DOE/RW-0426/Rev. 1

Multi-Purpose Canister System

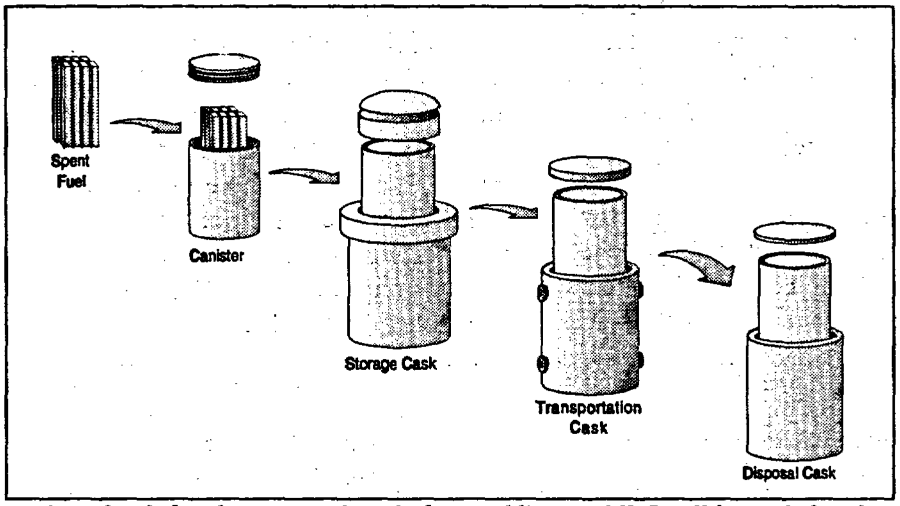
In 1982, the Nuclear Waste Policy Act was enacted and outlined a comprehensive plan for the safe disposal of spent nuclear fuel and other forms of high-level radioactive waste. The Act and its amendments require the Department of Energy to develop a system that would accept, transport and dispose this waste which will consist of a permanent geologic repository, an interim storage facility, if available, and a transportation system to move the spent nuclear fuel over the nations highways and railroads.

Spent nuclear fuel is generated from the use of nuclear power and is very hot and highly radioactive. To date, it has been stored on-site at the power plants in either steel-lined pools filled with water or in a dry environment inside large, steel or concrete containers. Nuclear utilities have been using a variety of storage technologies that incorporate similar systems but are not compatible with each other.

The Concept

Over the years, the Department of Energy has considered several different container systems. A container could be used just once - for storage, transport or disposal; it could be used twice -for storage and transport; or it could be used for all three - storage, transport and disposal. In early 1994, the decision was made to pursue the development of a canister-based system, known as the multi-purpose canister or MPC, that could be used for all stages of the waste management system.

The multi-purpose canister would be made of steel and other materials that inhibit any reactivity. Inside the canister is a metal frame used to hold the spent nuclear fuel assemblies, transfer heat to the outer surface, and add strength to the canister. The MPC has a shield plug and two lids for added strength and protection. Once spent nuclear fuel assemblies are loaded into the MPC, it is sealed and not reopened. The canister can then be placed inside separate casks for storage, transportation and disposal. And the MPC can be used for storage at either the nuclear power plant or an interim storage facility.



Once loaded with spent nuclear fuel assemblies, an MPC will be sealed and loaded into a cask for each phase of storage, transport or disposal.

The Design

The MPC is being designed to contain spent nuclear fuel from the two primary types of U.S. commercial reactors - boiling water reactors and pressurized water reactors. It will also come in two sizes - 125 tons and 75 tons. The weight includes the canister, spent nuclear fuel and the transportation cask. The 125-ton MPC can be used at plants with a crane capacity of at least 125 tons. The 75-ton MPC can be used at plants with a crane capacity of at least 75 tons.

Because of the weight, the MPC is intended for rail shipment. By using a large canister, as much spent nuclear fuel as possible can be loaded into one canister thereby reducing the number of shipments and the chance for transportation accidents.

Most of the nation's nuclear power plants can use the 125-ton MPC but because of a lack of rail access or lifting capacity, some cannot. These plants would then use a legal-weight truck cask. These casks, when fully loaded, can weigh no more than 80,000 pounds and still travel over the interstate highway system. Another option for those plants without rail access is to load the MPC onto a barge or heavy-haul truck and transport it to the nearest rail head.

The Alternatives

The Department of Energy is currently preparing an Environmental Impact Statement to help them make an informed decision concerning the use of MPCs in the waste management system. Part of this Environmental Impact Statement process is weighing the alternative systems and then, with help from public input, making an informed decision on which system to select.

Two of these alternatives include a single-purpose system and a dual-purpose system. The single-purpose system requires transferring the spent nuclear fuel assemblies from one cask to another for storage, transport and disposal. The assemblies are either stored in pools or in dry containers. They are then removed from storage and placed in a transportation cask for shipment. Then, at the repository, the assemblies are unloaded from the transportation cask and placed in a cask designed for disposal.

The dual-purpose system involves storing and transporting spent nuclear fuel in one cask and disposing of it in another. When the cask arrives at the repository, the spent nuclear fuel assemblies would be removed and placed in a waste package designed for disposal.

The multi-purpose system relies on canisters. Spent nuclear fuel is sealed inside a canister that is never reopened. Instead, the canister is inserted into separate casks for storage, transportation and disposal.

Preparing An Environmental Impact Statement

Because the decision is the fabrication and deployment of a canister-based system, an Environmental Impact Statement (EIS) must be prepared and will focus on comparing the environmental impacts of alternative canister systems. The EIS will evaluate the impacts on the environment through raw material usage and fabrication pollution for each of the alternative canister systems. The EIS will also evaluate how using each system for spent fuel storage at the nuclear power plants would affect the radiation exposure of power plant workers and the people living near the power plants, as well as public radiation exposure when spent fuel is transported.

DOE is not ready to transport spent fuel, thus DOE has not selected specific transportation routes. However, for each alternative studied, all potential transportation consequences will be assessed. Also since DOE has not selected a repository site, the EIS will not look at how the use of MPCs may affect the environment near a repository. These issues will be further addressed in later EISs prepared before DOE selection of a repository site or preparation to begin transporting spent fuel. All information used to prepare the MPC EIS will be available to the public.

For more MPC EIS information, please call, write, fax, or e-mail:
U.S. Department of Energy
c/o Argonne National Laboratory
9700 Cass Avenue, Building 900
Argonne, IL 60439
Attention: MPC Comments

800-MPC-3304 (toll-free)
800-MPC-4531 (fax)
MPCEIS @ smtplink.ead.anl.gov (e-mail)
800-MPC-1855 (bulletin board)

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What is an EIS?

The President signed into law the National Environmental Policy Act (NEPA) in 1970. The Act requires federal agencies to consider the impact of possible government actions on the environment prior to making any major decisions. If an action is expected to have a significant impact on the environment, the agency proposing the action must develop a study for public and agency review. This study is an analysis of the potential impacts to the natural and human environment from the proposed action as well as a range of alternatives. This study is called an Environmental Impact Statement or, for short, an "EIS".

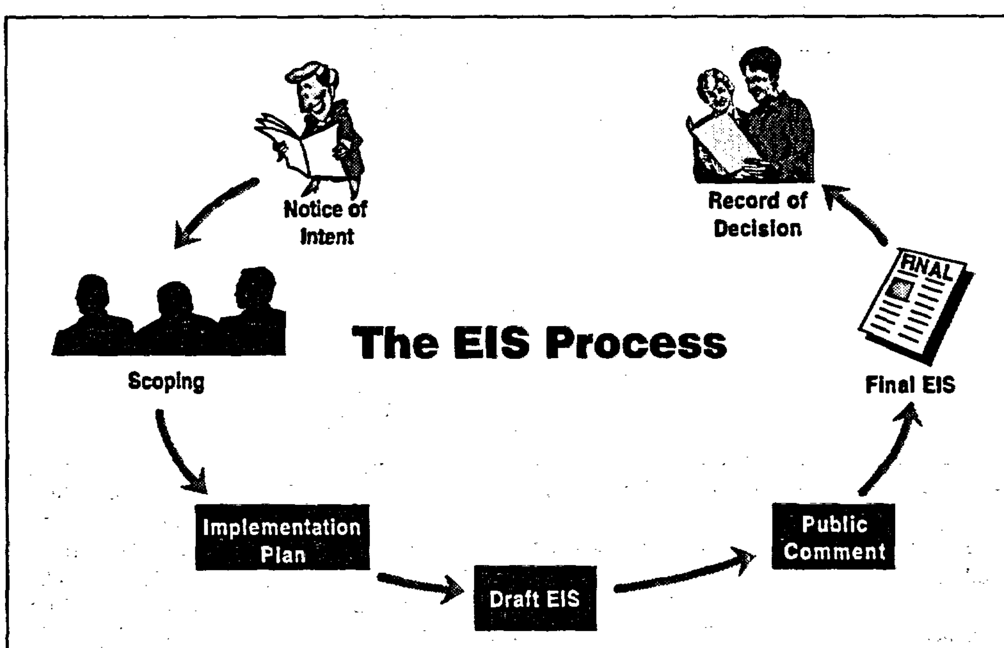
The EIS Process

Before the Department of Energy (DOE) develops an Environmental Impact Statement, issues important for analysis must be defined. DOE asks other federal and State agencies, affected Indian tribes, and the public to provide comments and suggestions.

