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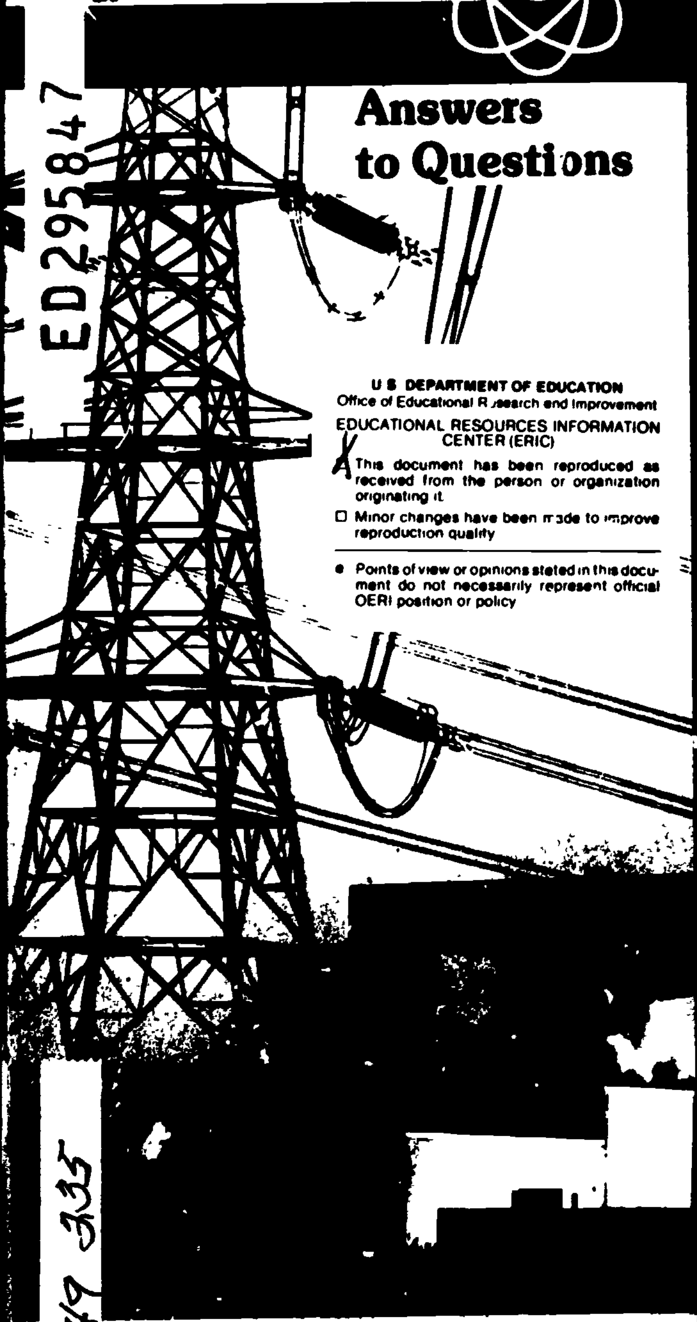
ABSTRACT

Electricity is an increasingly important part of our everyday lives. Its versatility allows one to heat, cool, and light homes; cook meals; watch television; listen to music; power computers; make medical diagnosis and treatment; explore the vastness of space; and study the tiniest molecules. Nuclear energy, second to coal, surpasses natural gas, oil, and hydroelectric power as an energy source for the production of electricity in the United States. With over 100 nuclear powerplants licensed for commercial operation, nuclear energy supplies over 16 percent of the electricity produced in the United States. Coal and nuclear energy are the two sources most capable of meeting increasing electrical needs of the United States in the foreseeable future. Provided in this pamphlet are answers to some frequently asked questions about nuclear energy to help in the understanding of this source of electricity. Sections included are: (1) "Introduction"; (2) "Nuclear Power Basics"; (3) "Radiation"; (4) "Safety"; (5) "Nuclear Waste"; and (6) "The Future." Some of the questions addressed include: "What is nuclear energy?"; "Where does radiation come from?"; "How safe are nuclear powerplants?"; "What does the term 'meltdown' mean?"; "What is nuclear waste?"; "How does the United States dispose of nuclear waste?"; and "What is the future of nuclear energy?" (RT)

Nuclear Energy

Answers to Questions



U.S. Department of Energy
Assistant Secretary of
Nuclear Energy
Office of Program Support

