HW2

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1) The Boiling Water Reactor (BWR) is a single coolant system while the Pressurized Water Reactor (PWR) is a two-coolant system; this is because a BWR can use the primary loop to drive the turbine while a PWR has to maintain the primary loop at the nominal subcooled liquid state.
   The primary loop for a BWR includes a steam water mixture that is separated through steam dryers at the top of the RPV. This separated steam travels through a turbine and is condensed before being fed back into the reactor - jet pumps ensure good flow in the recirculation to the bottom of the reactor.
   A PWR's primary coolant system includes 4 loops that each have a steam generator and a coolant pump; the pressurizer maintains liquid water and a system of U tubes is utilized to transport heat away from the primary loop to the secondary loop in the steam generator.
   PWRs have control rods that enter from the top of the RPV while BWRS have control blades that enter from the bottom of the RPV
   Both have fuel stored in fuel rods that are assembled into fuel assemblies, BWRs house 64 rods per assembly while PWRs have between 225 and 289 rods.
   A PWR produces 700 to 900 MW electric while a BWR has the same level of efficiency

2) Decay heat in a PWR is removed by the auxiliary feed system and the steam dump system. The auxiliary feed system pumps water from storage tanks to the steam generators where steam is generated and then condensed to take the heat out to the environment. Once the decay heat is not enough to create steam, the reactor coolant systems can be reduced to an operational limit to use the residual heat removal (RHR) system heat exchanger which is cooled by the component cooling water system (CCW) which still does not interact with the environment; the service water (SW) system transfers the final bit of heat through to the environment. Each of these loops have their own pumps - there is an RHR pump, CCW pump, and SW pump.

3) The ECCS, or the Emergency Core Cooling System, is used to minimize fuel damage after a loss of coolant accident. It is also utilized as a neutron poison to ensure shutdown after a main steam line rupture using a borated water source stored in the refueling water storage tank.
   The High pressure injection system injects borated water while the core is at a high pressures but still has a loss of coolant issue, while the intermediate pressure injection system injects borated water while the core is for small to intermediate sized piping breaks. Both require electrical power to operate.
   The cold leg accumulators, which don't need electrical power to operate, consist of a pressurized nitrogen bubble and a lot of borated water. If the pressure of the core drops too low, the nitrogen will push the borated water into the cold leg to help cool the reactor down.
   The long term core cooling or recirculation mode of the reactor is driven by the low pressure injection system and is dubbed so because of its connection to the residual heat removal system. This provides cooling for water from the containment sump and the refueling water storage tank.

4) Heat, in nominal operation, is removed by creating steam and using that steam to drive a turbine to generate electrical energy. To remove decay heat the turbine is skipped and the steam is dumped directly into the condenser. Once the pressure decreases to approximately 50 psig, the residual heat removal system kicks in to complete the cooldown process. The residual heat removal system utilizes the recirculation pump to transfer the water through the heat exchanger, reducing the number of penetrations into the reactor vessel. Pumped water from the outside is used to cool the recirculation water and to condense the steam from a BWR

5) The ECCS for BWRs can be split into systems designed to operate at high pressure and those for lower pressures. At high pressures the high pressure coolant injection system, which is driven by a turbine driven by diverted steam from the main steam line, pumps coolant into the main feedwater line to maintain core temperature - it is an dependent system that doesn't rely on external power. The automatic depressurization system is another high pressure system that aims to reduce the pressure in a BWR to allow low pressure systems to recover reactor water level. This is a system of safety relief valves
At lower pressures, the Low pressure coolant injection system (LPCI) allows for residual heat removal though it is not powered by diverted steam. This coolant is used for the containment spray - maintaining the temperature of the pool of water, while also cooling the recirculation loop water. The core spay pump is in charge of cooling the reactor through core spray and consists of its own pump