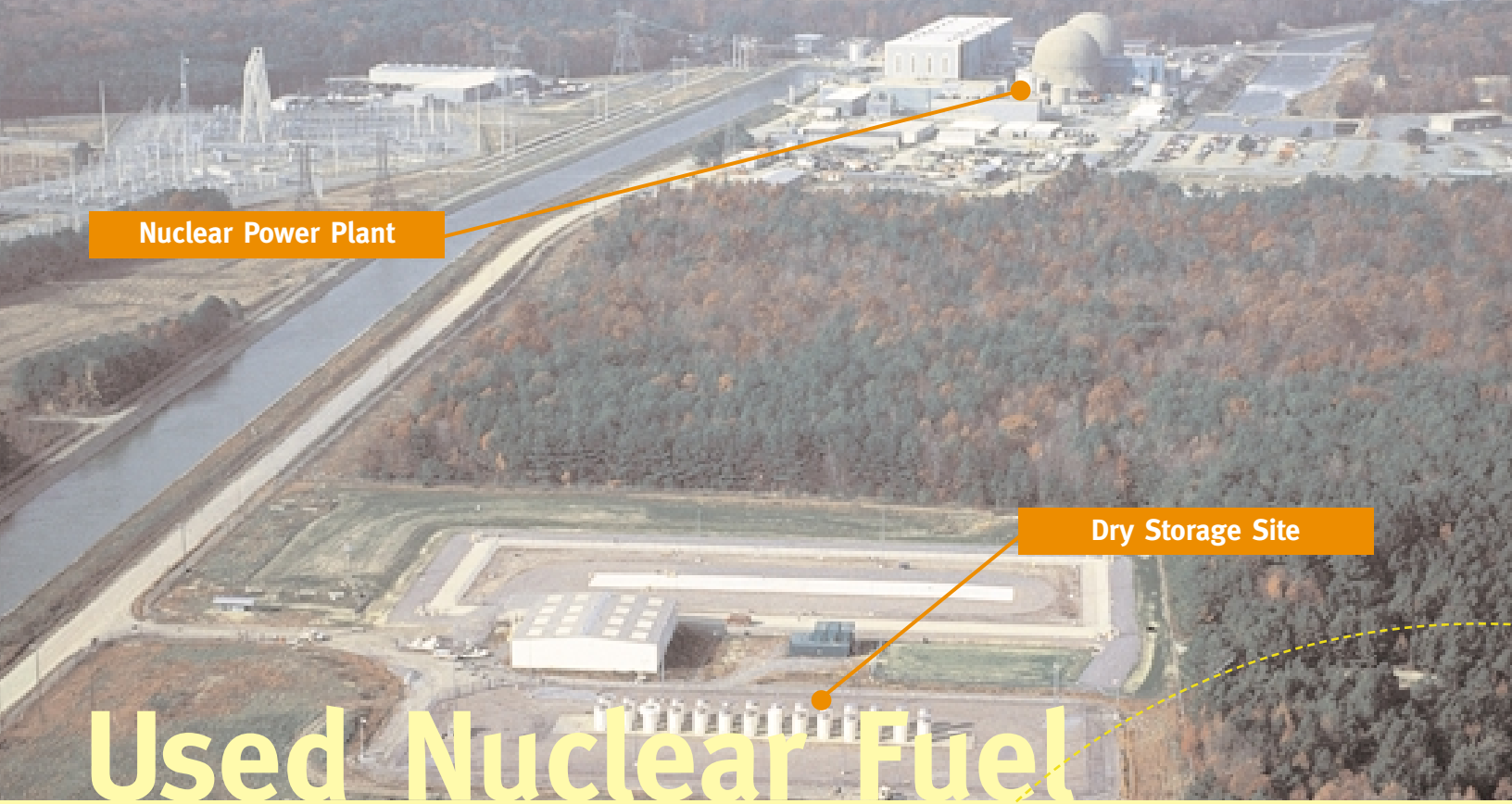
Used Nuclear Fuel: Handled With Care

How the nuclear energy industry manages used fuel on site



Used Nuclear Fuel

Today, more than 100 nuclear power plants contribute nearly 20 percent of the electricity generated in the United States—cleanly, with no air pollution.

A byproduct of nuclear-generated electricity production is radioactive used nuclear fuel. The U.S. nuclear energy industry has safely managed used fuel for decades, carefully containing it from release to the environment. When the federal government takes over responsibility of this material, the safe management of used nuclear fuel will be continued by the Department of Energy.

What Is Used Nuclear Fuel?

