

Commonly Raised Topics

Introduction

In carrying out his responsibilities related to Yucca Mountain, the Secretary of Energy has invited public, governmental, and tribal participation at all levels. Throughout the more than 20-year history of the project, the Department of Energy (DOE) has conducted public tours of Yucca Mountain, as well as individual tours for domestic and international organizations and governmental bodies. The DOE has also made numerous documents pertaining to Yucca Mountain available to the public. As part of his responsibilities under the Nuclear Waste Policy Act, the Secretary conducted official public scoping meetings before starting the Environmental Impact Statement. Later, the Secretary held a total of 24 public hearings on the draft and the draft supplemental Environmental Impact Statements.

With the release of the *Yucca Mountain Science and Engineering Report*, in May of 2001, the DOE opened a public comment period regarding the Secretary's consideration of a possible recommendation of the Yucca Mountain site for development as the nation's first geologic repository for spent nuclear fuel and high-level radioactive waste. The comment period continued through the release of the *Preliminary Site Suitability Evaluation* in July of 2001 and closed on October 19, 2001.

After publishing DOE's final rule, *Yucca Mountain Site Suitability Guidelines*, on November 14, 2001, the Secretary announced a 30-day supplemental comment period with a closing date of December 14, 2001. During these combined public comment periods, the DOE held 66 additional public hearings to receive comments on the Secretary's consideration of a possible recommendation of the Yucca Mountain site.

Over the years, DOE's personnel have answered thousands of questions during site tours and at public hearings; certain topics seem to be more prevalent. The purpose of this document is to provide discussion material on commonly raised topics about a repository at Yucca Mountain. The discussion materials in this pamphlet include:

1. What is radiation? How do we control our exposure? What is spent nuclear fuel and high-level radioactive waste?
2. Is Yucca Mountain the only site that DOE is studying for a repository?
3. What makes Yucca Mountain a good place to store waste?
4. Would a repository at Yucca Mountain protect public health and safety?
5. Can radioactive waste from the repository contaminate the groundwater in Las Vegas?

6. Would a repository at Yucca Mountain withstand earthquakes?
7. Would volcanoes affect repository safety?
8. Is the repository protected from sabotage?
9. Can waste be transported safely to a repository?
10. How do we protect shipments of spent nuclear fuel and high-level radioactive waste from sabotage?
11. Is my property insured against damage resulting from transporting high-level radioactive waste?
12. What direction, review, and oversight have been provided for the project?
13. How does the DOE manage uncertainties inherent in modeling a repository's processes over thousands of years?
14. Does the DOE plan to monitor the repository after its closure?
15. Will taxpayers subsidize large utilities for the disposal of high-level radioactive waste?
16. What is the waste storage capacity of Yucca Mountain?
17. What alternative technologies might eliminate the need for a repository?
18. What are some of the public policy issues associated with a repository the Secretary is considering?
19. Why have DOE's siting regulations changed?
20. What are the responsibilities of the Department in the repository development process?
21. What are the next steps of the repository development process following a recommendation by the Secretary?
22. Where are the wastes that would be placed in a repository?

What is radiation? How do we control our exposure? What is spent nuclear fuel?

Radiation is energy, similar to light. There are three types of nuclear materials that would be disposed of at Yucca Mountain: 1) solidified high-level waste containing byproducts from past processing of spent fuel for defense needs, 2) surplus plutonium from dismantled nuclear weapons, and 3) spent nuclear fuel from defense and civilian reactors.

Put quite simply, radiation is energy - radiant energy. While radiation is energy, radioactivity is the *spontaneous* emission of a particular kind of energy, called ionizing radiation.

The atoms of most elements in our universe are stable. They don't lose energy on their own, and their atomic structure never changes. But certain elements are naturally radioactive; the atoms of such elements are called radionuclides. When radionuclides lose excess energy and decay to a more stable atom with less energy, the energy released in the process is radiation.