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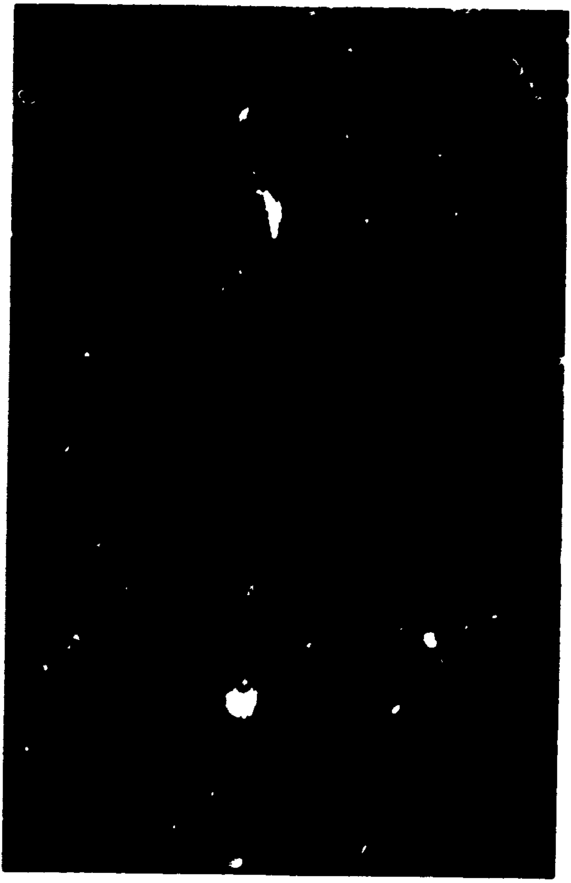
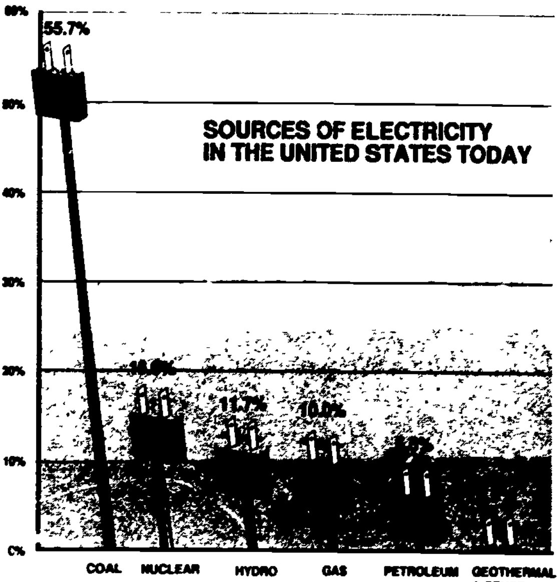
Introduction

Electricity has been an increasingly important part of our everyday lives ever since Thomas Edison and his colleagues perfected the light bulb in 1879. Few other forms of energy have been used in so many ways. Electricity allows us to heat, cool, and light our homes. It enables us to cook meals, watch television, and listen to music. It powers computers for our homes and businesses and makes modern medical diagnosis and treatment possible. Electricity allows us to explore the vastness of space and to study the tiniest molecules.



Electricity is an important part of our everyday lives.



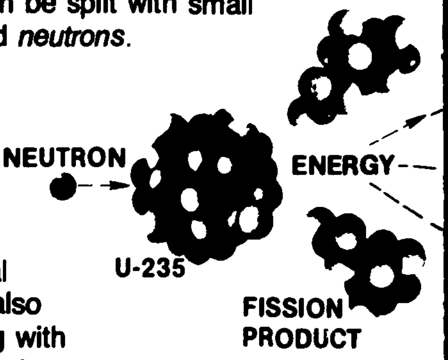
Source: *Monthly Energy Review, September 1986*, Energy Information Administration, March 1986.

Since 1982, nuclear energy has been second only to coal as an energy source for the production of electricity in the United States, surpassing oil, natural gas, and hydroelectric power. Today, with over 100 nuclear powerplants licensed for commercial operation, nuclear energy contributes over 16 percent of all the electricity generated in the United States. Although a variety of new energy technologies hold promise for the years ahead, coal and nuclear energy are the two energy sources most capable of meeting the growing electrical needs of the United States in the foreseeable future.

Here are the answers to some frequently asked questions about nuclear energy. The answers may help you to better understand this source of electricity.

What is nuclear energy?

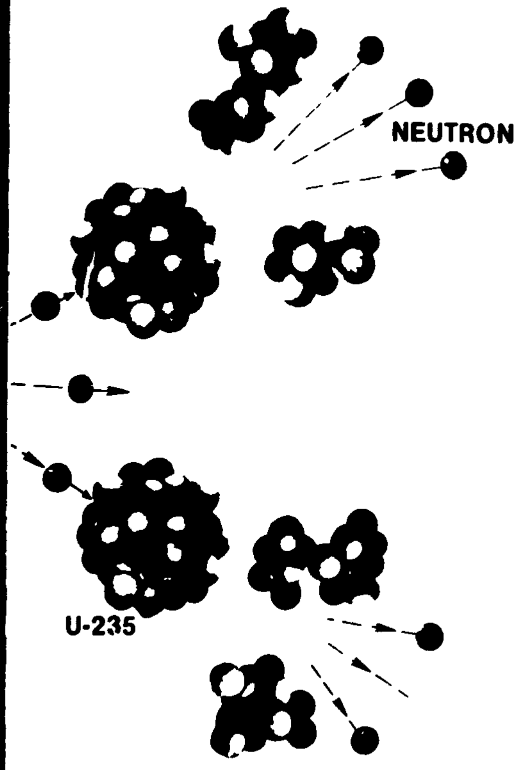
Nuclear energy is contained within the center, or nucleus, of the atom. Atoms are the building blocks from which matter is formed. Particles within the nucleus of an atom are held together by a strong energy bond. If the nucleus is broken apart or split, energy is released in a process known as *nuclear fission*. Under precise conditions, the nucleus of an atom can be split with small particles called *neutrons*. When certain very heavy atoms, such as some forms of uranium, are split, additional neutrons are also released along with the energy. Under the right circumstances, these neutrons can be made to strike other uranium atoms, causing more atoms to fission. When this takes place as a continuous chain reaction under controlled conditions, it releases heat in useful amounts.



What is a nuclear reactor?

A nuclear reactor is the heat source of a nuclear powerplant. The reactor is the part of the nuclear powerplant that makes it different from other electric powerplants. In most electric powerplants, water is heated and converted into steam, which drives a turbine-generator to produce electricity. Fossil-fueled powerplants produce heat by burning coal, oil, or natural gas. In a nuclear powerplant, the continuous fissioning of uranium atoms in the reactor provides the heat to produce steam for

A nuclear chain reaction releases heat used in producing electricity.

