NUCLEAR ENERGY (URANIUM) ENERGY FROM ATOMS

NUCLEAR ENERGY IS ENERGY FROM ATOMS

Nuclear energy is energy in the nucleus (core) of an atom. Atoms are tiny particles that make up every object in the universe. There is enormous energy in the bonds that hold atoms together.
Nuclear energy can be used to make electricity. But first the energy must be released. It can be released from atoms in two ways: nuclear fusion and nuclear fission.

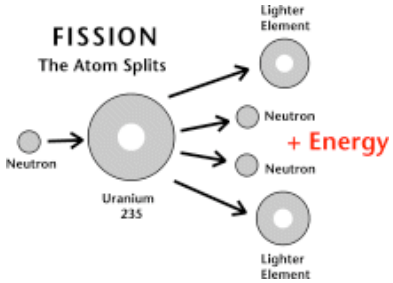
In **nuclear fusion**, energy is released when atoms are combined or fused together to form a larger atom. This is how the sun produces energy.

In **nuclear fission**, atoms are split apart to form smaller atoms, releasing energy. Nuclear power plants use nuclear fission to produce electricity.

NUCLEAR FUEL - URANIUM

The fuel most widely used by nuclear plants for nuclear fission is uranium. Uranium is nonrenewable, though it is a common metal found in rocks all over the world. Nuclear plants use a certain kind of uranium, U-235, as fuel because its atoms are easily split apart. Though uranium is quite common, about 100 times more common than silver, U-235 is relatively rare. Most U.S. uranium is mined, in the Western United States. Once uranium is mined the U-235 must be extracted and processed before it can be used as a fuel.

During nuclear fission, a small particle called a neutron hits the uranium atom and splits it, releasing a great amount of energy as heat and radiation. More neutrons are also released. These neutrons go on to bombard other uranium atoms, and the process repeats itself over and over again. This is called a chain reaction.



NUCLEAR POWER PLANTS GENERATE ELECTRICITY

Nuclear power accounts for about 19 percent of the total net electricity generated in the United States, about as much as the electricity used in California,Texas and New York, the three states with the most people. In 2007, there were 66 nuclear power plants (composed of 104 licensed nuclear reactors) throughout the United States.

Most power plants burn fuel to produce electricity, but not nuclear power plants. Instead, nuclear plants use the heat given off during fission as fuel. Fission takes place inside the reactor of a nuclear power plant. At the center of the reactor is the core, which contains the uranium fuel.

The uranium fuel is formed into ceramic pellets. The pellets are about the size of your fingertip, but each one produces the same amount of energy as 150 gallons of oil. These energy-rich pellets are stacked end-to-end in 12-foot metal fuel rods. A bundle of fuel rods is called a fuel assembly.

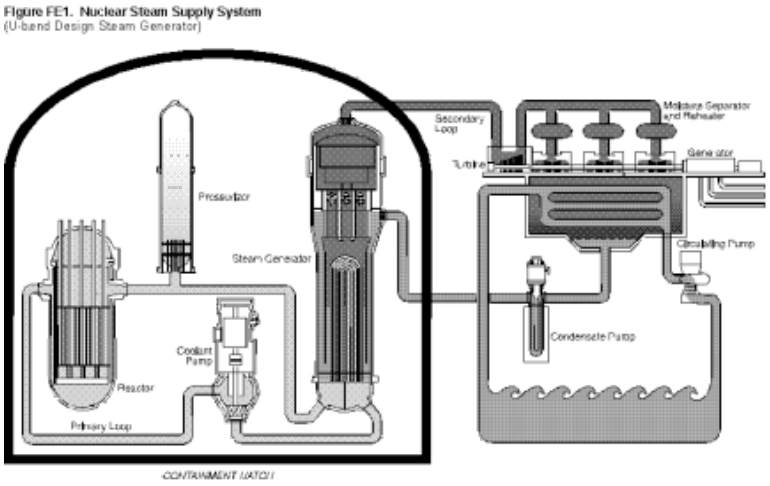
Fission generates heat in a reactor just as coal generates heat in a boiler. The heat is used to boil water into steam. The steam turns huge turbine blades. As they turn, they drive generators that make electricity. Afterward, the steam is changed back into water and cooled in a separate structure at the power plant called a cooling tower. The water can be used again and again.

TYPES OF REACTORS

Just as there are different approaches to designing and building airplanes and automobiles, engineers have developed different types of nuclear power plants. Two types are used in the United States: boiling-water reactors (BWRs), and pressurized-water reactors (PWRs).

In the BWR, the water heated by the reactor core turns directly into steam in the reactor vessel and is then used to power the turbine-generator. In a PWR, the water passing through the reactor core is kept under pressure so that it does not turn to steam at all -- it remains liquid. Steam to drive the turbine is generated in a separate piece of equipment called a steam generator. A steam generator is a giant cylinder with thousands of tubes in it through which the hot radioactive water can flow. Outside the tubes in the steam generator, nonradioactive water (or clean water) boils and eventually turns to steam. The clean water may come from one of several sources: oceans, lakes or rivers. The radioactive water flows back to the reactor core, where it is reheated, only to flow back to the steam generator. Roughly seventy percent of the reactors operating in the U.S. are PWR.

Nuclear reactors are basically machines that contain and control chain reactions, while releasing heat at a controlled rate. In electric power plants, the reactors supply the heat to turn water into steam, which drives the turbine-generators. The electricity travels through high voltage transmission lines and low voltage distribution lines to homes, schools, hospitals, factories, office buildings, rail systems and other users.



NUCLEAR POWER AND THE ENVIRONMENT

Compared to electricity generated by burning fossil fuels, nuclear energy is clean. Nuclear power plants produce no air pollution or carbon dioxide but a small amount of emissions result from processing the uranium that is used in nuclear reactors.

Like all industrial processes, nuclear power generation has by-product wastes: spent (used) fuels, other radioactive waste, and heat. Spent fuels and other radioactive wastes are the principal environmental concern for nuclear power. Most nuclear waste is low-level radioactive waste. It consists of ordinary tools, protective clothing, wiping cloths and disposable items that have been contaminated with small amounts of radioactive dust or particles. These materials are subject to special regulation that govern their disposal so they will not come in contact with the outside environment.

On the other hand, the spent fuel assemblies are highly radioactive and must initially be stored in specially designed pools resembling large swimming pools (water cools the fuel and acts as a radiation shield) or in specially designed dry storage containers. An increasing number of reactor operators now store their older and less spent fuel in dry storage facilities using special outdoor concrete or steel containers with air cooling. The United States Department of Energy's long range plan is for this spent fuel to be stored deep in the earth in a geologic repository, at Yucca Mountain, Nevada.

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Sources: Energy Information Administration, *Electric Power Annual* 2007, January 2009.