State of Illinois

Illinois Emergency Management Agency

Nuclear Generating Facilities in Illinois

About one-sixth of the world's electricity is generated by over 440 nuclear power reactors. The United States' 104 power reactors generate about 22 percent of the nation's electricity. In Illinois there are eleven operating commercial nuclear power reactors at six sites generating about 50 percent of the state's electricity. There are also three commercial nuclear power reactors no longer operating: two at Zion and one at Dresden. In addition, there is an inactive reprocessing facility near Morris, Illinois.

Several other reactors have previously operated in Illinois but are now shut down or decommissioned. These include the first nuclear reactor at the University of Chicago (CP1) and research reactors at Argonne National Laboratory and the University of Illinois at Champaign.

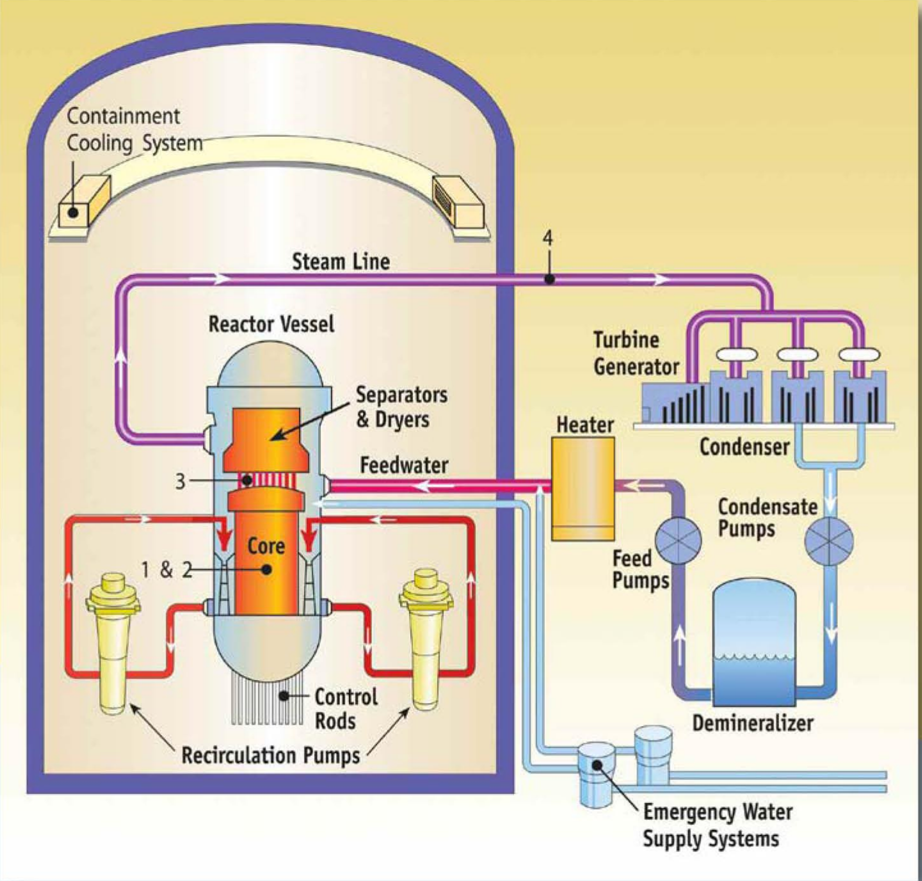
In Illinois electricity is generated by two types of power reactors: Boiling Water Reactors and Pressurized Water Reactors. Boiling Water Reactors (BWR) are located at the Dresden, Clinton, LaSalle, and Quad Cities Stations. Pressurized Water Reactors (PWR) are located at the Braidwood and Byron Stations.

Typical Boiling Water Reactor

How Nuclear Reactors Work

In a typical commercial boiling water reactor (1) the reactor core creates heat, (2) a steam-water mixture is produced when very pure water (reactor coolant) moves upward through the core absorbing heat, (3) the steam-water mixture leaves the top of the core and enters the two stages of moisture separation where the water droplets are removed before the steam is allowed to enter the steam line, (4) 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 to the condenser where it is 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 which are cooled by water, which is force-circulated by electrically powered pumps. 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 electric power and can be powered by onsite diesel generators. Boiling water reactors contain between 370-800 fuel assemblies.