The EIS process begins when the DOE publishes a **Notice of Intent** in the *Federal Register*. The notice describes the proposed action the agency is considering and provides background information on the action, its alternatives and potential impacts.

The **Scoping Process** is a period of time when the public can provide comments to DOE on the breadth of the EIS and can help determine the alternatives, issues, and environmental impacts to be analyzed. In the case of the MPC EIS, scoping will include public meetings, written comments, and other means for information gathering including toll-free hot lines for voice, fax, and an electronic bulletin board.

Although not required by NEPA, DOE prepares an **Implementation Plan** which is made available to the public. The Implementation Plan briefly records the results of the scoping process, defines the relevant issues and alternatives, the content of the EIS, and provides a schedule for EIS development.



Next, a **draft EIS** is written. The draft EIS analyzes and compares the environmental impacts of the potential action and its alternatives, and any mitigating actions. It also discusses the methodologies and assumptions used in the draft EIS analysis. If at this stage one or more preferred alternatives exist, they will be identified in the draft EIS.

After the draft EIS is prepared the document is made available for **Public Review and Comment.** DOE requires a minimum 45-day comment period to receive public comments for consideration in the final EIS. Once the public comment period on the draft EIS is completed, a **final EIS** is published and distributed. The final EIS reflects considerations of all the comments received during the public comment period, the responses to those comments, and the revised EIS text. The final EIS will identify the agency's preferred alternative.

Following the publication of the final EIS, a minimum 30-day waiting period is required before a **Record of Decision** can be issued. The record of decision notifies the public which decision was made on the proposed action and the reasons for that decision. No action may be taken until the decision is made public.

Multi-Purpose Canister EIS

The Department of Energy is proposing to fabricate and deploy a canister system to be used for the storage, transportation, and eventual disposal of spent nuclear fuel from commercial nuclear power plants. This EIS will evaluate the environmental impacts of using several types of canister systems. This will allow DOE to incorporate environmental impacts into the decision process along with cost, schedule, and technological considerations.

Your Chance To Comment

The EIS process for the MPC system is now underway. You can provide your comments to the Department of Energy by attending a public meeting in Washington, D.C.; Chicago, IL; or Las Vegas, NV; or by sending your written comments to:

U.S. Department of Energy
c/o Argonne National Laboratory
9700 S. Cass Ave, Bldg. 900
Argonne, IL 60439
Attention: MPC Comments

For more MPC EIS information, please call, write, fax, or e-mail:
U.S. Department of Energy
c/o Argonne National Laboratory
9700 Cass Avenue, Building 900
Argonne, IL 60439
Attention: MPC Comments

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MPCEIS @ smtplink.ead.anl.gov (e-mail)
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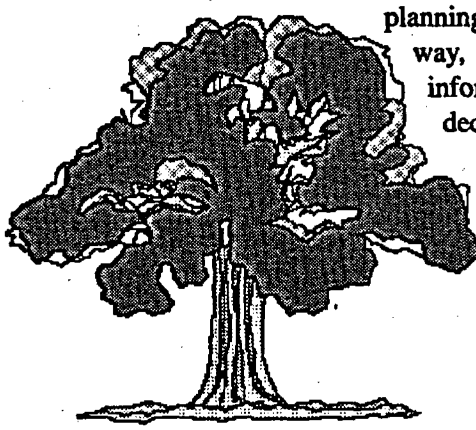
DOE/RW-0453

National Environmental Policy Act

In 1970 the National Environmental Policy Act was signed into law. This Act requires federal agencies, including the Department of Energy, to evaluate potential environmental impacts when planning a major federal action. In this way, public officials gain necessary information to use in making informed decisions.



Another major emphasis of the Act is to promote public awareness at the earliest planning stages and to provide opportunities for the public to provide input. The process is meant to be a dialogue.

"The National Environmental Policy Act (NEPA) is our basic national charter for protection of the environment. The Act ensures that environmental information is available to public officials and citizens before decisions are made and before actions are taken." - taken from Part 1500 of the Code of Federal Regulations

NEPA, Start To Finish

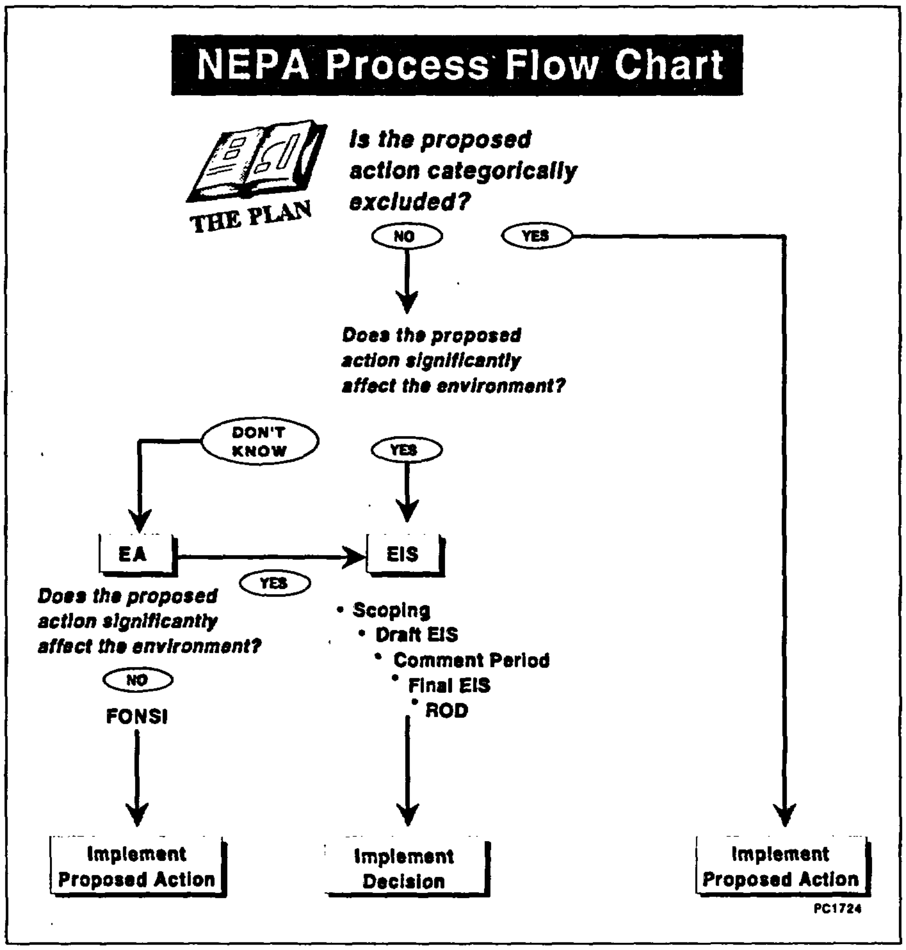
The National Environmental Policy Act, or NEPA, established the Council on Environmental Quality which acts as a "watch-dog" for the NEPA process. This organization is part of the executive branch and has developed a set of procedures for federal agencies to follow when developing an Environmental Impact Statement or EIS. Each government agency, including the Department of Energy (DOE), has developed specific regulations to comply with the Council's procedures.

Major federal actions come in all shapes and sizes: a rerouted interstate highway, a new dam, a ski resort expansion on federally-owned land. The first question NEPA asks is whether the proposed action merits a "categorical exclusion." If an action has been studied in the past and does not have significant impact, or if it can be compared to different activities the law defines as not having significant impact, then no further NEPA studies are necessary. The agency can then implement its proposed action.

If the proposed action is not excluded from further study, the process continues. The next question asked is whether an action will have significant impacts on the environment. If the answer is yes, NEPA outlines a detailed process for an EIS. If the answer is unknown, a less detailed study or an Environmental Assessment is prepared.

An Environmental Assessment is an overview of potential impacts. Enough analysis is done to determine either that the more detailed Environmental Impact Statement is necessary or that only a Finding of No Significant Impact is necessary.

Preparing the Environmental Impact Statement is a well-defined process in itself. First, a notice of intent must be issued in the *Federal Register* to inform the public that a study will be done. Then, in a process known as "scoping," the general public as well as other federal and state agencies and Indian tribes, are asked to give their comments and to better define the issues that should be covered. Next, a draft Environmental Impact Statement is written. NEPA requires a minimum 45-day period for public comment when the draft EIS is issued. Afterwards, the federal agency issues a final Environmental Impact Statement which responds to oral and written comments received during the public review of the draft. The agency is now prepared to make an informed decision and, after a 30-day waiting period, issues a Record of Decision. The federal agency may then begin implementation of its decision.



For more specifics about the National Environmental Policy Act, visit your local library for a copy of 40 Code of Federal Regulations, sections 1500-1508 or call the MPC EIS Hotline, 1-800-MPC-3304.

Focus Of An EIS

After scoping and during the preparation of an Environmental Impact Statement, experts examine the potential impacts of the proposed action, as well as impacts from several reasonable alternatives. The study will identify both negative and positive effects. The Environmental Impact Statement must look at all interrelated elements of the environment -- not only the natural component (air, water, geology, ecology) but the human component (jobs, housing, schools, health and safety, transportation, cultural resources, noise, aesthetics). The study must also identify opportunities for reducing or eliminating significant adverse impacts.