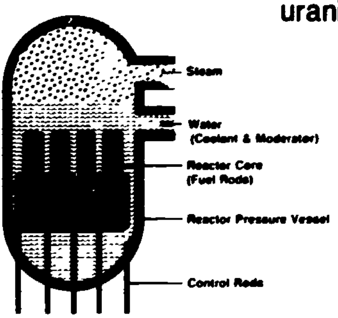


generating electricity. Electricity produced at a nuclear powerplant is identical to the electricity produced at other powerplants.

Several commercial reactor designs are currently in use in the United States. The most widely used design consists of a heavy steel pressure vessel surrounding a reactor core. The pressure vessel is approximately 40 feet tall and 16 feet in diameter. The reactor core contains the uranium fuel. The fuel is formed into cylindrical ceramic pellets about one-half inch in diameter, which are sealed in long metal tubes called *fuel pins*. The pins are arranged in groups to make a *fuel assembly*. A group of fuel assemblies, in turn, forms the *core* of the reactor.

How does a reactor work?

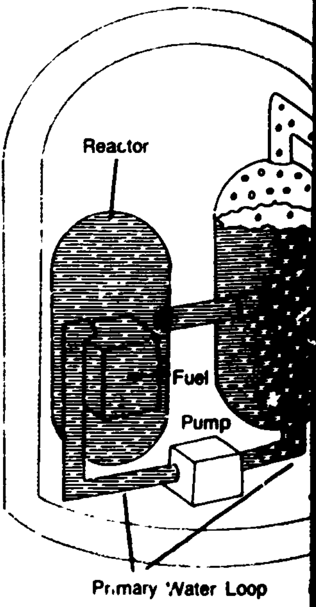
Heat is produced in a nuclear reactor when neutrons strike uranium atoms in a continuous *chain reaction. Control rods*, which are made of material that absorbs neutrons, are placed among the fuel assemblies.



When the control rods are pulled out of the core, more neutrons are available and the chain reaction speeds up, producing more heat. When they are inserted into the core, more neutrons are absorbed, and the chain reaction slows or stops, reducing the heat.

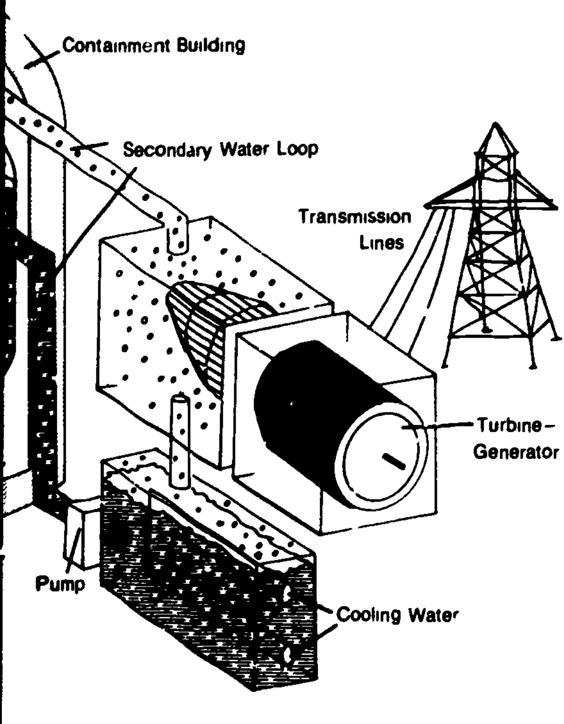
Most commercial nuclear reactors use water to remove the heat created by the fission process. These are called *light water reactors*.

The water also serves to slow down, or "moderate" the neutrons. In this type of reactor, the chain reaction will not occur without the water to serve as a *moderator*. In the United States, two different light-water reactor designs are currently in use for producing steam from the heated water.

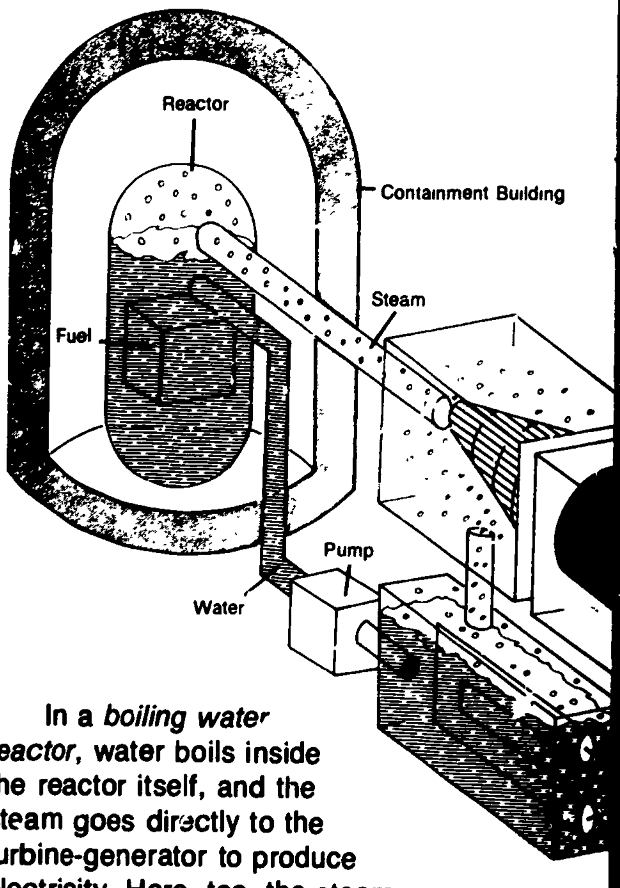


In a *pressurized water reactor*, the heat is removed from the reactor by water flowing in a closed pressurized loop. The heat is transferred to a second water loop through a heat exchanger. The second loop is kept at a lower pressure, allowing the water to boil and create steam, which is used to turn the turbine-generator and produce electricity. Afterward, the steam is condensed into water and returned to the heat exchanger.