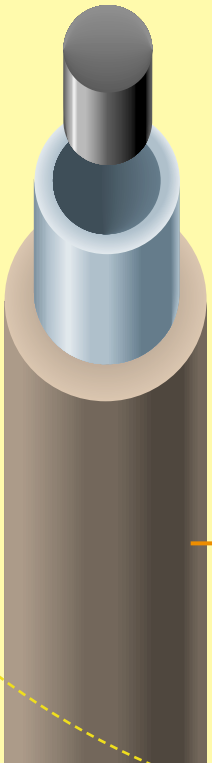
To generate electricity, nuclear power plants use uranium oxide. This solid fuel—in the form of small ceramic pellets—is placed inside metal fuel rods, which are grouped into bundles called assemblies.

Fission—which involves the splitting of uranium atoms in a chain reaction, rather than the burning of fossil fuels—produces a tremendous amount of heat energy that is used to boil water into steam. That steam, in turn, drives a turbine-generator to produce electricity, which is sent across power lines to homes, businesses and schools.

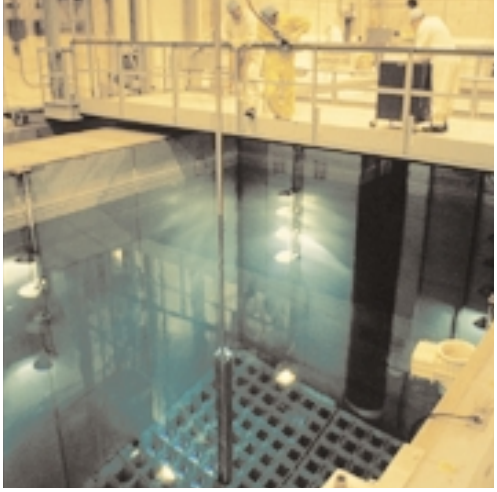
Over time, the energy in a nuclear plant's fuel is consumed, and every 12-24 months the plant is shut down and the oldest fuel assemblies are removed and replaced by new ones.

Q. What is on-site, dry storage?

A. On-site storage systems involve sealing used nuclear power plant fuel in massive, air-tight steel or concrete-and-steel canisters that provide both structural strength and radiation shielding. All storage canisters—which can hold seven to 68 twelve-foot-long used fuel assemblies—are naturally cooled and ventilated (they involve no mechanical devices for cooling or ventilation) and are built to withstand natural disasters such as tornadoes and earthquakes. They are placed upright on a three-foot-thick concrete pad or horizontally in a steel-reinforced concrete vault.



Fuel Pellet and Rod
(actual size)



Nuclear power plants store used fuel in steel-lined concrete pools.

Those assemblies, in the process of generating enormous amounts of energy, have become intensely radioactive as a result of the fission process. But contrary to what you see in fictional movies or television programs, this used fuel is carefully shielded and safely managed at the plant sites. It is solid and compact, and relatively small in volume.

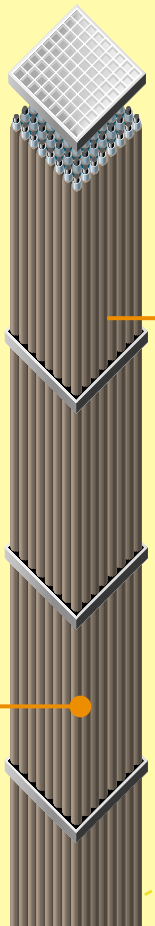
At most plants, used fuel is stored in steel-lined, concrete vaults filled with water. In these used fuel pools, the water acts as a natural barrier for radiation from the fuel assemblies.

The water also keeps the fuel cool while the fuel decays—becomes less radioactive. The water itself never leaves the inside of the power plant's concrete building.