The three major, commonly recognized types of ionizing radiation are alpha, beta, and gamma radiation. Alpha and beta radiation are emitted in the form of tiny, electrically charged particles. Gamma radiation is electromagnetic rays, similar to light and X-rays. An alpha particle is identical to the nucleus of a helium atom (i.e., two neutrons and two protons) and is positively charged. Beta particles are usually electrons (and thus negatively charged), but they can be positrons (positively charged particles of the size and weight of an electron).

Everyone is exposed to natural and man-made (background) sources of radiation (e.g., cosmic rays, smoking, radon, building materials, food, and medical procedures). The average American receives an annual background dose of about 360 millirem from these sources. (A millirem is a standard measurement of radiation dose absorbed by the human body.)

How do we control our exposure?

We can manage our exposure to radiation by controlling time, distance, and shielding. The less time we spend near materials emitting radiation, and the farther away we stay, the lower our exposure; thus, the lower the dose our bodies receive. Alpha particles are comparatively large and can travel only a short distance in air before being stopped or are blocked by something as thin as a sheet of paper. Beta particles are smaller than alpha particles and travel a longer distance in air before being stopped, but, again, they can be blocked by something as ordinary as a sheet of aluminum foil.

Like X-rays, gamma radiation is very penetrating and travels a great distance in air before being stopped, but even gamma rays can be blocked by sufficiently thick pieces of steel, concrete, or lead.

What is spent nuclear fuel, surplus plutonium and high-level radioactive waste?

Nuclear fuel is made of solid ceramic pellets containing enriched uranium (i.e., having a greater percentage of uranium-235 than found naturally). The pellets are sealed in corrosion-resistant metal tubes called cladding. These tubes are then bundled together to form a fuel assembly. The uranium pellets are used in nuclear reactors to produce heat, which makes steam for turning turbines that generate electricity. After the fuel is no longer efficient at generating heat, it is considered spent.

Uranium is an alpha-emitter and the metal cladding surrounding the pellets is sufficient to stop the alpha particles. But once the fuel undergoes fission in the reactor, the uranium nuclei are broken apart into fragments. Some of these fragments produce gamma radiation, which can penetrate the cladding. Transportation casks contain several inches of steel and lead to protect workers and the public from unsafe levels of gamma radiation.

Surplus plutonium is plutonium from dismantled nuclear weapons considered surplus because of arms-reduction treaties.

High-level radioactive waste that would be disposed of in a repository at Yucca Mountain is: 1) solidified high-level waste containing byproducts from past processing of spent fuel to extract plutonium for nuclear weapons for defense needs, and 2) other highly radioactive material that the Nuclear Regulatory Commission, consistent with existing law, determines by rule requires permanent isolation.

Radioactive materials are routinely managed and handled for medical, industrial, and defense purposes. Safe techniques and procedures for handling these materials are well understood and well established.

Is Yucca Mountain the only site that DOE is studying for a repository?

Yes. In 1987 Congress amended the Nuclear Waste Policy Act and directed the DOE to study only Yucca Mountain.

After extensive study of Yucca Mountain and other sites, Congress directed the DOE in 1987 to concentrate only on Yucca Mountain. In the 1960s and 1970s, the U.S. Atomic Energy Commission, in cooperation with the U.S. Geological Survey, conducted national surveys to identify potential locations for the nation's first repository for high-level radioactive waste. The Secretary originally had identified nine possible sites, and he later narrowed the choices to five. Then, in accordance with the Nuclear Waste Policy Act, and with the President's approval, the DOE developed plans for studying three sites in different geologic media: a bedded salt site in Deaf Smith County, Texas; a basaltic site in Hanford, Washington; and a volcanic tuff site at Yucca Mountain, Nevada. Substantive preliminary studies were conducted at these sites. The next phase of site characterization would have required extensive surface drilling and underground excavation. The projected costs of thorough scientific study of three different sites, however, would have proved to be an expensive undertaking. In 1987 Congress amended the Act and directed the DOE to study only Yucca Mountain. The amendments also directed the Secretary to report to Congress if the site was found unacceptable for development of a geologic repository.