Source:
U.S. Nuclear Regulatory Commission

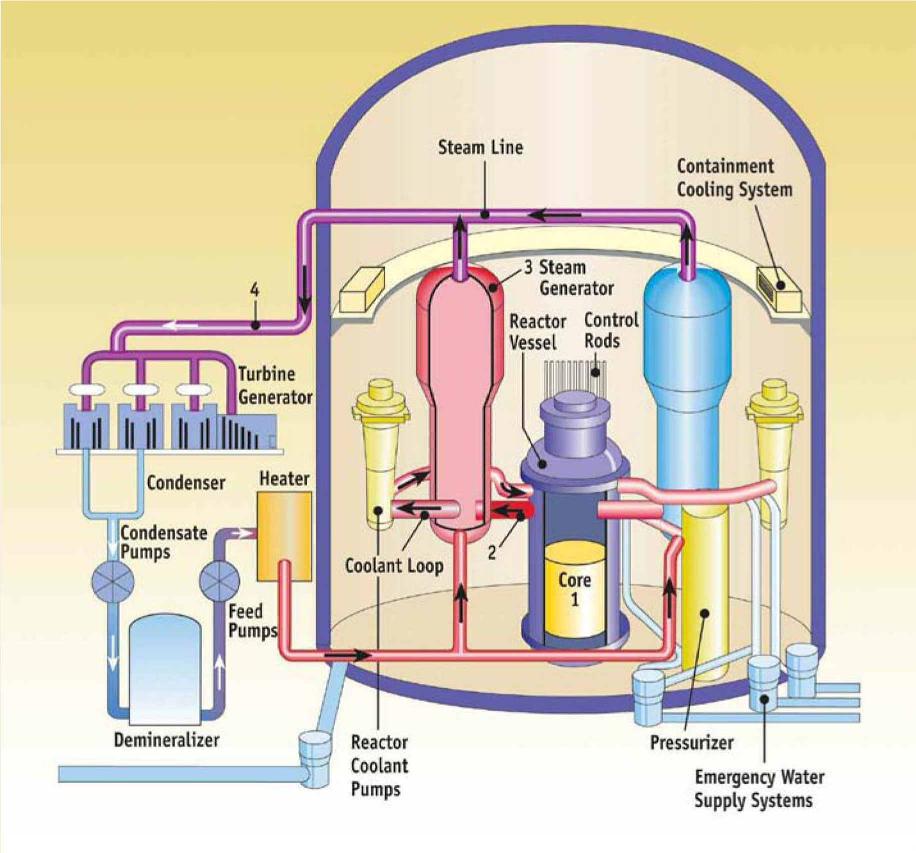


Typical Pressurized Water Reactor

How Nuclear Reactors Work

In a typical commercial pressurized light-water reactor (1) the reactor core creates heat, (2) pressurized water in the primary coolant loop carries the heat to the steam generator, (3) inside the steam geerator heat from the primary coolant loop vaporizes the water in a secondary loop producing steam, (4) 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 to the condenser where it is condensed into water. The resulting water is pumped out of the condenser with a series of pumps, reheated, and pumped back to the steam generator. The reactor's core contains fuel assemblies which are cooled by water, which is force-circulated by electrically powered pumps. 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 electric power and can be powered by onsite diesel generators. Pressurized-water reactors contain between 150-200 fuel assemblies.

Source:
U.S. Nuclear Regulatory Commission



Spent Nuclear Fuel

Nuclear fuel provides the energy source for a nuclear reactor. The fuel consists of small ceramic pellets, about the size of a pencil eraser. These pellets are arranged in 14 foot long tubes and loaded into the reactor core to provide the reactor's heat source. As electricity is generated, the uranium inside the fuel pellets is gradually depleted and the pellets must be replaced. When the used fuel is removed from the core, it is called spent nuclear fuel. The spent fuel is still capable of producing a significant amount of heat and radiation. It must be stored in such a way as to remove the heat and provide protection from the radiological hazards.

Most spent nuclear fuel in Illinois is stored on-site at each nuclear power plant in specially designed pools of water under at least 20 feet of very pure water. The water provides shielding from the radiation given off from the spent nuclear fuel and also provides cooling from the heat that is created by spent nuclear fuel. Fuel assemblies are always moved under water to provide radiation protection for workers. About one-third to one-fourth of the fuel assemblies are replaced with new fuel every two years during a refuel outage. The spent fuel assemblies are moved to the spent fuel pool and after several years moved to dry cask storage.

In the late 1970's the need for alternative spent fuel storage began to grow when spent fuel pools at many nuclear reactor sites began to fill up with stored spent fuel. Utilities began looking at options such as dry cask storage to increase spent fuel storage capacity. Independent Spent Fuel Storage Installations (ISFSI), also known as Dry Cask Storage, allows spent fuel that has already been cooled in a spent fuel pool to be relocated into a steel container called a cask and surrounded by

an inert gas (helium). The casks are steel cylinders that are seal welded closed. The steel cylinder provides leak-tight containment of spent fuel. Each steel cylinder is surrounded by additional steel and concrete to provide radiation shielding to workers and members of the public. Selected casks can be used for both storage and transportation. Currently, the Dresden and Quad Cities Stations are storing some spent fuel on-site in NRC-licensed dry casks.

The Nuclear Waste Policy Act of 1982 specifies that spent nuclear fuel will be disposed of underground, in a deep geologic repository, and that Yucca Mountain, Nevada, will be the single candidate site for characterization as a potential geologic repository. Spent fuel from nuclear power plants in the US would be stored, entombed in concrete and metal canisters capable of withstanding any conceivable seismic shock or military strike. Until such time as Yucca Mountain is operational, spent nuclear fuel will continue to be stored on-site at nuclear power stations.

Illinois is ready, once the repository is operational, to deal with the concerns of shipping spent nuclear fuel across Illinois. In over thirty years of commercial spent nuclear fuel shipments across the country, there have been no accidents resulting in a release of radioactive materials or radiation. The shipping casks are designed and rigorously tested to withstand extreme accident conditions. The State of Illinois inspects and escorts, in cooperation with the Illinois Commerce Commission and the Illinois State Police, each shipment while it is in the state. Approximately 500 of these shipments have been escorted through Illinois.

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