Pressurized Water Reactor



Boiling Water Reactor

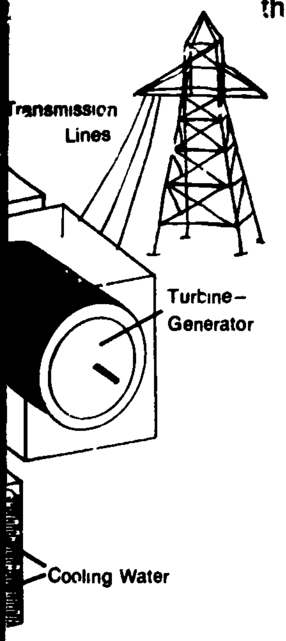


In a *boiling water reactor*, water boils inside the reactor itself, and the steam goes directly to the turbine-generator to produce electricity. Here, too, the steam is condensed and reused.

Another type of reactor is also in use in the United States. This design uses helium gas instead of water to remove heat produced by the fission process. The reactor, known as a *high-temperature gas-cooled reactor*, transfers heat from the high-temperature helium through a heat exchanger to boil water and produce steam. As in other powerplants, the steam drives a turbine-generator to produce electric power.

How is uranium prepared for use in a nuclear reactor?

Like other fuels, uranium must be processed before being used in powerplants to produce electricity. Uranium ore is mined and then sent to a mill, which is usually built near the mines. At the mill, the uranium ore is crushed and ground into a fine sand, and the uranium is removed from the ore. It is then refined and purified into a uranium compound called *yellowcake*, which describes its color and consistency.



The yellowcake is shipped to a conversion plant and combined with fluoride to form gaseous uranium hexafluoride.

The uranium must be enriched to increase the concentration of the type of the uranium that is usable as fuel.* The enriched uranium is taken to a fuel-fabrication plant where it is converted to uranium dioxide powder. The powder is then formed into cylindrical ceramic pellets, the form uranium is in when it is used as fuel in a nuclear reactor.

**Natural uranium is made up of uranium-238 (99.3 percent) and uranium-235 (0.7 percent). Of these, only uranium-235 is usable as fuel.*

How is a nuclear powerplant licensed and regulated?

Before a utility can build and operate a nuclear powerplant in the United States, a lengthy series of licensing procedures must be followed, including extensive technical reviews and public hearings. This open and detailed process is designed to protect public health and safety and the environment.

Comprehensive nuclear powerplant licensing regulations have been established, and the Nuclear Regulatory Commission (NRC) bears the primary responsibility for their enforcement. The existing NRC licensing process has two steps: (1) A utility must obtain a permit to build the plant, and (2) another permit must be obtained to operate it. Neither permit is granted until the NRC is satisfied that the plant can operate safely.

A utility must submit a formal application to the NRC to obtain a construction permit to build a powerplant at a particular site. The application must describe the design and location of the proposed plant and the safety systems to be provided. The application is first reviewed by the NRC and the Advisory Committee on Reactor Safeguards (ACRS), an independent, technical advisory group, which recommends to the NRC whether or not a permit should be issued. The NRC concurrently performs an environmental review and issues a draft Environmental Impact Statement for public comment. Public hearings are required to give private citizens, community groups, and State and local officials an opportunity to express their views on the plant.

The NRC may authorize limited amounts of work to be done before a construction permit is given. This *Limited Work Authorization* can be granted only after the environmental findings are reviewed and found to satisfy the safety conditions.

After a construction permit is issued and work on a facility has progressed to the point where the design and operating information is available, the utility can apply for an operating license. This application goes through essentially the same rigorous examination as the construction permit application.

The regulatory process does not end when an operating license is issued. Throughout the construction and operation of a plant, the NRC conducts inspections to check for strict compliance with licensing regulations. If there are any violations, a utility can be fined or can even lose its license. The utility must also submit annual reports to the NRC about the operation of the plant and special reports on unusual occurrences. All of these reports are made available to the public upon request.

The NRC reviews the design of all nuclear powerplants to ensure that each utility complies with safety regulations before a license is issued.

What is radiation?

Radiation is a natural energy force that has always existed on Earth and throughout the cosmos. It is energy transferred over distance through waves or particles. The term radiation can include such things as light and radio waves but is most often used to mean *ionizing radiation*. Ionizing radiation cannot be detected by any of our five senses. It is made up of energized particles or waves of pure energy. Its name refers to the fact that it can ionize, or electrically charge, stable atoms. Ionizing radiation can cause a change in the chemical composition of many things—including living tissue.

Some naturally occurring elements, such as uranium, radium, and thorium, emit ionizing radiation as they change into more stable forms. Manmade elements like plutonium and curium also have this property. Such elements are said to be *radioactive.*

Where does radiation come from?

We receive radiation from both natural and manmade sources. The primary sources of natural radiation are cosmic rays from outer space and naturally radioactive elements in the Earth's crust. These sources contribute to *natural background radiation*. The altitude at which we live and the types of rocks that surround us affect the amount of background radiation we receive. Even the bricks that our homes are built of and the ground we walk on are slightly radioactive because of the minerals they contain. Natural sources of radiation are also found in plants, animals, and the human body. For example, bones contain naturally radioactive potassium, and body tissues contain radioactive carbon.

We also receive radiation from manmade sources. In the United States, most manmade radiation comes from medical and dental sources, including x rays, medical diagnoses, and treatment. Radiation also comes from smoke detectors, television sets, nuclear powerplants, and smoke emissions from coal-fired powerplants. Uranium fuel becomes intensely radioactive as heat is produced in a nuclear reactor. Coal contains naturally occurring radioactive elements that are released into the atmosphere when it is burned.