At the time of the 1987 congressional decision, scientists had already collected much information about Yucca Mountain from field and laboratory studies and it ranked highest in most comparisons among the sites under study. Yucca Mountain has many positive attributes that would contribute to safe geologic disposal, including the site's remoteness, arid climate, multiple natural barriers, deep depth to water table, and an isolated hydrologic basin.

The mountain sits on restricted federal land: part of the Nevada Test Site, combined with portions of the Nellis Air Force Range and parcels managed by the Bureau of Land Management. Since January 1951 over 900 U.S. nuclear weapon tests have been conducted at the Nevada Test Site. The U.S. Geological Survey and national laboratories have been studying the area's geology and hydrology since the start of atomic testing. All major nuclear power generation facilities in the United States are located near large metropolitan centers to reduce the amount of power that is lost during transmission. In fact there are few large metropolitan centers that do not have a major nuclear facility (commercial, medical, or defense) that is located within 75 miles. Yucca Mountain would be one of the few nuclear facilities located in a remote area where there are no metropolitan centers within 75 miles.

Yucca Mountain would not be the first repository for radioactive waste to be developed by the DOE. After more than 20 years of scientific study, the Waste Isolation Pilot Plant (WIPP) was licensed by the Environmental Protection Agency to receive defense generated transuranic waste, and began receiving waste on March 26, 1999. Transuranic refers to radionuclides with an atomic number greater than 92 (the atomic number for uranium). This repository is intended for waste that includes Plutonium-239 as a common constituent. The WIPP site is located in a stable salt dome outside of Carlsbad, New Mexico.

What makes Yucca Mountain a good place to store waste?

Water is the main means of transporting radionuclides out of a repository and into the accessible environment. Yucca Mountain is located in one of the most arid and remote deserts in the United States. Yucca Mountain also has many natural barriers that limit or delay what little water is available from entering the emplacement drifts. DOE has designed a set of engineered barriers that take advantage of the natural features and work in concert with the natural environment to isolate waste for tens of thousands of years.

The Yucca Mountain site is on federal land in one of the most arid locations in the United States. The site is remote, sparsely populated, and is in an isolated hydrologic basin. The natural and engineered barriers can work in concert to isolate radionuclides from the accessible environment for tens of thousands of years. Yucca Mountain has five key attributes that are important to long-term performance.

Limited Water Entering Emplacement Tunnels The climate at Yucca Mountain is arid, with precipitation averaging about 7.5 inches per year. Future climates during the regulatory compliance period are expected to be slightly cooler and produce a slightly higher mean annual precipitation. Little of this precipitation percolates into the mountain; nearly all of it (about 95 percent) either runs off, is picked up by the root systems of vegetation, or is lost to evaporation. This significantly limits the amount of water available to infiltrate the surface, move down through the thousand feet of unsaturated rock, and seep into emplacement tunnels.

Yucca Mountain consists of alternating layers of welded (volcanic ash that was laid down when it was very hot and welded itself into a solid mass of rock) and nonwelded (volcanic ash that was laid down when it was cool and become a cohesive mass when compressed by overlaying rock) volcanic tuff layers: welded tuff at the surface, welded tuff at the level of the repository, and an intervening layer of nonwelded tuffs. These nonwelded units contain few fractures; thus, they delay the downward flow of moisture into the welded tuff layer below, where the repository would be located. At the repository level, a significant portion of what little water is available in small fractures has a tendency to remain in the fractures rather than flow into larger openings, such as tunnels.

Long-Lived Waste Package and Drip Shield Chemical conditions that could cause corrosion are not expected to occur in the repository environment, and both the titanium drip shield and the Alloy 22 outer barrier of the waste package are expected to have long lifetimes. In the repository environment, Alloy 22 is very corrosion-resistant, with general corrosion penetrating only about 0.03 inches in 10,000 years. The Titanium

Grade 7 is also corrosion-resistant, with general corrosion penetrating only about 0.08 inches in 10,000 years. Only about 1 percent of the waste packages are projected to lose their integrity during the first 80,000 years.