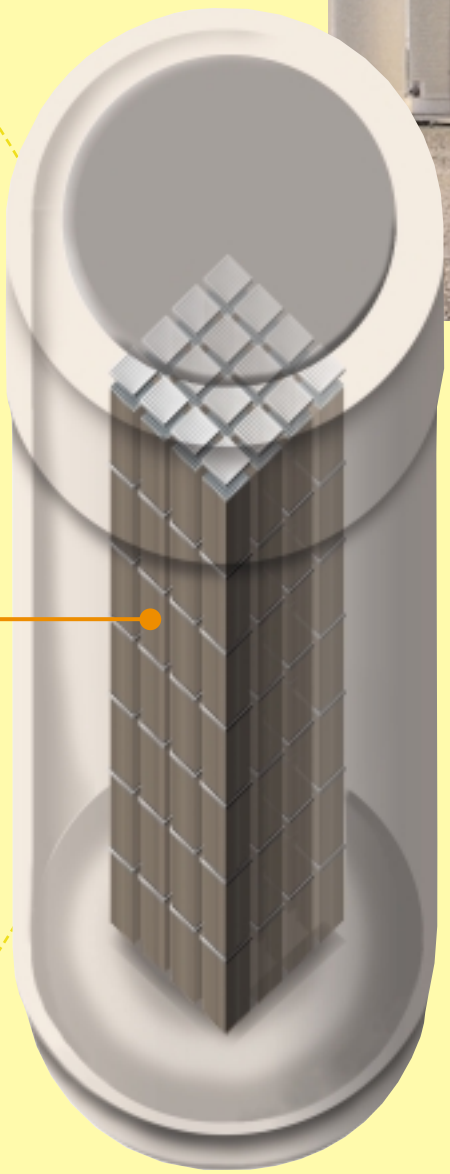
Nuclear power plants were designed to store at least a decade's worth of used fuel. Some plants soon will—or already have—run out of used fuel pool capacity. The federal government was to begin moving used fuel from plant sites in 1998, as mandated by the Nuclear Waste Policy Act of 1982, but it is running behind in its waste management program.

It now appears the government may not begin to remove used fuel before a permanent repository opens or is near completion—sometime around 2007.

Many nuclear companies are using above-ground, dry storage facilities to expand on-site storage capacity.



Fuel Assembly

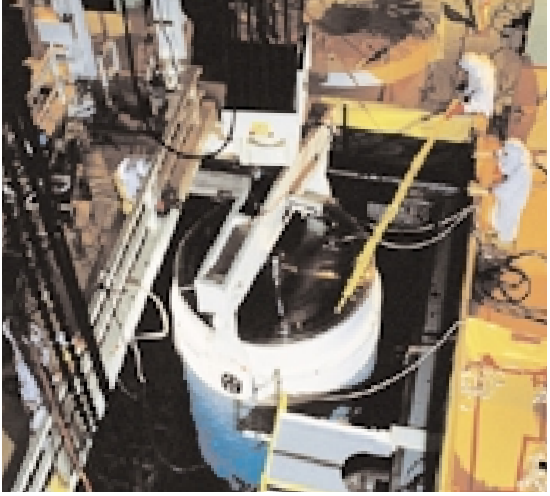


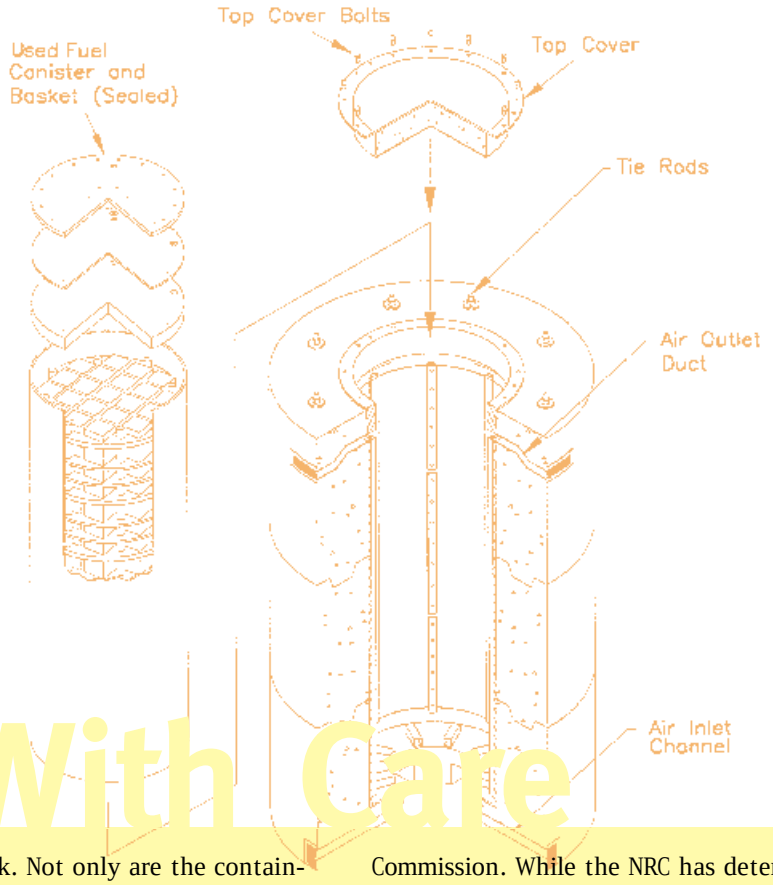
Dry Storage Canister

Q. How long can used fuel be stored safely on site?

A. The Nuclear Regulatory Commission has determined that used nuclear fuel can be stored safely and with minimal environmental impact—either in used fuel pools or in above-ground containers—for at least 30 years beyond the licensed operating life of a nuclear power plant.

