity adjustment would be accomplished by modulating the recirculation flow of the reactor vessel.

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Steam Turbines

Steam produced in the reactor core passes through steam separators and dryer plates above the core and then directly to the turbine, which is part of the reactor circuit. Because the water around the core of a reactor is always contaminated with traces of radionuclides, the turbine must be shielded during normal operation, and radiological protection must be provided during maintenance. The increased cost related to operation and maintenance of a BWR tends to balance the savings due to the simpler design and greater thermal efficiency of a BWR when compared with a PWR.

Size

A modern BWR fuel assembly comprises 74 to 100 fuel rods, and there are up to approximately 800 assemblies in a reactor core, holding up to approximately 140 tonnes of uranium. The number of fuel assemblies in a specific reactor is based on considerations of desired reactor power output, reactor core size and reactor power density. Safety Systems The BWR reactor core continues to produce heat from radioactive decay after the fission reactions have stopped, making nuclear meltdown possible in the event that all

safety systems

have failed and the core does not receive coolant. Also a boiling-water reactor has a negative void coefficient, that is, the thermal output decreases as the proportion of steam to liquid water increases inside the reactor.

CANDU TYPE REACTOR CANDU

stands for “CANada Deuterium Uranium”. It‟s a Canadian-designed power reactor of PHWR type (Pressurized Heavy Water Reactor) that uses heavy water (deuterium oxide) for moderator and coolant, and natural uranium for fuel.

CANDU-specific Features and Advantages

Use of Natural Uranium as a Fuel

1.CANDU is the most efficient of all reactors in using uranium: it uses about 15% less uranium than a pressurized water reactor for each megawatt of electricity produced

2 Use of natural uranium widens the source of supply and makes fuel fabrication easier. Most countries can manufacture the relatively inexpensive fuel

3.There is no need for uranium enrichment facility

4 Fuel reprocessing is not needed, so costs, facilities and waste disposal associated with reprocessing are avoided

5,CANDU reactors can be fuelled with a number of other low-fissile content fuels, including spent fuel from light water reactors. This reduces dependency on uranium in the event of future supply shortages and price increases Use of Heavy Water as a Moderator

6. Heavy water (deuterium oxide) is highly efficient because of its low neutron absorption and affords the highest neutron economy of all commercial reactor systems. As a result chain reaction in the reactor is possible with natural uranium fuel