Limited Release of Radionuclides from the Engineered Barriers Notwithstanding that the waste packages and drip shields are expected to be long lived in the repository environment, the repository model predicts the eventual loss of waste package integrity. If water were to penetrate a breached waste package, several characteristics of the waste forms and the repository would limit radionuclide releases. First, because of the warm temperatures of the waste, much of the water that penetrates the waste package will evaporate before it can dissolve or transport radionuclides. Neither spent nuclear fuel nor glass waste forms will dissolve rapidly in the water expected in the repository environment. In addition, the invert, part of the engineered barrier system under the waste package and support pallet, would contain crushed tuff that would also retard the transport of radionuclides into the unsaturated host rock.

Delay and Dilution of Radionuclide Concentrations by the Natural Barriers Eventually, the engineered barrier systems could lose their integrity, and small amounts of water could contact waste, dissolve it, and carry some radionuclides out of the repository and into the rock below. As water flows through fractures, dissolved radionuclides would diffuse into and out of the pores of the rock matrix, increasing both the time it takes for radionuclides to move from the repository and the likelihood that radionuclides will be exposed to sorbing minerals (minerals that attract and hold them).

Rock units in both the unsaturated zone and the saturated zone at Yucca Mountain contain minerals called zeolites that work like activated charcoal to adsorb many radionuclides.

Flow paths from beneath the repository are generally southerly toward the Amargosa Desert. Radionuclide migration through the unsaturated and saturated zone is affected in two ways. [First, radionuclides are exposed to minerals in the rocks that sorb many species of the radioactive waste, this delays the transport of radionuclides to the accessible environment. Second, dispersive processes that occur during transport through the saturated zone dilute and reduce radionuclide concentrations in groundwater.

Also, the groundwater systems in the Yucca Mountain region are internally contained. Specifically, the groundwater systems in the Las Vegas Valley, Pahrump, and the Amargosa Valley are not connected. Yucca Mountain is located in the Death Valley hydrologic basin. Water in this basin does not flow into any rivers or oceans and is isolated from the aquifer systems of Las Vegas and Pahrump (the largest community in Nye County).

Low Likelihood of Potentially Disruptive Events The DOE considered three specific disruptive processes and events (i.e., volcanism, seismic events, and nuclear criticality) that could impact the performance of a repository at Yucca Mountain. Seismicity is

treated as a nominal or expected event in the analyses, and criticality was found to be less likely than that which requires consideration in the regulations.

Of the three, volcanism resulted in a low but calculable dose when considering the low probability of a volcanic disruption. The likelihood of the repository being disrupted by igneous intrusion is extremely small (about 1 in 70 million per year). The calculated peak dose would be less than one percent of the Nuclear Regulatory Commission and Environmental Protection Agency radiation protection standards.

Would a repository at Yucca Mountain protect public health and safety?

Yes. The Environmental Protection Agency and the Nuclear Regulatory Commission have established conservative standards that protect the health and safety of individuals living in the vicinity of Yucca Mountain. The results of repository performance analyses indicate that a repository at Yucca Mountain would likely protect the health and safety of the public and workers.

The safety of future generations is one of the major reasons to dispose of spent nuclear fuel and high-level radioactive waste in deep geologic repositories. Protection of the health and safety of future generations is ensured by Environmental Protection Agency and Nuclear Regulatory Commission standards that apply after closure of the repository. The standards also preserve the quality of the environment by establishing concentration standards for the groundwater. The Nuclear Regulatory Commission would review any application for a license to construct a repository at Yucca Mountain. Before it will grant a license, the Nuclear Regulatory Commission will require assurance that the repository would be safe for future generations.

The DOE has conducted a safety evaluation for the period after the closure of the repository. The median projected results of this safety analysis show that the performance of a repository is likely to be much better than the safety standards. The median peak projected potential exposure to the public is less than 1 percent (less than 1/10 of a millirem) of the dose limit in the applicable radiation protection standards.