An Environmental Impact Statement must also examine the impacts of not implementing the proposed action. This is called the "no-action" alternative and may mean that the agency simply continues using existing approaches.

The NEPA process does not dictate that an agency choose the most environmentally friendly alternative, nor does it dictate the least expensive. The purpose of the NEPA process is to ensure that necessary and accurate studies are done, that they are done with public involvement, and that public officials, like those at the Department of Energy, make decisions based on an understanding of environmental consequences.

You Are Vital To The NEPA Process

Public input in the NEPA process is emphasized early on in the scoping phase and during public comment periods. Your input strengthens the NEPA process. Concerns raised during public scoping help shape the issues in the Environmental Impact Statement. Comments received during comment periods are responded to and included in the final document. Watch the *Federal Register* and area newspapers for Notices of Intent as well as announcements of Public Scoping Meetings or Public Comment Meetings.

Or for more information call or write:
OCRWM Information Center
Post Office Box 44375
Washington, D.C. 20026
1-800-225-NWPA or (202)-488-5513 in Washington, D.C.

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DOE/RW-0455

How To Be Involved

Your ideas are important! The Department of Energy is preparing an Environmental Impact Statement that will explore potential environmental effects of a multi-purpose canister-based system for the storage, transport and disposal of nuclear waste, and the possible alternatives. This information will assist in the preparation of making a decision on employing a multi-purpose canister-based system. A large part of this effort includes public input.

The National Environmental Policy Act specifies a series of steps for federal agencies to follow when developing an Environmental Impact Statement including opportunities for public comment. Some of these opportunities include regional public scoping meetings, toll free information lines, a bulletin board information line and a structured comment form.

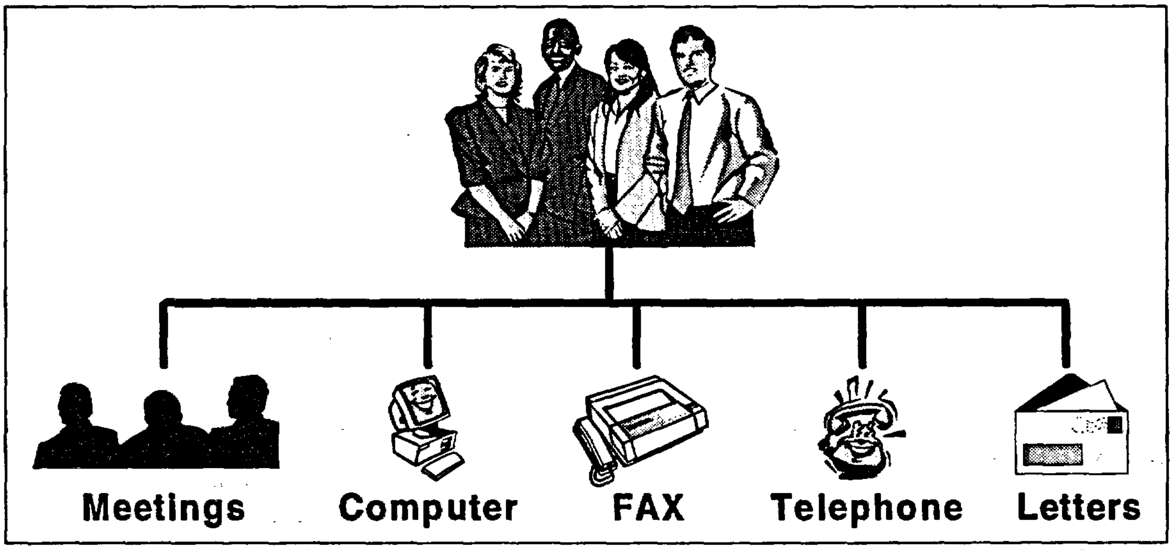
The Department of Energy is considering whether to fabricate and deploy a canister-based system that will store, transport and dispose of spent nuclear fuel from the nation's commercial nuclear power plants. This Environmental Impact Statement will evaluate the environmental effects of several alternatives to the canister-based system including a "no action" alternative or continuing with the current system of spent nuclear fuel storage.

How To Get Involved

The National Environmental Policy Act was enacted in 1970 to guide federal agencies toward informed decisions when proposing major projects. The process outlined by the Act emphasizes public involvement early on and then periodically throughout the preparation of an Environmental Impact Statement.

Federal and state agencies, Indian tribes, and the general public are first consulted in a phase of the process called scoping.

For this Environmental Impact Statement, regional public scoping meetings are being held in Washington, DC; Chicago, IL; and Las Vegas, NV. The meetings are open to anyone interested in attending and comments will be taken for the record. These comments will be used to help better define the issues that will be addressed in the Environmental Impact Statement. You will also be able to obtain details about these



The process outlined by the National Environmental Policy Act emphasizes public involvement early on and then periodically throughout the preparation of an Environmental Impact Statement.

meetings in the *Federal Register*, a daily publication of announcements by federal agencies, and your local and regional newspapers.

If you are unable to attend these regional meetings, there are several other ways to provide your input. A **toll-free phone** line, an **information bulletin board** and a **computer e-mail** address have been set up to keep people up-to-date.

Comments and concerns collected during the scoping process will be addressed in an Implementation Plan written by the Department of Energy that describes what will be included in the Environmental Impact Statement. After a draft Environmental Impact Statement is prepared, another **public comment** period with public hearings is held. All comments received in this period will be addressed in the final Environmental Impact Statement along with the Department of Energy's responses. A record of decision may be issued after a 30-day minimum waiting period following publication of the final Environmental Impact Statement.

How To Get More Information

The Department of Energy has established various ways to make it easier for you to get information and make your comments known. Public scoping meetings and public hearings are announced in the *Federal Register* and area newspapers. An Information Hotline, (1-800-MPC-3304), is available for you to call with questions about the process or schedules, and to request additional information. A **structured comment card** can be filled out and mailed or faxed in (1-800-MPC-4531) with your comments, to the Department of Energy. Also a computer bulletin board (1-800-MPC-1855) and Internet address (MPCEIS @ smtplink.ead.anl.gov) have been set up to encourage additional information flow.

Remember, your comments are vital to this process that will guide the Department of Energy's decision on the multi-purpose canister-based system.

For more MPC EIS information, please call, write, fax, or e-mail:

U.S. Department of Energy
c/o Argonne National Laboratory
9700 Cass Avenue, Building 900
Argonne, IL 60439
Attention: MPC Comments

800-MPC-3304 (toll-free)
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DOE/RW-0358/Rev. 1

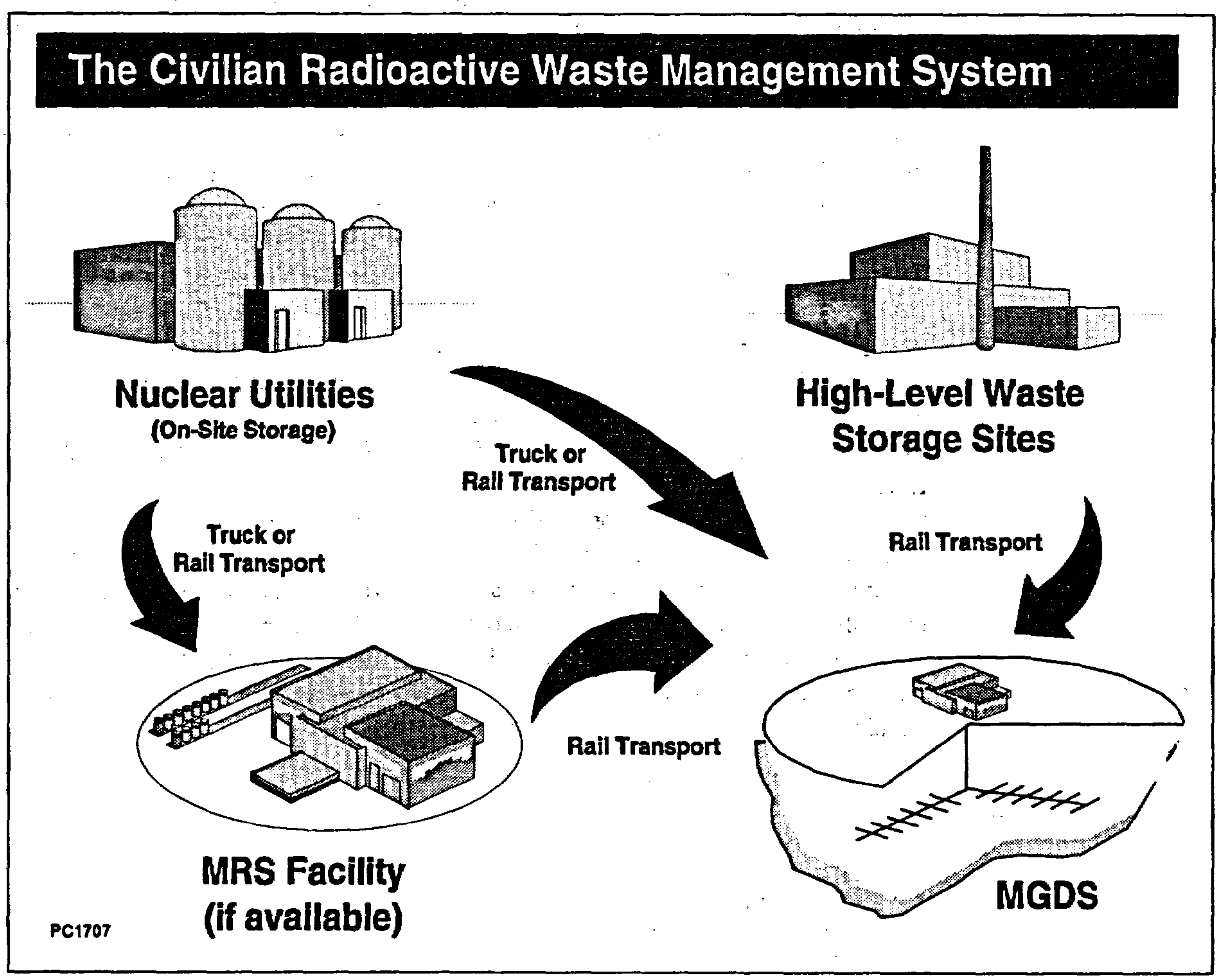
The Civilian Radioactive Waste Management System