The amount of radiation released during the normal operation of nuclear powerplants is very small compared to other manmade and natural sources. A National Academy of Sciences study* estimates that a person living in the United States receives, on the average, far less than 1 percent of his total radiation exposure per year from all operations of the nuclear power industry.

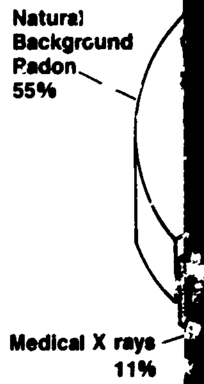
Does radiation present a hazard to public health?

Man has always lived with small amounts of natural background radiation with no ill effects. It has long been recognized, however, that extremely large doses of radiation are hazardous and can cause sickness, increased cancer risk, or death.

The biological effects of radiation are commonly measured in units called *millirem* (mrem). Most people receive a total of about 360 mrem of radiation a year from all sources—both natural and manmade. Most of this exposure comes from natural radiation in the environment and medical diagnosis and treatment. Limits for radiation exposure from manmade sources have been established through extensive scientific research. These limits are continually reviewed to ensure that they do not represent a significant risk to public health.

*Source: *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation*, National Academy of Sciences, 1980.

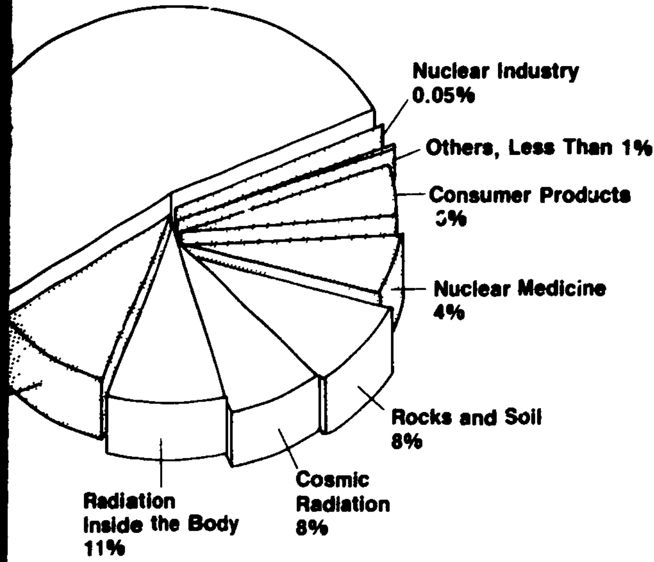
Current radiation exposure limits, established by the Nuclear Regulatory Commission and the Environmental Protection Agency, require that no worker in a radiation industry be exposed to more than 5,000 mrem in any year. Furthermore, the U.S. nuclear industry is required to keep exposures as low as reasonably achievable beneath those limits. Exposures for the general public cannot exceed 25 mrem per year above background levels. To put these limits in perspective, no permanent biological effects have been observed for even sudden exposures below 50,000 mrem.



If allowable radiation limits pose any human health and safety risk at all, even a small one, many people argue that the limits should be lowered. The same question could be raised about highway speed limits. The lower the speed, the lower the risk of injury. The only absolutely safe limit would be 0 miles per hour. But then there would not be the benefits that the automobile has brought to our society. Similarly, any risks from nuclear energy must be weighed against the benefits made possible by its careful use.

How safe are nuclear powerplants?

Nuclear energy has been used commercially in the United States to produce electricity for 30 years. During this time, it has established itself as one of our safest energy technologies. Safety is a major consideration throughout the design, construction, and operation of a nuclear powerplant. Hundreds of systems monitor, control, and support the safe operation of the reactor at each powerplant. These safety features are designed to provide maximum safety and reliability and to minimize the chance of an accidental release of radioactivity into the environment.

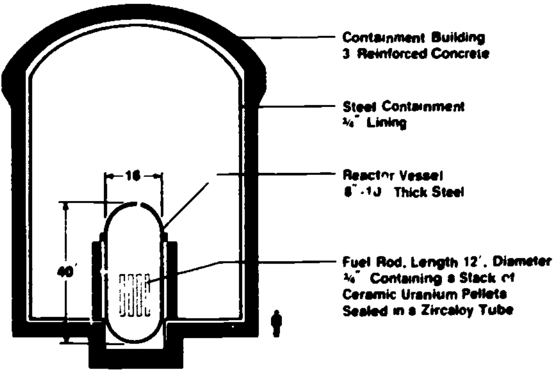


Note: Shaded portion indicates manmade radiation

Source: *National Council on Radiation Protection and Measurements NCRP Report No 93*

The fuel used in nuclear powerplants becomes intensely radioactive and thermally hot. For this reason, nuclear powerplants have numerous physical barriers to guard against the accidental release of this radioactive material. These barriers include the ceramic fuel pellets; the metal fuel pins; the reactor vessel with 8- to 10-inch-thick walls of steel; and a *containment building* with a lining of 3/4-inch steel and walls of reinforced concrete 3 or more feet thick. This containment building is strong enough to withstand earthquakes, violent storms, and even the direct impact of a large aircraft. It is designed to keep harmful radioactive material from being released into the environment even if there are serious mechanical failures or operator errors at the plant.

Engineered safety systems are used to prevent reactor accidents and to minimize the effects if accidents occur. All crucial safety systems have backup systems that duplicate their jobs.



Protective barriers are built into nuclear powerplants to prevent the accidental release of radioactive materials into the environment.

For example, huge stainless steel pipes about 2 feet in diameter carry water to the reactor core where it cools the fuel. Any of several independent emergency cooling systems included in the design of the plant are able to cool the reactor adequately if the others should fail.