By way of comparison, the average American receives an annual background dose of about 360 millirem from both natural and man-made sources (cosmic radiation, radon, food, medical and dental procedures, etc.). If the very small potential exposure from the repository, or even the maximum permissible dose established in the EPA standard, were combined with the area's natural background dose, the level of radiation exposure in Amargosa Valley would result in an indistinguishable variation from other nearby communities.

As required by law, any repository would be monitored even after closure. This monitoring would provide additional assurances that the health and safety of future generations will be preserved.

Can radioactive waste from the repository contaminate the groundwater in Las Vegas?

No. The groundwater system that encompasses Yucca Mountain is not connected to the ground water system of the Las Vegas Valley. These hydrologic basins have been separated for millions of years.

The groundwater systems in the Las Vegas Valley, Pahrump, and the Amargosa Valley are not connected. Yucca Mountain is located in the Death Valley hydrologic basin. The boundaries of the Death Valley Hydrological Basin, in which the repository would be located, are defined and understood. Water in this basin does not flow into any rivers or oceans and is isolated from the aquifer systems of Las Vegas and Pahrump (the largest community in Nye County).

Isolated hydrologic basins are a relatively rare geologic feature. In the United States, they are found mostly in the southern portion of the Basin and Range Province. The groundwater systems in this province correlate well to the mountainous topography and have been stable for millions of years. The boundaries of the Death Valley Hydrologic Basin, in which the repository would be located, are defined and understood.

Analyses indicate that the geologic repository system would protect the public from harmful doses or exposure to radionuclides. Environmental Protection Agency and Nuclear Regulatory Commission regulations address the performance of a repository by setting performance limits that protect the environment and public.

Would a repository at Yucca Mountain withstand earthquakes?

Yes. Engineers will design facilities to withstand the most severe earthquake considered likely at Yucca Mountain.

Nuclear Regulatory Commission regulations require that all facilities it licenses be designed and constructed to withstand the effects of natural phenomena, including earthquakes, without representing a threat to public health and safety from their operations. Scientists and engineers expect future earthquakes to occur in the Yucca Mountain area. However, these earthquakes will not adversely affect safety.

Scientists' extensive knowledge of the faults allows them to estimate the frequency and size of future earthquakes, the potential intensity of ground movement, and the possible effects on the area's geologic features and man-made structures. With this information, engineers will design the facilities to withstand the most severe earthquake considered likely at Yucca Mountain.

The repository would be located about 1,000 feet underground in solid rock, which would keep its contents safe from any significant impacts of any earthquake. Because vibratory ground motion decreases with depth, earthquakes have much less impact underground than on or near the surface. Underground inspections at Yucca Mountain and the tunnels at the Nevada Test Site after earthquakes have revealed little disturbance.

The phenomenon is not unique to Yucca Mountain. Worldwide, inspections of subsurface structures after major earthquakes have reinforced this observation.

Extensive experience and proven techniques allow building the repository's surface structures so that they perform their safety functions both during and after an earthquake.

Would volcanoes affect repository safety?

No. The probability of a volcano disrupting the repository is extremely low (one chance in about 70 million per year).

Between about 15 and 12 million years ago, a series of large-scale volcanic eruptions that were located well to the north resulted in the formation of Yucca Mountain. These eruptions were the result of a crustal extension that continuously moved westward. Hundreds of thousands of years ago, small-volume volcanoes (known as cinder cones) erupted lava flows and cinders to the west and south of Yucca Mountain. Volcanic activity in the Yucca Mountain region has been waning since then, with the last small eruption nearly 100,000 years ago. Because the conditions necessary for renewed volcanic activity have been reduced so much at Yucca Mountain, experts consider the chance of a volcano disrupting a repository to be extremely small. In addition, magma typically comes to the surface through weak spots in the crust, such as faults. There are no major faults in the repository block, further decreasing the possibility of a volcano disrupting the repository. Nevertheless, the DOE has analyzed the possibility of renewed volcanic activity that might have an impact on how well a repository would contain and isolate the waste.