The U.S. Congress has assigned responsibility for the nation's nuclear waste disposal system to the Department of Energy. The Nuclear Waste Policy Act (1982) and its amendments (1987) established the Office of Civilian Radioactive Waste Management within the Department of Energy to develop, construct, and operate a system for spent nuclear fuel and high-level radioactive waste disposal, including a permanent geologic repository, interim storage capability and transportation system.

Since the late 1950s, the American people have relied more and more on nuclear energy. Nuclear power plants now supply about one-fifth of the electricity we use to light and heat our homes, schools, factories, offices, and farms. The Office of Civilian Radioactive Waste Management is responsible for the planning, research, and management necessary to dispose of high-level waste and spent nuclear fuel produced by commercial nuclear power plants.

A Temporary Solution

Currently, as the nuclear fuel that generates electricity in reactors is used, or "spent," and is no longer efficient to fuel a reactor, it is removed and stored in specially designed



pools of water, or in some instances, placed into heavy, thick-walled metal or concrete structures for storage above-ground at reactor sites. Such storage has been proven safe, but is only intended to be a temporary solution.

The first element of the system the Department of Energy may manage is a temporary storage facility. This facility may be in the form of a monitored retrievable storage facility, a specially designed, above-ground structure that would receive spent nuclear fuel from utilities and store it until a repository opens. A related interim storage approach involves the use of a multi-purpose canister (MPC). An MPC would be loaded with spent nuclear fuel assemblies, and then sealed at each reactor site. Rather than handle individual spent nuclear fuel assemblies directly at other transfer points in the disposal system, the MPC could then be placed inside other containers specially designed for either transportation, interim storage or permanent disposal. An MPC-based system offers a uniform approach to handle and dispose of spent nuclear fuel.

Transportation

Another important element of the system is transportation. In order to safely and efficiently move radioactive waste around the country, the Department of Energy is developing special containers, or "casks," for highway and rail transport, and working with state, local, and tribal officials to ensure appropriate emergency response capabilities. The rugged, thick-walled casks are designed with protection of the public and the environment in mind, even in accident situations, and those designs must pass a series of rigorous safety tests in order to be certified for use by the Nuclear Regulatory Commission, the federal agency with responsibility for licensing nuclear facilities and approving transportation methods.

Repository

The final element of the system is known as a permanent geologic repository. The Nuclear Waste Policy Act, as amended, directed the Department of Energy to study Yucca Mountain, Nevada, to determine its suitability as a safe disposal site for spent nuclear fuel. Teams of scientists are studying the mountain from the surface as well as from tunnels within the rock to test such characteristics as the likelihood of volcanic or earthquake activity or movement of water through the mountain. The depth of the proposed repository would be about 300 meters (1,000 feet) below the surface of the mountain but still about 240 meters (800 feet) above the water table within a very hard layer of rock called volcanic tuff. If the site is found suitable, operation is scheduled to start in 2010. If it is found unsuitable, studies will be stopped, the site will be restored, and DOE will report to Congress within six months on a recommended course of action.

The Nuclear Waste Fund

The Nuclear Waste Policy Act established a specific funding mechanism for developing the waste disposal system, the Nuclear Waste Fund. Funds are collected from those who use electricity produced by nuclear reactors rather than the general taxpayer.

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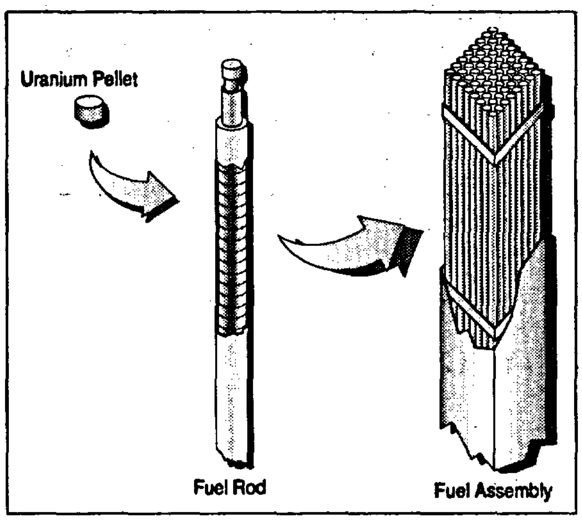
DOE/RW-0378/Rev. 1

Spent Nuclear Fuel

In December of 1957, history was made when Pennsylvania's Shippingport nuclear reactor became the first commercial power plant to generate electricity by harnessing the energy released by nuclear fission. More than 100 commercial nuclear power plants have since been built in the United States and about 20 percent of the nation's electricity comes from nuclear power. In some regions of the country over 50 percent of the electricity is produced from nuclear power.



Nuclear power allows utility companies to keep up with the ever increasing demands for electricity. Like other industrial plants, nuclear power stations produce waste. The primary waste byproduct from a nuclear reactor is used or "spent" nuclear fuel assemblies.

What Does Spent Nuclear Fuel Look Like?

Nuclear fuel consists of small, ceramic-like pellets of enriched uranium, slightly larger than pencil erasers. These small pellets produce a tremendous amount of energy when used in a nuclear power plant. For example, one pellet contains the energy equivalent to almost one ton of coal. The pellets are stacked end-to-end and sealed in strong metal tubes 3.5-4.5 meters (12-15 feet) long. Each small pellet is capable of producing tremendous amounts of energy. For example, one pellet contains the energy equivalent to almost one ton of coal. The tubes containing the uranium pellets are bundled together in groups of about 200 to form nuclear fuel assemblies. These fuel assemblies are placed inside a nuclear reactor where the nuclear fission process takes place. Fission is a controlled chain reaction, where atoms split, releasing energy and heat. The heat is used to generate steam and produce electricity until the fuel is spent, or no longer efficient in generating heat.

Approximately every 18 months, about a third of a reactor's fuel is removed and replaced with new, more efficient fuel. Radioactive materials remain inside the sealed tubes of spent nuclear fuel assemblies. Because the fuel assemblies emit radiation, they must be isolated from the environment for thousands of years while the radiation decreases to acceptable levels already found in nature. This process happens naturally over time.

Temporary Storage

After spent nuclear fuel assemblies are removed from a reactor, they are stored at the reactor site in specially treated water pools lined with concrete and steel. Water not only cools the spent nuclear fuel but acts as a natural barrier to shield workers from radiation. Although nuclear power plants in the United States store their spent nuclear fuel this way, it is not intended to be a permanent storage solution.

When additional storage space is needed, utilities have elected to use dry storage systems. This method of storage involves heavy concrete or steel containers, called dry casks, placed on a concrete pad or in a concrete bunker above-ground at the reactor site. Like pool storage, dry storage has been proven safe but is not intended to be a permanent solution for waste disposal.

As a part of the Department of Energy, the Office of Civilian Radioactive Waste

Management has been given the responsibility by Congress to plan, construct, and manage a national system for the disposal of spent nuclear fuel and high-level radioactive waste. Congress also provided special funding for the program through the Nuclear Waste Fund. Utilities and rate-payers who benefit from nuclear energy, rather than the general taxpayer, contribute to the fund through their utility bills.

