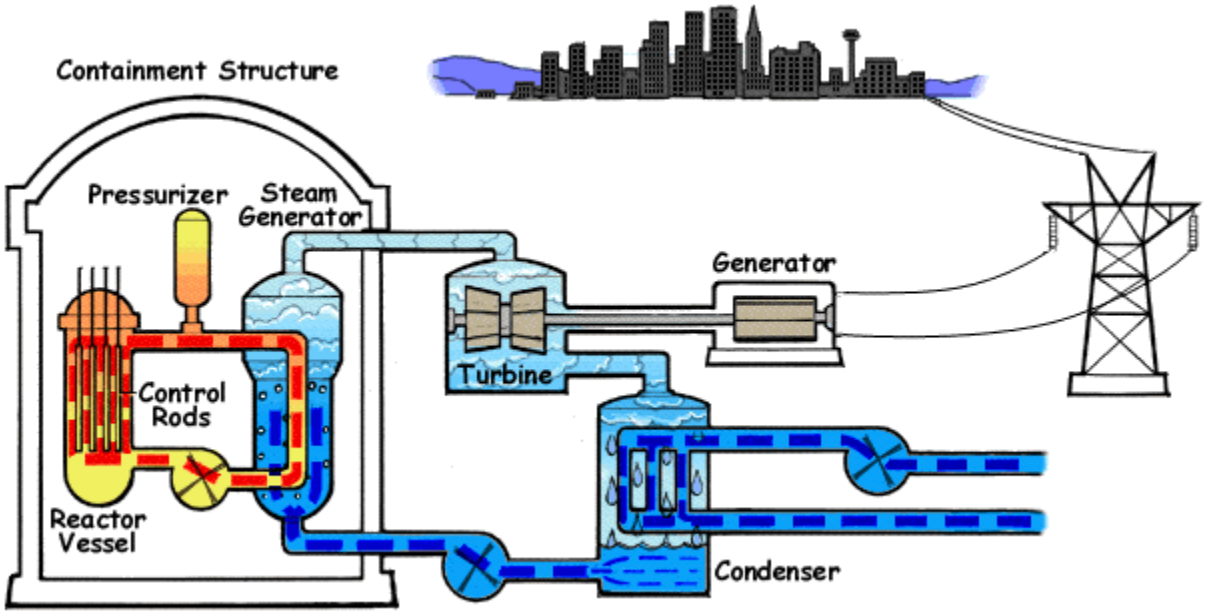
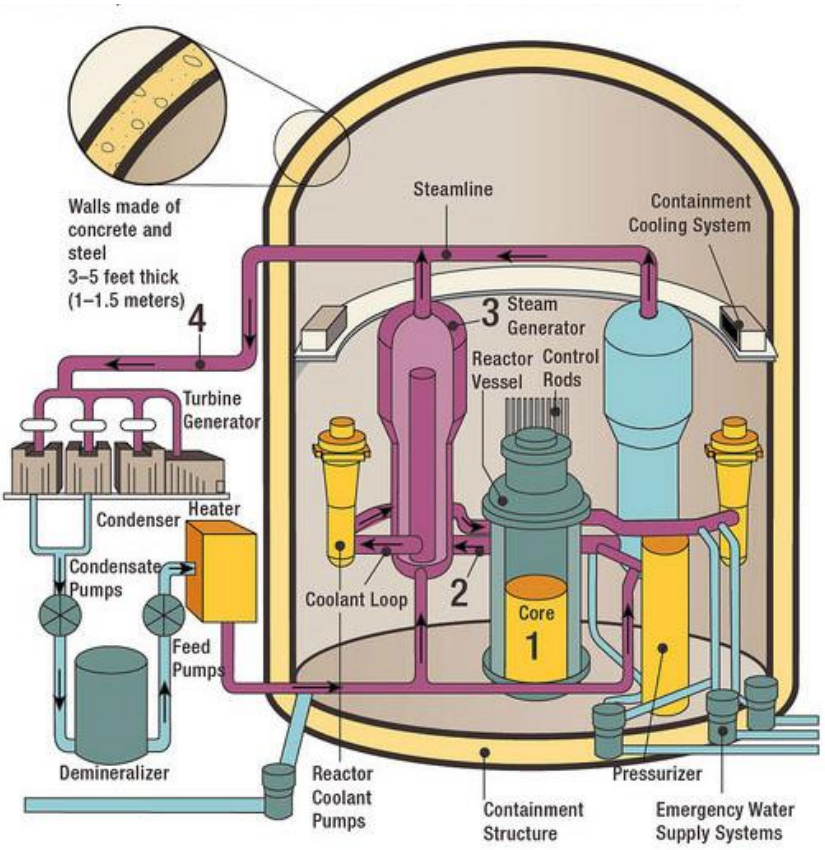
PRESSURIZED WATER REACTORS