Scientists started with a careful analysis of the entire geologic setting of Yucca Mountain. Then, with abundant data on regional volcanoes, they used computer modeling to understand each volcanic center's controlling structures. From this basis, experts estimated the likelihood of magma intruding into one of the repository's emplacement tunnels. The DOE estimates the likelihood of such an event occurring during the first 10,000 years after repository closure to be one chance in about 70 million per year.

Using sophisticated computer simulations and considering the extremely small probability of a volcanic event, scientists project that if magma intruded into an emplacement tunnel, it could eventually result in a dose that is less than one percent of the Nuclear Regulatory Commission and Environmental Protection Agency radiation protection standards.

Is the repository protected from sabotage?

Yes. Disposal of nuclear waste in a geologic repository ensures an unmatched level of security against acts of terrorism or sabotage.

A repository at Yucca Mountain would safeguard radioactive materials from acts of terrorism or sabotage. It is highly unlikely that an attack at the surface of a repository could have a significant impact on the spent nuclear fuel and high-level radioactive waste contained in their extremely durable waste packages secured in tunnels some 1,000 feet underground in solid rock. In addition, the Yucca Mountain site is remotely located on federal land to which access is currently restricted owing to its proximity to the Nevada Test Site. The Nellis Air Force Range surrounds the Nevada Test Site on three sides and the site has a highly effective rapid-response security force, and the airspace above Yucca Mountain is restricted.

As a result of the terrorist assault on the United States on September 11, 2001, many agencies are reviewing the physical security of radioactive waste. The Nuclear Regulatory Commission requires that nuclear facilities and temporary storage systems be capable of withstanding severe impacts. For example, the containment buildings that surround reactors are designed to withstand many accidents. In addition, general access to reactor sites is restricted.

Can waste be transported safely to a repository?

Yes. The likelihood of an accident with a release of radioactive material is extremely small, so small in fact that the DOE does not expect any accident to result in a release.

Analyses indicate that the potential impacts from transportation to individuals living and working along the potential routes would be so small that they would be indiscernible to the general public.

The DOE will draw on comprehensive knowledge, experience, and technology in safely transporting radioactive materials. Spent nuclear fuel has been transported safely in the United States for over 35 years. In fact, since 1965, government and industry groups have transported more than 10,000 spent fuel assemblies in more than 2,700 shipments over more than 1.6 million miles. While there have been few accidents (four highway and three rail) involving the transport vehicles, none has resulted in the breach of a cask or the release of radioactive materials above prescribed regulatory limits.

The DOE would use extremely durable transportation casks that are certified by the Nuclear Regulatory Commission for all waste shipments to the repository. To be certified by the Nuclear Regulatory Commission casks must be designed to withstand severe accidents without release of their radioactive contents. To be certified by the Nuclear Regulatory Commission, a single transportation cask must be able to withstand all of the following tests, in the given sequence:

- A drop from 30 feet (9 meters) onto an unyielding surface (a surface so hard and resistant that it absorbs essentially none of the energy, causing the damaging energy to be absorbed by the cask itself at its weakest point. The forces that a cask experiences from this drop test is equivalent to hitting a bridge abutment at 120 m.p.h.), followed by
- A drop from 40 inches (1 meter) onto a shaft 6 inches (15 centimeters) in diameter, followed by
- A fully engulfing fire at 1475°F (800°C) for 30 minutes, and finally, followed by
- Immersion in 3 feet (0.9 meters) of water for 8 hours

A separate cask must also be able to withstand immersion in 650 feet (200 meters) of water for at least one hour.

At the request of the Nuclear Regulatory Commission, in 1987 Lawrence Livermore National Laboratory analyzed the real-world forces produced by the most severe rail and highway accidents ever to occur in the United States. The analysts then compared the magnitudes of the forces involved in these actual accidents with the forces defined by the Nuclear Regulatory Commission's transportation regulations. The study concluded that shipping casks meeting the Nuclear Regulatory Commission's minimum requirements would have safely contained nuclear materials had they been involved in these real-world situations. In addition to their extreme strength and durability, transportation casks are designed to protect people from harmful levels of radiation (in the form of electromagnetic rays, somewhat like microwaves) given off by the solid waste.