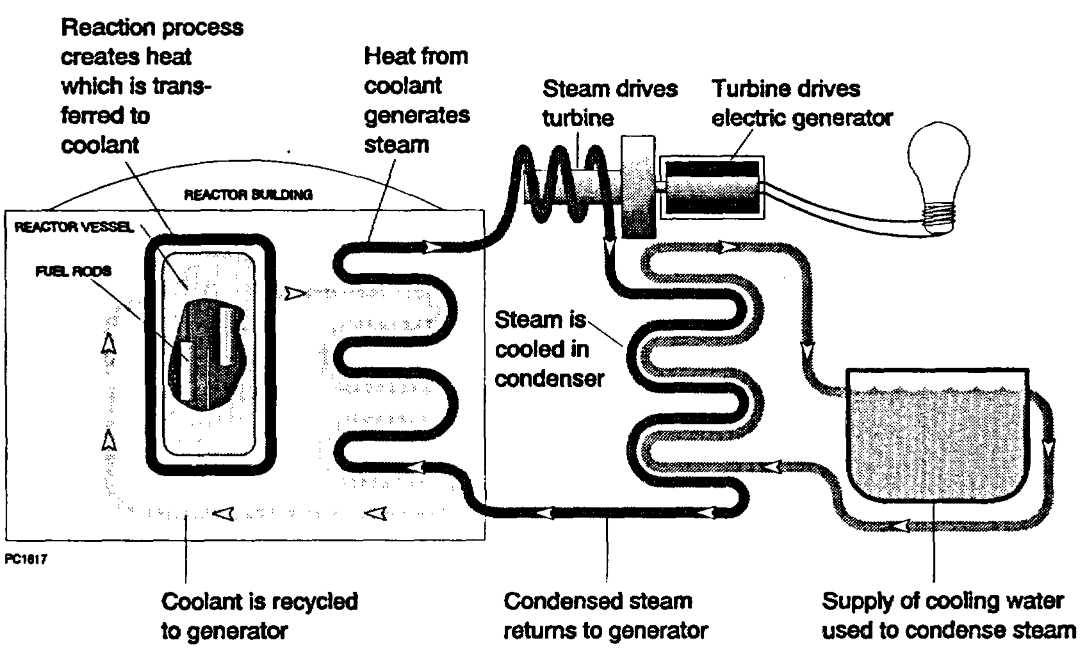
A Permanent Solution

Spent nuclear fuel and high-level radioactive waste will eventually be disposed of in an underground repository. The repository will be built deep beneath the earth's surface and will be designed to contain high-level radioactive material for up to 10,000 years. Certain "engineered barriers" will be incorporated into the design to complement natural barriers and further isolate radiation. Congress has directed the Department of Energy to examine Yucca Mountain, Nevada, and study the area's suitability for a repository. These studies are known as site characterization.

Volume Of Spent Nuclear Fuel

Through 1993, civilian nuclear reactors had produced more than 28,000 metric tons of spent nuclear fuel, about enough to cover one football field three yards deep. The nation's inventory of spent nuclear fuel will reach 40,000 metric tons by the year 2000. This is not a large amount in comparison with the millions of tons of hazardous waste produced each year in the United States. But because spent nuclear fuel is highly radioactive, it requires special measures of protection.

Schematic of Nuclear Power Generation Cycle



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DOE/RW-0355/Rev. 1

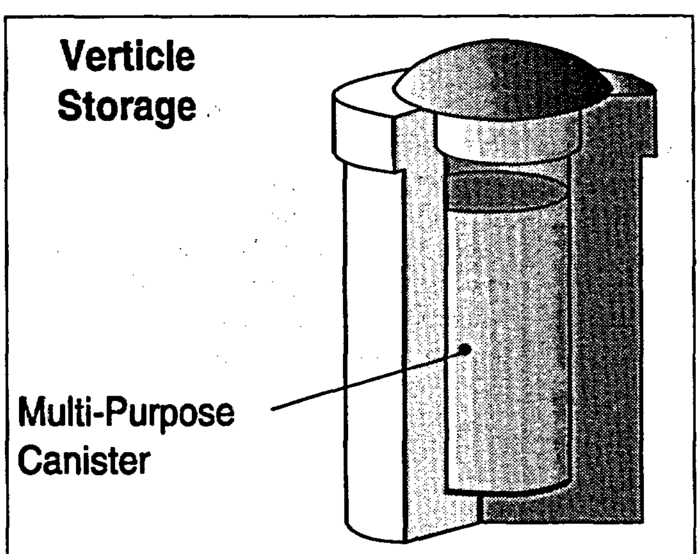
Storage of Spent Nuclear Fuel

In 1982, Congress enacted the Nuclear Waste Policy Act which outlined a comprehensive plan for the safe disposal of spent nuclear fuel and other forms of high-level radioactive waste. The Department of Energy, through its Office of Civilian Radioactive Waste Management, was given the responsibility for planning, constructing, and operating such a disposal system.

Nuclear power plants safely store radioactive materials using a variety of proven technologies. Such storage, particularly for high-level radioactive waste and spent nuclear fuel, must protect those who work and live nearby from radiation. Until a permanent geologic repository is in operation, spent nuclear fuel will continue to be stored in specially designed water filled pools and above-ground facilities.

What Is Being Stored?

To produce electricity, nuclear power plants use solid, ceramic-like pellets of enriched uranium, slightly larger than pencil erasers, stacked atop each other and sealed in strong metal tubes, called fuel rods. The rods are 3.5-4.5 meters (12-15 feet) long, and are bundled together in groups of about 200 to form nuclear fuel assemblies. These fuel assemblies, when placed inside a nuclear reactor where the fission process takes place, produce heat that is used to generate steam and make electricity.



After three or four years in an operating nuclear reactor, the energy remaining inside the pellets is no longer efficient enough to produce usable heat. Used, or "spent," nuclear fuel assemblies are removed from the reactor and replaced with fresh fuel. The spent nuclear fuel assemblies have become highly radioactive during the fission process and must be isolated from the environment for long periods of time. In fact, it takes thousands of years for the radiation to naturally decrease to the acceptable levels already found in nature.

Current Spent Nuclear Fuel Storage

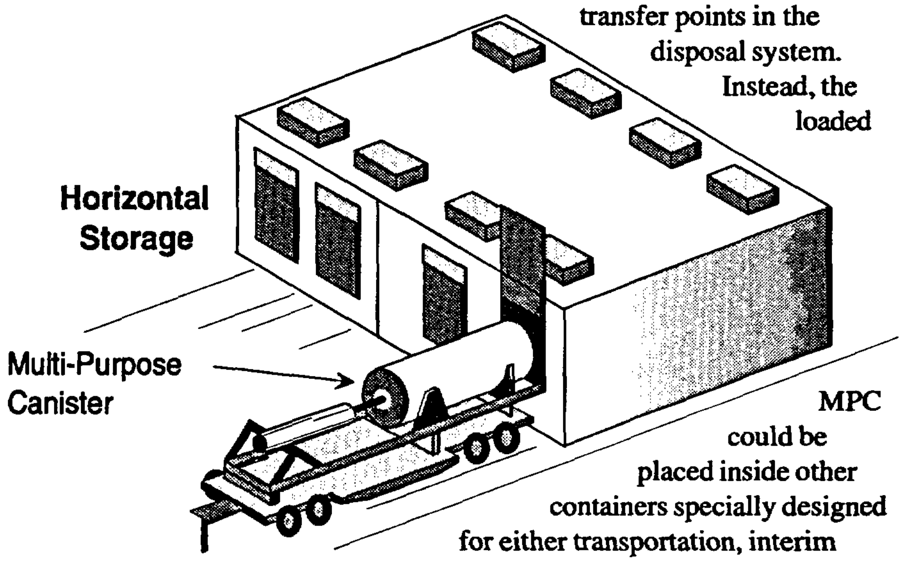
Each nuclear power plant has facilities on site to temporarily store spent nuclear fuel as it comes out of the reactor. Although the spent nuclear fuel is highly radioactive, there are relatively low volumes of it. Most fuel is placed in large pools of water that are lined with concrete and steel. Besides helping to cool the spent nuclear fuel, water provides a natural barrier to radiation.

Other methods of storing spent nuclear fuel at the reactor site do not involve water. Spent nuclear fuel assemblies can be stored in a "dry" environment using heavy containers or casks made of steel or concrete. Casks are either placed upright on concrete pads, or stored horizontally in concrete bunkers. Like pool storage, dry storage has been proven safe but is not intended to be a permanent solution for waste disposal.

Interim Storage Options/Plans For The Future

As a step toward final disposal, the Department of Energy is considering options for interim storage. A monitored retrievable storage facility could provide a collection point for some of the nation's spent nuclear fuel while a permanent repository is being built.

Another option that the Department of Energy is now exploring is a special container-based system using what is called a multi-purpose canister or an MPC. Spent nuclear fuel assemblies could be loaded into an MPC, which will provide shielding protection, and sealed at each reactor site. It would then not be necessary to handle spent nuclear fuel assemblies at other transfer points in the disposal system. Instead, the loaded MPC could be placed inside other containers specially designed for either transportation, interim storage or permanent disposal, and would be used at the reactor site, monitored retrievable storage facility or repository. The MPC concept builds upon storage technologies already in operation and demonstrated to be safe.



Permanent Solutions

The permanent solution in a disposal system is a repository. Many options have been studied to determine the best environment for isolating radiation over long periods of time. For instance, leaving the waste at the reactor site, burying it in the ocean floor, putting it in polar ice sheets, and rocketing it into outer space were all considered. Most scientific organizations, including the National Academy of Sciences and U.S. Geological Survey, have recommended geologic disposal.

After consideration of many sites across the United States, Congress directed the Department of Energy to concentrate site characterization studies on Yucca Mountain, Nevada. The process of site characterization is very detailed and will require many years of research, testing and evaluation. If at any time DOE or the teams of scientists discover the site to be unsuitable, they will stop characterization activity, restore the area, and report to Congress within six months on a recommended course of action.

Yucca Mountain is in an arid climate about 100 miles from Las Vegas. The proposed depth of the repository is 300 meters (1,000 feet) below the surface, but still about 240 meters (800 feet) above the water table in a very hard rock called volcanic tuff. Scientists are studying the mountain and its structure by examining the surface, core samples from drilling deep into the mountain, digging trenches, and studying sound waves as they move through the rock. Tunneling into Yucca Mountain will be conducted in order to construct an Exploratory Studies Facility, where scientists can get a better picture of the mountain from within.