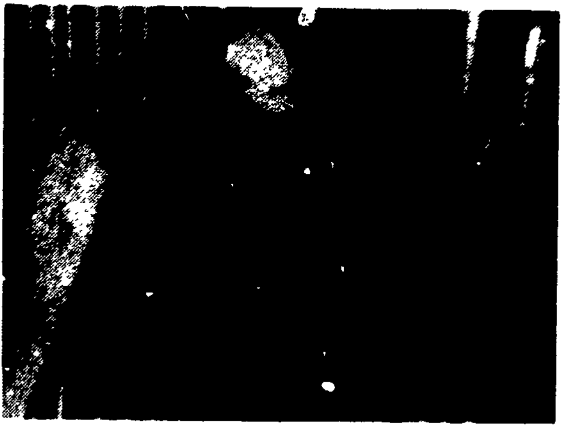
In addition to these physical barriers and engineered safety systems, a vital part of nuclear powerplant safety is the intensive training and preparedness of the people who operate the powerplant. Reactor operators are trained and tested on the procedures of powerplant operation. To train operators, utilities use sophisticated powerplant *simulators*—exact replicas of the control room of a real powerplant. The simulators are computer controlled, allowing the operators to gain practical experience in managing all types of normal and unusual occurrences without any danger to the public or the environment.

The nuclear industry's rigid safety standards are set and regulated by the NRC. Utilities operating nuclear powerplants must demonstrate to the NRC that each plant is designed and built to meet these stringent safety standards. Periodic inspections also ensure that each facility is being operated safely. Utilities face severe financial penalties if NRC inspections show that the plant is not being operated in full compliance with Federal regulations.

Some people have expressed fear that a nuclear reactor could explode like an atomic bomb. This cannot happen. A very high concentration of fissionable uranium (the form that can be split to release energy) is required for a nuclear explosion. The fuel used in nuclear powerplants has a very low concentration of fissionable uranium—only about 3 percent. An atomic bomb is designed to release tremendous amounts of energy instantaneously. A nuclear powerplant is designed to release energy at a steady, controlled rate.

Simulated control rooms are used to train nuclear powerplant operators to be prepared for emergencies.

Since 1957, utilities in the United States have operated commercial nuclear powerplants. During this time, there have been no deaths or injuries to any members of the American public as a result of operations at a commercial nuclear powerplant. Efforts to ensure the safety of nuclear powerplants are constantly emphasized to maintain this safety record, which compares very favorably with all other ways of making electricity.



The NRC performs periodic inspections on nuclear powerplants to ensure that each facility is being operated safely.

What does the term *meltdown* mean?

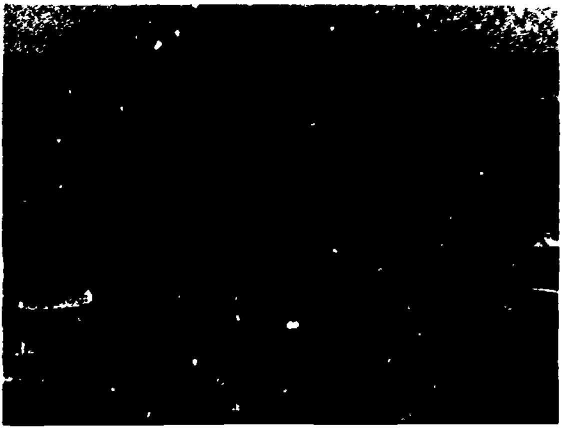
A reactor core *meltdown* is one of the most thoroughly studied nuclear accident scenarios. During normal operation, the reactor core is cooled by water circulating through the reactor vessel. This keeps the reactor's temperature well below the 5,000°F melting point of the fuel. For a meltdown to occur, the cooling water would have to be lost from around the fuel for an extended period, allowing fuel pins and pellets to overheat. To prevent this, nuclear powerplants are designed with many independent cooling systems that come on automatically if there is a loss of coolant.

It has been suggested that if reactor fuel were to melt, the molten fuel could then melt through the reactor vessel and the reinforced concrete containment building. The extensive studies made of this accident scenario indicate that, even if all emergency cooling systems were to fail, the fuel would cool before it could pass through the containment building into the environment. No such accident has ever occurred at a nuclear powerplant in the United States.

What happened in the accident at Three Mile Island?

On March 28, 1979, the Three Mile Island (TMI) Nuclear Power Station near Harrisburg, Pennsylvania, experienced this country's most serious accident in a commercial nuclear powerplant. TMI's Unit #2 suffered a loss-of-coolant accident in which the reactor's primary cooling system failed. Operators made a relatively minor incident more serious by cutting off backup systems. This error caused the water level to drop low enough to uncover all but about 2 feet of the reactor's 12-foot-long fuel assemblies. Without cooling water surrounding the fuel, its temperature exceeded 5,000°F, causing melting and damage to a substantial portion of the reactor core. As a result of this damage, radioactive material normally confined to the fuel was released into the reactor's cooling water system. It was several hours before the operators understood the magnitude of the problem, and by then, the core had been damaged.

The accident at TMI was a serious commercial reactor accident from an economic standpoint and pointed out the need to continually seek ways to improve powerplant



The Three Mile Island Nuclear Power Station near Harrisburg, Pennsylvania.

safety and training. However, the safety systems and protective barriers designed into the facility protected TMI personnel and the public. No one was injured during the accident, and no offsite property was contaminated. Recent studies of the population in the vicinity of the TMI plant have indicated no change in the normal incidence of cancer.

What changes have been made by the nuclear industry since the accident at TMI?

The U.S. electric power industry responded quickly to lessons learned from the TMI accident. Training and certification procedures for nuclear powerplant operators have been reviewed and enhanced:

- Stricter training requirements for plant operators have been imposed;
- Operator trainees are required to make higher test scores than before to become licensed operators;
- All licensed operators are required to complete additional periodic retraining courses to keep their skills at the highest levels.