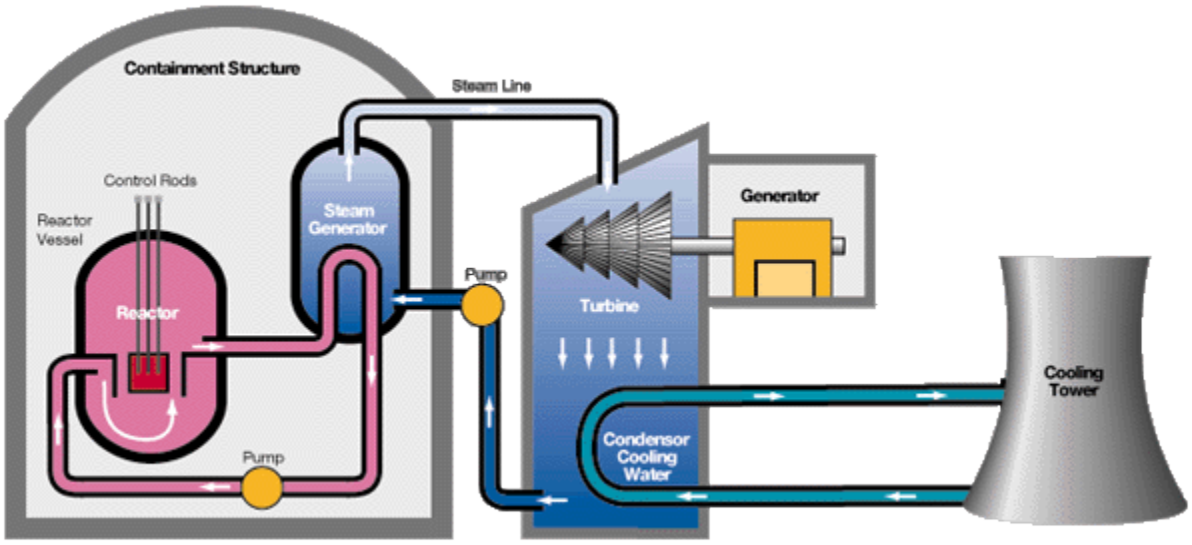
Introduction

Pressurized water reactors (PWR) are generation II nuclear power reactors that use ordinary water under high pressure as coolant and neutron moderator. The primary coolant loop is kept under high pressure to prevent the water from reaching film boiling, hence the name. PWRs are the most common type of power producing reactor and are widely used all over the world. More than 230 of them are in use to generate electric power, and several hundred more for naval propulsion. They were originally designed at the Oak Ridge National Laboratory for use as a nuclear submarine power plant. Follow-on work was conducted by Bettis Atomic Power Laboratory.



In a typical commercial pressurized light-water reactor the core inside the reactor vessel creates heat, pressurized water in the primary coolant loop carries the heat to the steam generator, inside the steam generator, heat from the steam, and the steam line directs the steam to the main turbine, causing it to turn the turbine generator, which produces electricity. The unused steam is exhausted in to the condenser where it condensed into water. The resulting water is pumped out of the condenser with a series of pumps, reheated and pumped back to the reactor vessel. The reactor's core contains fuel assemblies that are cooled by water circulated using electrically powered pumps. These pumps and other operating systems in the plant receive their power from the electrical grid. If offsite power is lost emergency cooling water is supplied by other pumps, which can be powered by onsite diesel generators. Other safety systems, such as the containment cooling system, also need power. Pressurized-water reactors contain between 150-200 fuel assemblies.

Thermofluid Concepts



The Pressurized Water Reactor has 3 separate cooling systems. The reactor coolant system, shown inside the containment, consists of 2, 3, or 4 cooling "loops" connected to the reactor, each containing a reactor coolant pump, and steam generator. The reactor heats the water that passes upward past the fuel assemblies from a temperature of about 530°F to a temperature of about 590°F. Boiling, other than minor bubbles called nucleate boiling, is not allowed to occur. Pressure is maintained by a pressurizer connected to the reactor coolant system. Pressure is maintained at approximately 2250 pounds per square inch through a heater and spray system in the pressurizer. The water from the reactor is pumped to the steam generator and passes through tubes. The reactor cooling system is expected to be the only one with radioactive materials in it.

In a secondary cooling system, which include the main steam system and the condensate-feedwater systems, cooler water is pumped from the feedwater system and passes on the outside of those steam generator tubes, is heated and converted to steam. The steam then passes through the main steam line to the turbine, which is connected to and turns the generator. The steam from the turbine condenses in a condenser. The condensed water is then pumped by condensate pumps through low pressure feedwater heaters, then to the

feedwater pumps, then to high pressure feedwater heaters, and then to the steam generators. The diagram above simplifies the process by only showing the condenser, a pump, and the steam generator.

The condenser is maintained at a vacuum using either vacuum pumps or air ejectors. Cooling of the steam is provided by condenser cooling water pumped through the condenser by circulating water pumps, which take a suction from water supplied from the ocean, sea, lake, river, or cooling tower.

Source : http://me1065.wikidot.com/pressurized-water-reactors