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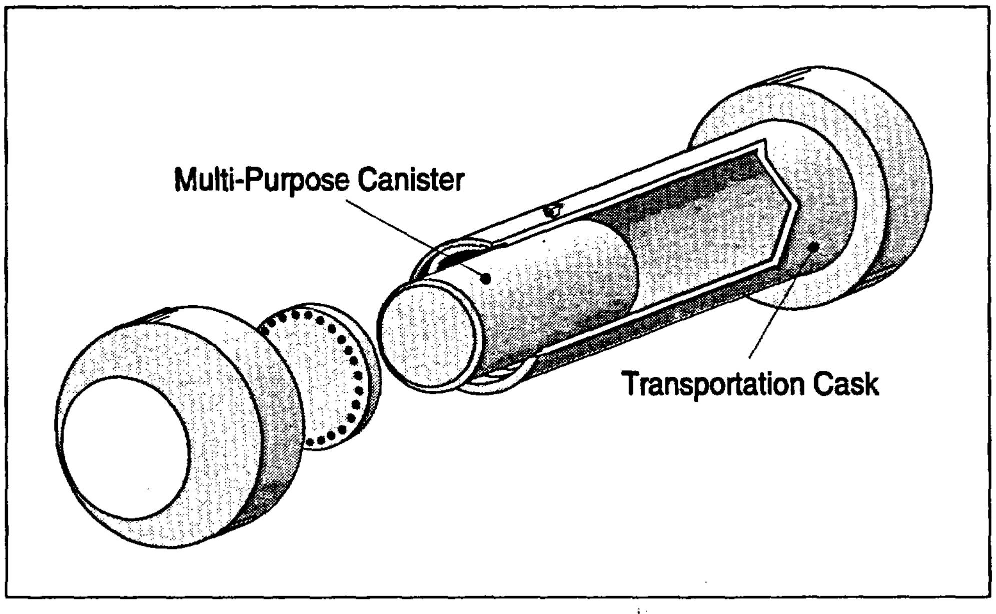
DOE/RW-0356/Rev. 1

Transportation of Spent Nuclear Fuel

A safe, dependable transportation system is a crucial link in both the operation of any proposed temporary storage facility and a permanent geologic repository for the disposal of spent nuclear fuel. The Nuclear Waste Policy Act, as amended, requires the Department of Energy (DOE) to accept, transport, and dispose of spent nuclear fuel.

Over the last 25 years, more than 2,500 shipments of spent nuclear fuel have been transported safely over America's highways, waterways, and railroads. During this time, an exemplary safety record has been established with no fatalities, injuries, or environmental damage caused by the radioactive nature of the cargo.

Several factors have contributed to this success story. The spent nuclear fuel is a solid, rock-hard material enclosed in metal tubes and shipped dry in rugged containers.



Without having to be reopened, a loaded multi-purpose canister can be placed in a transportation cask for shipping.

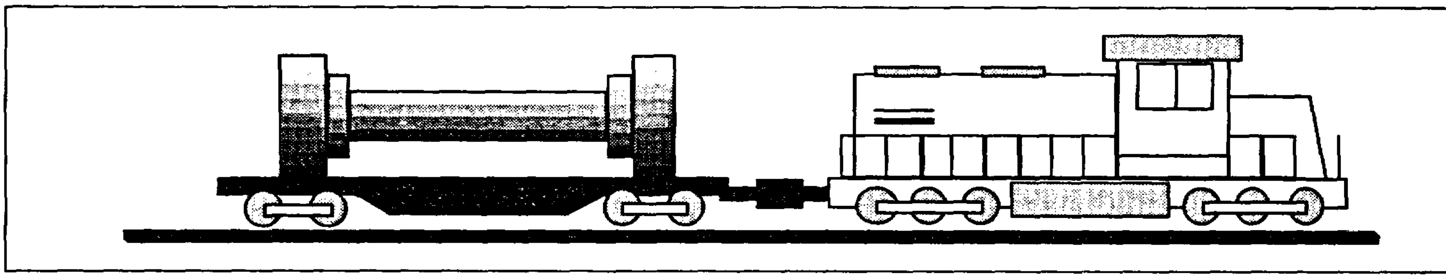
These containers are heavy, sealed, thick-walled, steel structures that safely confine the spent nuclear fuel. These specially engineered containers are designed to keep their radioactive cargo from being released into the environment.

Testing To Ensure Safety

Each shipping container is designed to maintain its integrity under routine transportation conditions and during severe accidents. The containers must ensure radiological safety even after being subjected to the Nuclear Regulatory Commission's (NRC) hypothetical accident conditions. These tests are administered in sequence and include:

- A 9 meter (30-foot) free fall on to an unyielding surface
- A puncture test allowing the container to free-fall 1 meter (40 inches) onto a steel rod 15 centimeters (6 inches) in diameter
- A 30-minute, all-engulfing fire at 802 degrees Celsius (1475 degrees Fahrenheit)
- An 8-hour immersion under .9 meter (3 feet) of water.

While the NRC is responsible for approving container design, the Department of Transportation (DOT) has established regulations for loading, unloading, and handling shipping containers, labeling containers and placarding transport vehicles for identification purposes; driver training and certification; and highway routing.



The MPC system will result in a decrease in the number of highway shipments of spent nuclear fuel.

What If An Accident Occurs?

Because there is a chance that an accident involving a radioactive shipment could occur, emergency response plans will be in place to handle any situation that could arise. The key to effective emergency response is quality training and preparation. Therefore, the DOE will provide assistance for training of State, Tribal, and local government officials in the development of emergency response and preparedness plans and emergency responders in handling accident situations.

All shipments will travel along DOT designated highway routes or rail routes. A state-of-the-art tracking device will link the truck or train with a communications center to be located centrally somewhere in the U.S. to allow instantaneous feedback between the shipment and communications personnel.

As the number of shipments increase, spent nuclear fuel will continue to be moved safely across our nation's highways and railroads. To maintain the program's exemplary safety record, DOE will continue to strive to improve container design and emergency response capabilities and strengthen the lines of communication among all parties involved.

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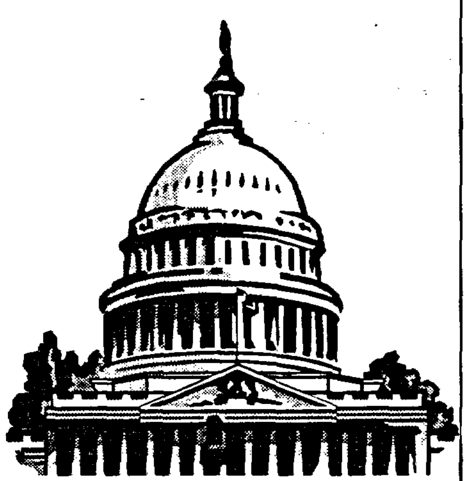
Nuclear Waste Policy Act and Amendments

In 1982, Congress enacted the first comprehensive legislation regarding spent nuclear fuel and high-level radioactive waste disposal. This federal law is called the Nuclear Waste Policy Act. Congress based this law on recommendations from groups such as the National Academy of Sciences, the U.S. Geological Survey, and several professional scientific organizations.

Spent nuclear fuel is the radioactive by-product of generating electricity at commercial nuclear power plants. Most high-level radioactive waste is the by-product of production at defense facilities. It is these categories of waste for which the Nuclear Waste Policy Act directs the Department of Energy to develop a waste disposal system.



Nuclear Waste Policy Act

Congress directed the Department of Energy to establish the Office of Civilian Radioactive Waste Management to develop, construct, and operate a system for spent nuclear fuel and high-level radioactive waste disposal, including a permanent geologic repository, interim storage capability and a transportation system.

Scientists have studied many options, including leaving the waste at the reactor sites, burying it in the ocean floor, putting it in polar ice sheets, and rocketing it into outer space. Based on a final Environmental Impact Statement prepared in 1980 that evaluated all of these options, deep underground geologic disposal was determined to be the safest solution.

The Nuclear Waste Policy Act established a specific funding mechanism for developing the waste disposal system, the Nuclear Waste Fund. Funds are collected from those who use electricity produced by nuclear reactors rather than the general taxpayer.

Site Selection Process

In the search for a site for the permanent repository, nine sites were originally studied in six different states. Then President Ronald Reagan approved three sites for more detailed study, called site characterization. These locations were: Hanford, Washington; Deaf Smith County, Texas; and Yucca Mountain, Nevada.

1987 Amendments

In December 1987, Congress amended the Nuclear Waste Policy Act and directed the Department of Energy to study only one site, Yucca Mountain, Nevada, to determine whether it was a suitable site for a repository. The Amendments Act stressed that if at any time Yucca Mountain was found unsuitable, studies would be stopped immediately, the site restored, and the Department would report to Congress within six months on a recommended course of action.

The Amendments Act also authorized the Secretary of Energy to site a Monitored Retrievable Storage facility. This facility differs from the repository in that it is an above-ground facility that would store a limited amount of spent nuclear fuel for a limited time prior to sending it to a permanent repository. It would also provide flexibility in the system while a repository is being built.