The NRC must approve every container design. Its regulations cover testing, manufacturing and maintenance.





▲ *The used fuel is transferred from the water-filled storage pool to a dry canister for on-site storage and eventual transport to a federal repository.*

Handled With Care

The delay of a federal repository or other centralized storage facility means that nuclear power plants must store more used fuel than expected and longer than originally intended. By 2010, the earliest opening date for a repository, 78 power plants will find themselves with no room left in their used fuel pools.

Safeguards Are Integral to Dry Storage Systems

Since 1986, more than a dozen U.S. plants—including several shutdown units—have supplemented their storage capacity by building above-ground, dry storage facilities known as Independent Spent Fuel Storage Installations. Other countries also have safely and successfully stored used fuel above ground since the mid-1970s.

Above-ground storage systems—like used fuel pools—incorporate a number of safeguards to protect public health and safety.

The foremost safety feature is the construction of the containers: steel or steel-reinforced concrete, 18 or more inches thick. Not only are the containers extremely rugged, materials like steel, concrete and lead serve as a proven, effective radiation shield. Each container—depending on the design—can hold from seven to 68 twelve-foot-long used fuel assemblies. Once loaded, the containers are stored horizontally in a concrete vault, or they stand upright on a three-foot-thick concrete pad. By mid-1999, nearly 150 of these containers were being used safely at U.S. nuclear power plant sites.

Dry storage containers are designed and tested to prevent the release of radioactivity under the most extreme conditions—earthquakes, tornadoes, hurricanes, floods and sabotage. All of the designs are naturally cooled and ventilated. No mechanical devices are needed.

To further ensure public health and safety, each container design must be approved by the Nuclear Regulatory Commission. While the NRC has determined that used fuel can be stored at plant sites without adverse health or safety consequences for at least 30 years beyond the licensed operating life of a nuclear power plant, the agency requires that dry storage containers be constantly monitored and relicensed every 20 years.

▲ *Dry storage containers are monitored constantly and inspected regularly by nuclear plant personnel.*

Centralized Storage Will Hold Down Costs to Consumers

While the use of above-ground, dry storage allows the nation's nuclear power plants to continue providing reliable, economical and emission-free electricity to millions of Americans, these systems are expensive.

Depending on the design, a container's cost can range from $500,000 to more than $1 million. Some nuclear plants will need dozens of these containers until the federal government opens a centralized used fuel management facility. Consumers of nuclear-generated electricity will have to foot the bill for these on-site storage systems, even though they were never envisioned in the Nuclear Waste Policy Act of 1982. There's one other reason a centralized facility is needed: Nuclear power plants—while carefully and safely managing used fuel for more than three decades—were never built for long-term storage. Experts agree that moving used fuel to a single facility—built specifically for that purpose—will lessen the cost to the public while improving on an already excellent safety record.

Until a centralized facility opens, nuclear utilities will continue to use dry storage systems that are subject to the same rigorous safety standards and regulatory oversight as every other aspect of nuclear power plant operations.

Responsible Management

At each of America's nuclear power plants, public health and safety are paramount—from the plants' conservative design with multiple barriers and backup operating systems to continual training and testing of the people who run the plants.

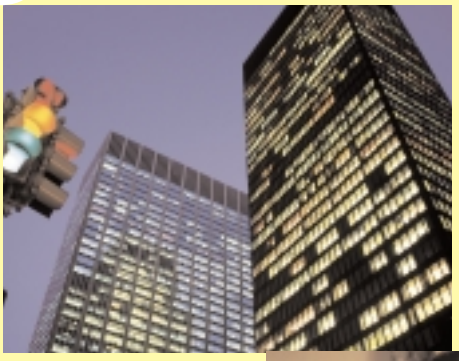
Used Fuel Management Preserves Nuclear Energy's Benefits

Nuclear power plants are the nation's largest source of emission-free electricity. No other source of electricity in the United States contributes such a large share of energy production while having such a limited environmental impact.

Just as important, as America's second-leading source of electricity, U.S. nuclear plants play a significant role in improving people's lives—whether it's powering offices and factories or providing the light for a bedtime story.

Performance measures tracked since 1980 show that these plants continue to improve their safety and performance records. Used fuel management practices also clearly demonstrate the nuclear industry's concern for public health and safety.

Plant operators are committed to manage the nation's used nuclear fuel safely and responsibly until the federal government opens a centralized repository. Doing so not only protects public health and safety, it also ensures that Americans can enjoy the benefits of reliable, economical and emission-free nuclear energy.



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