Many equipment changes were also recommended to increase safety:

- More instruments have been placed in control rooms to improve the monitoring of reactor conditions;
- Communications equipment and procedures have been improved, and changes in control room layout have been made to enable reactor operators to work more efficiently;
- Improved monitoring and testing equipment has also been installed to better detect radiation in the air and water and to enable operators to better track the condition of the reactor when problems occur.

The NRC has also made the rules for emergency procedures stricter. Each utility is now required to have emergency procedures to report plant status, coordinate personnel, and support reactor operators in case of an accident. Emergency plans and procedures for surrounding communities have been upgraded, and coordination among Federal agencies, utilities, and State and local governments has been improved.

Why was the accident at Chernobyl so serious?

On April 26, 1986, an accident occurred at the Chernobyl Atomic Power Station in the Soviet Union that resulted in serious core damage, a fire, and the release of a large amount of radioactivity into the environment. Many people were hospitalized for radiation exposure, and 31 deaths occurred among the firefighters and emergency personnel who worked at the scene. During the days following the accident, over 100,000 people were evacuated from the area.

Multiple operator errors, combined with aspects of the Chernobyl reactor design, were the reasons that a large amount of radioactivity escaped into the environment as a result of the accident. The Chernobyl reactor design is unique to powerplants used inside the Soviet Union. It cannot be compared to commercial reactors in the United States or other Western countries. The Chernobyl reactor's design makes it unstable during low-power operation. At the time of the Chernobyl accident, the reactor was being operated at low power. Operators performing experiments made a series of crucial mistakes that caused an uncontrollable reaction that destroyed the reactor core and released a large amount of radioactivity.

What is nuclear waste?

Nuclear waste is material that is either radioactive itself or has been contaminated by radioactive elements. It includes the byproducts of mining ore, producing electricity in commercial reactors, processing defense materials, and preparing nuclear medicine.

Nuclear waste is generally categorized as either low level or high level. Low-level waste is produced by many commercial, industrial, and medical users and includes items such as discarded protective clothing, filters, mops, brooms, rags, and other slightly contaminated items. Low-level waste has a low level of radioactivity that decays relatively quickly, reaching background levels of radioactivity within a period of 100 years or less.

High-level waste is generated either during the production of electricity in commercial nuclear powerplants or during the production of nuclear materials for national defense. At powerplants, this waste is contained inside the spent (used) fuel assemblies along with remaining uranium and plutonium. High-level waste is characterized by high-energy radiation.

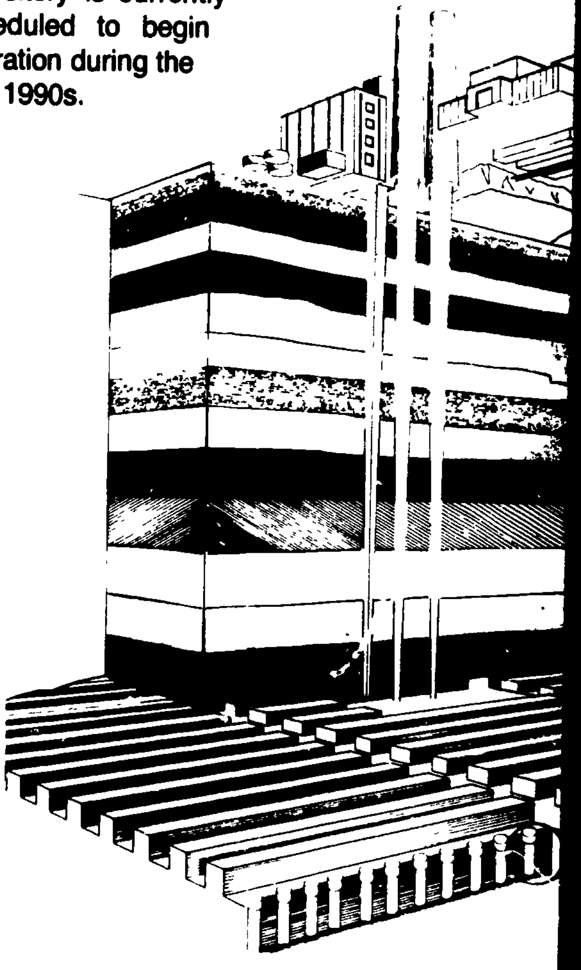
How does the United States dispose of nuclear waste?

Because of the differences in levels of radioactivity, low-level and high-level wastes are disposed of in different ways. Low-level waste is currently disposed of through shallow burial at regulated sites. Disposal of low-level waste is the responsibility of the States in which it is produced.

High-level waste from nuclear powerplants is mostly in the form of spent fuel. Spent fuel is currently stored in specially designed pools of purified water at the reactor site. The water serves as a radiation shield and removes heat from the spent fuel. Although this is considered temporary storage, some spent fuel has been stored safely this way for more than 30 years.

Spent fuel is stored in pools of purified water at the reactor site.