To facilitate siting an interim storage facility, Congress established the Office of the Nuclear Waste Negotiator within the Executive branch and independent from the Department of Energy. The Negotiator is responsible for developing an agreement to host such a facility between any willing hosts and the federal government. The agreement may include reasonable incentives and financial arrangements, as well as various types of public programs, projects, and problem-solving assistance.

The amendments of the Nuclear Waste Policy Act also included some additional requirements. It requires spent nuclear fuel and high-level waste to be transported in containers certified by the Nuclear Regulatory Commission, the same organization that must license permanent and interim storage facilities. The amendments also require that the Department of Energy abide by the regulations of the Nuclear Regulatory Commission regarding advance notification to States, local governments and tribal officials prior to transportation. Also, the Department of Energy will provide technical assistance and funding for safety and emergency response training of State, local and tribal officials in affected areas. This funding is in the planning stages in preparation for future transportation.

Independent Evaluation

The Nuclear Waste Policy Act, as amended, created the Nuclear Waste Technical Review Board, an independent establishment within the executive branch of the government, to evaluate the technical and scientific validity of the Department of Energy's activities. Members are nominated by the National Academy of Sciences and appointed by the President to serve terms of four years. The Board reports to Congress at least twice each year and presents conclusions from investigations on the current program activities as well as recommendations.

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Radiation

Radiation is a natural part of our every day lives. Cosmic rays filtering through the atmosphere are an example of natural radiation, as is radon gas. In fact, radiation in some forms is necessary to life on earth.

More than four-fifths of the radiation we receive comes from natural sources like sunlight, soil and certain types of rocks. This is called background radiation because it is present everywhere all the time.

In addition, people are exposed to radiation from manufactured sources. There is no difference between background radiation and manufactured radiation. Common household items like color televisions and smoke detectors are sources of what is called man-made radiation as are x-rays. These man-made sources account for less than one-fifth of our radiation exposure.

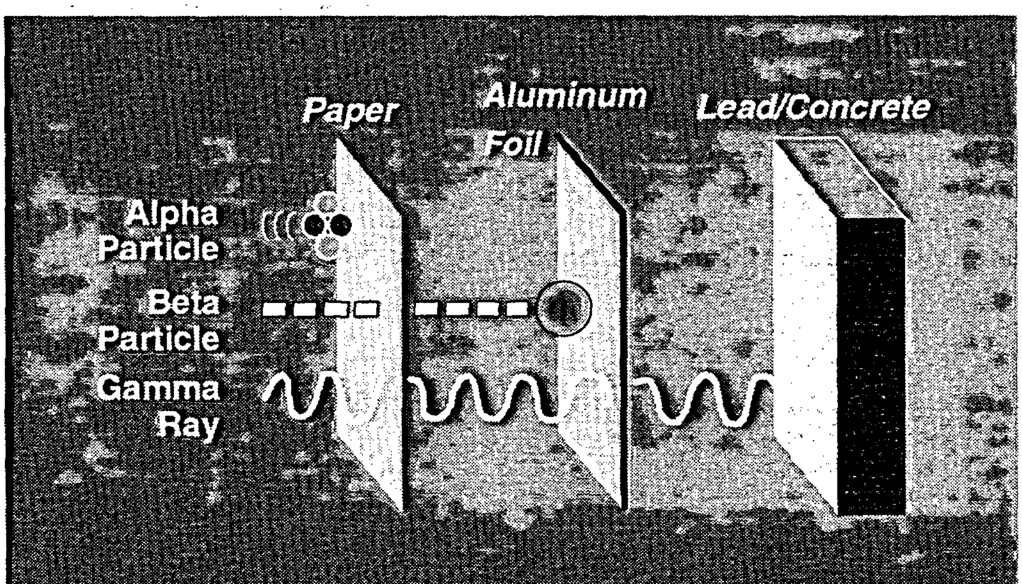
Radiation Basics

The study of radiation begins with the atom. Tremendous amounts of energy are stored in an atom's center, or nucleus. Scientists have studied how to split an atom in order to capture the energy stored there. When atoms are split, two things are produced: one is heat, the other is radiation. The heat produced in this type of reaction can be used to turn water into steam and produce electricity. This is the basis for nuclear power production.

The radiation produced from splitting an atom's nucleus is emitted in three forms: alpha and beta particles, and gamma rays. Alpha particles are the slowest moving of the three types of radiation. They can travel only a few inches in the air, and can easily be shielded by a sheet of paper or the outer layer of a person's skin. Alpha particles are only harmful if swallowed or inhaled.

Beta particles are more energetic than alpha particles. They can travel in the air for a few feet. Although they can pass through a sheet of paper, they can be stopped with a sheet of aluminum foil, or glass. Like alpha particles, they may cause the most serious effects if swallowed or inhaled.

Gamma rays, unlike alpha or beta particles, are pure energy and are essentially high-energy x-rays. This type of radiation can be very penetrating and requires shielding from such materials as concrete, lead, steel or water to stop them. Water, as a natural barrier to radiation, is used often to isolate radioactive spent nuclear fuel assemblies at nuclear power stations.



A person's exposure to radiation is measured in units called millirems. Millirems measure the effects of radiation on the human body just as degrees measure temperature. An average

American's exposure to radiation is about 360 millirems per year. Roughly 300 millirems come from natural sources of radiation; 60 millirems come from man-made sources, primarily medical procedures. Less than one millirem per year comes from the use of nuclear power.

Other Factors

Geography can play a part in how much radiation a person receives. Background radiation varies from state to state. A person living in Louisiana would receive 92 millirems per year. The same person in Colorado would receive 179 millirems per year. Colorado's dose is higher due to that state's higher altitude and soil content. The atmosphere is thinner at higher altitudes and allows more radiation exposure from space to penetrate. In Kerala, India, with the highest known level of background radiation for an inhabited area, a person receives 1,300 millirems per year, more than three and one-half times as much as a person living in the U.S.

It is not uncommon for people to receive far more than the average of 360 millirem per year due to a variety of other factors. Airplane travel, dental and medical x-rays, and occupation may affect average radiation levels.

Setting Limits

Standards for public protection from the effects of radiation have been in existence for more than 40 years. Exposure standards are set by the U.S. National Council on Radiation Protection and Measurement, the International Commission on Radiation Protection, and the International Atomic Energy Agency.

Federal law requires that nuclear facilities be licensed by the Nuclear Regulatory Commission. Maximum exposure for the general public from the operation of a nuclear facility is set at 25 millirems per year. Exposures far below this limit are achieved by employing conservative design features and adhering to strict operating procedures for all fuel handling operations.

Some Examples

- ❑ A person flying in an airplane across the country would add about 5 millirems per flight because of the increased elevation during the trip. Airline pilots and flight attendants are exposed to higher levels of radiation routinely due to their occupations.
- ❑ A person receiving a full set of dental x-rays would add about 40 millirems per year.
- ❑ A person living directly outside a nuclear power facility would add approximately 1 millirem per year.
- ❑ A person working in a nuclear power plant would add approximately 300 millirems per year.
- ❑ A person sitting on a park bench as a truck carrying nuclear waste passes by would add less than one-tenth of a millirem.

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Safety: The Key to Success

Disposing of the spent nuclear fuel from the nation's commercial nuclear reactors is a highly technical activity as well as a challenging environmental issue. While nuclear power provides a valuable, alternative source of energy and allows utility companies to keep up with ever increasing energy demands, its by-product, used or "spent" nuclear fuel, must be disposed of safely.

The Office of Civilian Radioactive Waste Management within the Department of Energy has the responsibility for planning, constructing, and managing a national system to dispose of spent nuclear fuel. The system has four elements: waste acceptance, storage, transportation, and disposal. A principal component stressed at every level of the program is the importance of containing radioactive material until the radioactivity decreases.

Temporary Storage

Utility companies have been storing spent nuclear fuel safely since the 1950s when nuclear energy was first used. After spent nuclear fuel is removed from a reactor, it is stored at reactor sites most often in specially treated water pools lined with concrete and steel. Water not only cools the spent nuclear fuel but acts as a natural barrier to shield workers from radiation. Although this storage method has been proven safe, it is not intended to be a permanent storage solution.

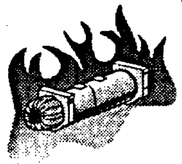
In some cases, utilities have decided to use dry storage systems. Fuel assemblies are loaded into heavy stainless steel or concrete casks and are stored either upright on a concrete pad or horizontally in concrete bunkers. Like pool storage, dry storage has been proven safe but is not intended to be a permanent solution for waste disposal.

Permanent Disposal

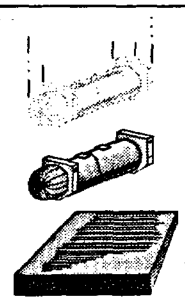
Many possibilities for permanent disposal have been studied in depth. Options included leaving the waste at the reactor site, burying it in the ocean floor, putting it in polar ice sheets, and rocketing it into outer space. Based on a final Environmental Impact Statement prepared in 1980, and recommendations from groups such as the National Academy of Sciences, the U.S. Geological Survey, and several professional scientific organizations, deep underground disposal was chosen as the best option.

In 1982, Congress enacted legislation regarding high-level radioactive waste disposal, called the Nuclear Waste Policy Act. The Act established within the Department of Energy the Office of Civilian Radioactive Waste Management to develop, construct, and operate a system for spent nuclear fuel and high-level radioactive waste disposal.

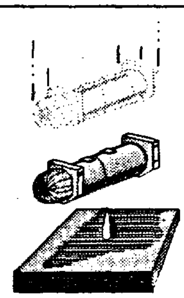
Safety Cask Testing



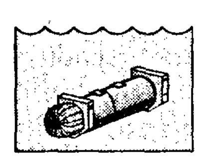
Exposure of the entire package to a temperature of 802° C (1475° F) for 30 minutes.



A 9 meter (30-foot) fall onto a flat, unyielding surface.



A 1 meter (40-inch) drop onto a 15 centimeter (6-inch) diameter steel pin at least 20 centimeters (8 inches) long.



Immersion of the package under .9 meter (3 feet) of water for at least 8 hours.

The system will include elements for waste acceptance, storage, transportation, and a permanent geologic repository.

Mined Geologic Disposal System

The repository, or a mined geologic disposal system, will be a system of tunnels built deep beneath the surface, and surface facilities. Many natural barriers will enhance the safety of an underground facility. The characteristics of the rock layers in which spent nuclear fuel could be placed are studied very carefully by teams of geologists. Other teams of scientists study important factors such as the likelihood of volcanic or earthquake activity or the way water moves within the rock.

In an amendment to the Nuclear Waste Policy Act in 1987, Congress directed the Department of Energy to concentrate site characterization studies on one site, Yucca Mountain, Nevada, located about 161 kilometers (100 miles) northwest of Las Vegas. Detailed geologic and hydrologic site characterization studies will continue for many more years. A system of tunnels and underground laboratories is planned to allow scientists access to the level of the proposed repository about 300 meters (1,000 feet) below the surface. This level is still about 240 meters (800 feet) above the region's water table.

The Nuclear Waste Policy Act, as amended, stressed that if at any time Yucca Mountain is found unsuitable, studies will be stopped immediately, the site will be restored, and DOE will report to Congress within six months on a recommended course of action.

In addition to the many natural barriers a repository site will provide, several man-made barriers will enhance protection of the environment from radiation. Within the repository, fuel assemblies are inside sealed canisters surrounded with additional layers of steel, concrete, or other metals. Highly trained engineers and scientists will monitor the repository's condition and radiation levels from a network of surface facilities.

Transporting Spent Nuclear Fuel: Decades Of Success

Spent nuclear fuel and other radioactive materials are moved around the country almost every day. Shipments go to and from research institutions, nuclear power plants, government research facilities and storage facilities. The safety record for spent nuclear fuel transport is excellent. In over three decades, there has not been a single death or injury due to the release of the radioactive contents of the specially designed casks during transportation.

The specialized casks used to ship nuclear waste are the primary transportation safety feature. Each is carefully designed and built to withstand rigorous conditions before it is certified by the Nuclear Regulatory Commission. A cask design must be able to withstand a 9 meter (30-foot) drop onto an unyielding surface, a drop onto a 15 centimeter (6-inch) pin, immersion in water for eight hours, and being engulfed in flame for 30 minutes. NRC certification is to ensure that cask designs will withstand credible transportation accidents.

To compliment the technical safety characteristics built into casks, the Department of Energy was directed by the Nuclear Waste Policy Act, as amended, to provide funds for training for affected State, local, and Tribal officials. Training will cover both safe, routine transportation practices and emergency response procedures.

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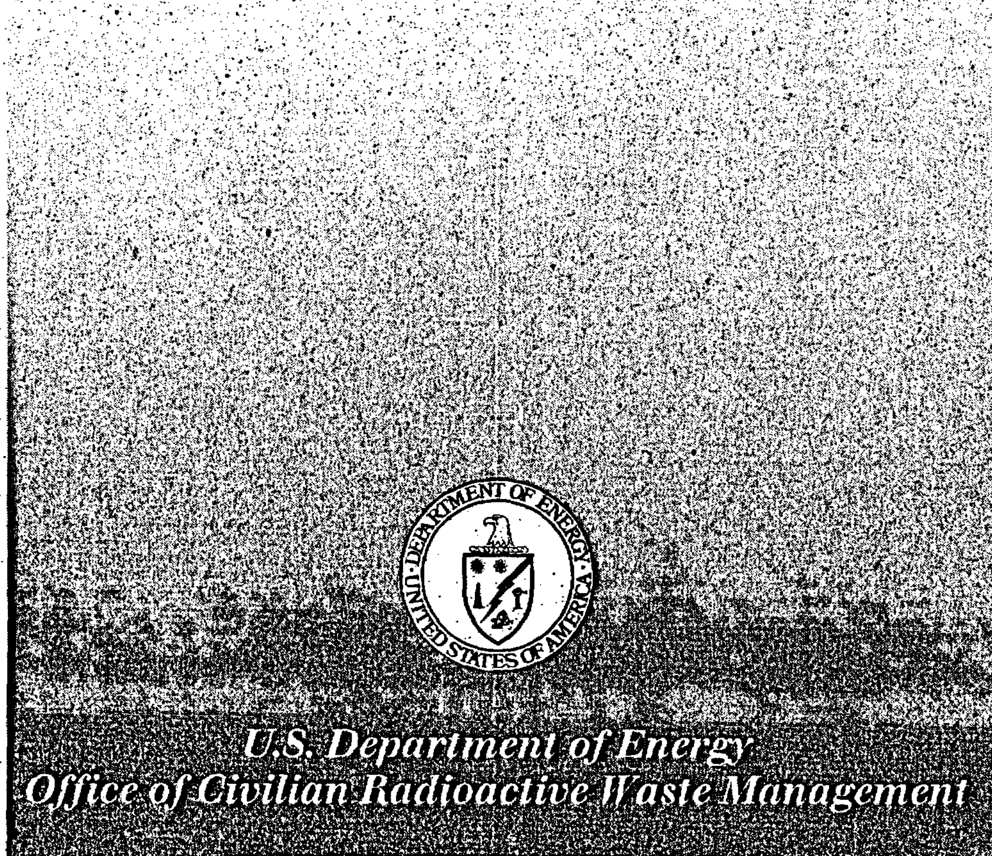
Multi-Purpose Canister System

Environmental Impact Statement Information



For more information about the Multi-Purpose Canister
Environmental Impact Statement,
please call, write, fax or e-mail:

U.S. Department of Energy
Attn: MPC Comments
c/o Argonne National Laboratory
9700 S. Cass Avenue, Building 900
Argonne, IL 60439

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PacTec's primary focus is providing the USDOE and the nuclear industry with:

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- **Independent Reviews and Assessments** of packaging certification applications and SARPs;
- **Shielded In-plant Handling Equipment** for transfer and/or processing of radioactive materials.

PacTec's personnel are responsible for the successful completion of the following projects:

- **125-B Damaged Fuel Cask** (C of C No. 9200)
- **TRUPACT-II** (C of C No. 9218)
- **T-3 Irradiated Fuel Cask** (C of C No. 9132)

Current and recent projects include:

- **Multi-Purpose Canister (MPC)** system design for TESS, USDOE's M&O contractor of the CRWMS. PacTec is the design leader for the MPC development team, which consists of Westinghouse, PacTec, and Chem Nuclear. The MPC system will provide storage and transportation capability for all commercial spent nuclear fuel.
- **Radioactive Waste Removal System (RWRS)** design and fabrication for the NRF Expended Core Facility operation in Idaho Falls. The RWRS consists of a 60-ton, shielded, bottom loading transfer cask providing containment for 6-ton containers of radioactive waste.
- **Radioisotope Thermoelectric Generator (RTG)** Transportation System development for USDOE under an on-going contract with Westinghouse Hanford.
- **BUSS (Beneficial Uses Shipping System) Cask Normal Form SARP** prepared under contract with Westinghouse Hanford to re-license the package as a containment package.
- Impact limiter development for the **NUHOMS® MP-187 Cask** for VECTRA Technologies, Inc.

Design and Certification

PacTec, through the experience of its team members, possesses one of the most extensive package design, certification and fabrication capabilities ever assembled in North America. PacTec brings together a veteran team of successful packaging experts with over two decades of experience. This team is responsible for securing more than 30 separate USNRC Certificates of Compliance. Every nuclear utility is currently using packages designed and licensed by this team.

Analyses and Testing

PacTec has a broad range of analytical skills with selected engineering disciplines such as: structures, dynamics, engineering mechanics, heat transfer, shielding and criticality. The team also has extensive experience with both full and sub-scale package testing programs. PacTec's success is its ability to integrate these skills and experiences in a way that yields a realistic and cost effective solution while, at the same time, addressing regulatory perceptions and concerns. This unique ability is a result of literally decades of interactions with regulatory officials and places PacTec far above the competition in obtaining regulatory approval of SARP applications.

Fabrication

PacTec provides hardware fabrication capabilities by utilizing approved, pre-qualified subcontractors. These subcontractors are experienced in the fabrication of licensed transportation packages and in-plant handling equipment for the nuclear industry. PacTec engineers have proven experience in managing and completing fabrication activities within budgetary and schedular constraints.

Quality Assurance

PacTec maintains a Quality Assurance Program which meets or exceeds the requirements of 10 CFR 71, Subpart H, and is approved by the USNRC, Approval Certificate Number 0678.

For more information contact:

Mr. Richard T. Haelsig or Mr. Robert A. Johnson
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