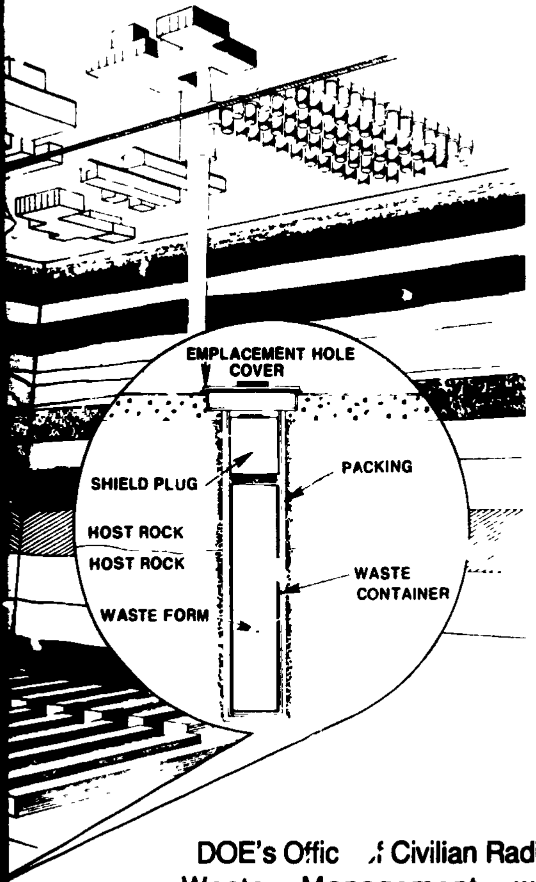
The Nuclear Waste Policy Act of 1982 (NWPA) requires that Federal geologic repositories be developed for the permanent disposal of high-level waste. Sealed corrosion-resistant cylinders have been designed to contain the waste and reduce the possibility of the release of any radioactive material. The repositories will be able to handle both commercial spent fuel and reprocessed high-level waste, as well as high-level waste from defense activities. The first repository is currently scheduled to begin operation during the late 1990s.



A Federally managed permanent waste disposal facility will be designed to receive nuclear waste from commercial reactors.

How is high-level waste transported?

Once a permanent Federal waste repository is available, commercial high-level waste will be transported by truck or rail from the nuclear powerplant to a packaging and handling facility or to the permanent repository for disposal. The U.S. Department of Transportation (DOT), the NRC, the U.S. Department of Energy (DOE), and State agencies will all play key roles in the transportation of spent fuel to the repository.



DOE's Office of Civilian Radioactive Waste Management will be responsible for managing the transportation of spent fuel; and DOT, the NRC, and the States will be responsible for regulating DOE transportation.

What precautions are taken to protect the public during the transportation of nuclear waste?

There are risks associated with shipping nuclear waste, just as there are with shipping any material.

The greatest risk in transportation is the possibility of a vehicle accident. Stringent regulations governing package design and transport significantly reduce the risks associated with shipping nuclear waste. Before a cask can be used to ship spent nuclear fuel, it must be certified by the NRC for commercial shipments or by DOE for DOE shipments. To be certified, the cask must withstand a series of mechanical (drop-and-puncture), thermal (fire), and water-immersion tests. These tests are designed to ensure that the radioactive contents of the cask are contained even under severe accident conditions.

Another potential hazard in the transportation of nuclear waste is the sabotage or theft of nuclear material. Federal safeguards and highly trained security personnel help minimize this type of threat.

What measures are taken to safeguard nuclear materials?

Strict security precautions are taken to protect fuel for nuclear powerplants in the United States and around the world. This is because uranium and plutonium, the fissionable materials that serve as fuel for nuclear powerplants, are also used to make nuclear weapons. However, highly enriched uranium or purified plutonium is required in order to make a bomb. Neither of these materials is present in commercial nuclear powerplants. Nevertheless, it is conceivable that theft or diversion of nuclear fuel could be attempted. For this reason, security measures are in place to protect the fuel at the powerplant and during transportation.

A well-trained security force, physical barriers, electronic surveillance, and visitor screening are all part of the normal security at nuclear powerplants. These measures are also designed to deter, prevent, and respond to the attempted theft or diversion of nuclear materials. During transportation, careful routing, armed security, and advanced communications equipment ensure that the reactor safely reaches its destination.

In addition to plant and transportation security, the size, weight, and radioactivity of spent reactor fuel acts as a deterrent to a would-be thief. A typical fuel assembly is about 14 feet in length and weighs up to 1 ton. During shipment, spent-fuel assemblies are encased in casks that weigh nearly 65 tons.

The United States' concern about the misuse of nuclear materials is international in scope. Extracting the fissionable material from spent fuel, known as reprocessing, requires advanced technology and large facilities. The United States does not currently reprocess commercial nuclear fuel, nor does it export the technology to other countries. Furthermore, the United States has postponed the development of the breeder reactor, an advanced nuclear powerplant design, partly because of its link to nonproliferation issues.

Finally, under the terms of the Nuclear Nonproliferation Treaty of 1970 and Nuclear Nonproliferation Act of 1978, the United States does not sell nuclear power components to nations who might divert or misuse the nuclear materials in armed conflicts.

These treaties have bound nonnuclear weapons states to agree to international inspection of their nuclear powerplants and to a commitment not to build nuclear explosives. In this way, all nuclear powerplant facilities operated by participating nations are safeguarded—providing an international network of nuclear nonproliferation The International Atomic Energy Agency (IAEA) is the international agency that oversees and inspects nuclear powerplants around the world. The IAEA has played a major role in supporting international cooperation in the development of nuclear energy for electric power and in safeguarding against the proliferation of nuclear weapons. The goal is to prevent the spread of nuclear weapons while meeting the energy needs of the world's nations.

What is the future of nuclear energy?

America has come to rely on electricity as a clean, versatile energy form. The need for a secure and economical supply of adequate electrical power has led this country to explore new technologies for producing electricity from many energy resources.

Since the first commercial nuclear powerplant began operating in 1957, nuclear energy has grown into a significant energy source in the United States and much of the industrialized world. Nuclear energy has shown the potential of being a valuable and safe source of energy well into the 21st century and will contribute to our national energy policy goal of providing Americans with an adequate supply of energy, available at reasonable costs. This goal is intended to lead the United States along a pathway to growing energy stability, security, and strength.

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This is one in a series of publications on nuclear energy. For additional information on a specific subject, please write to ENERGY, P.O. Box 62, Oak Ridge, TN 37831.

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