The Nuclear Regulatory Commission's regulations limit the radiation level from a loaded cask to a dose rate of 10 millirem/hour at a distance of 6.5 feet (2 meters) from the edge of the truck bed or railcar to which the cask is attached. A person would have to stand near the vehicle for one full hour to receive a dose equal to about one medical X-ray. Notably, increasing one's distance from the source of the radiation significantly reduces the dose. Analyses indicate that the potential impacts from transportation to individuals living and working along the potential routes would be so small it would be indiscernible from other members of the public. For example, if a person lived about 100 feet from a major transportation route, that person would receive less than 1 millirem per year. By comparison, the average American's annual background dose is about 360 millirem per year from both natural and man-made sources (food, radon, building materials, cosmic rays, medical and dental procedures, etc.).

How do we protect shipments of spent nuclear fuel and high-level radioactive waste from sabotage?

Physical security measures and the exceptional strength and durability of the transportation casks would protect shipments of radioactive waste from acts of terrorism or sabotage.

The same design features that make transportation casks capable of surviving severe accidents also limit their vulnerability to sabotage. In addition, the Nuclear Regulatory Commission surveys and must approve all routes, and each shipment must be escorted. The governor of each state would be notified in advance, and shipments would be monitored through a satellite-based tracking system. All shipments would also be coordinated with local and federal law enforcement agencies.

The Nuclear Regulatory Commission has a special set of rules in place to address the physical protection of spent nuclear fuel in transit. These rules are designed to minimize the possibility for sabotage, especially within heavily populated areas. These rules require the following:

- Notifying the Nuclear Regulatory Commission and governor prior to the transport within each state.
- Current procedures for the licensee to follow in safeguards emergencies
- Instructions for the escorts on how to determine if a threat exists and how to deal with it
- A communications center to constantly monitor the progress of each shipment
- Advance arrangements with law enforcement agencies along the route
- Advance route approval by the NRC
- At least one escort to maintain visual surveillance of the shipment during any stop
- Status reporting every 2 hours by the escort(s)
- The capability to immobilize the cab or cargo-carrying portion of the vehicle
- Armed escorts in heavily populated areas
- Protection of specific information about any shipment

Because of the recent disasters at the World Trade Center and the Pentagon, the Chairman of the Nuclear Regulatory Commission has directed the Commission's staff to thoroughly review their security regulations and procedures. If the regulations for safeguards and security measures that apply to spent nuclear fuel transport are revised, the DOE will comply with the revised regulations in effect at the time of any shipments.

Is my property insured against nuclear damage resulting from transporting high-level radioactive wastes?

Yes. The existing Price-Andersen Act would ensure prompt and full compensation.

The existing Price-Andersen Act ensures prompt and full compensation for all persons for any property damage or personal injury incurred from a nuclear incident or precautionary evacuation resulting from the transport of high-level radioactive waste as well as the operation of a repository.

What direction, review, and oversight have been provided for the project?

The DOE's work on Yucca Mountain has likely received more oversight than any project in history; is subject to external regulation by other federal agencies; and has been reviewed by national and international professional organizations.

The DOE's policies and practices emphasize safety and environmental considerations above other goals. In addition, the Secretary places great emphasis on openness and public involvement, consistent with applicable laws, regulations, and contracts. The Nuclear Waste Policy Act not only assigned responsibility to the DOE to study Yucca Mountain; it also put in place a check on the DOE's work. The DOE cannot proceed to develop a repository without getting a license from the Nuclear Regulatory Commission.

The DOE's work on Yucca Mountain has likely received more oversight than any project in history; is subject to external regulation by other federal agencies; and has been reviewed by international professional organizations. Site characterization information for Yucca Mountain was collected under quality assurance plans approved and accepted by the U.S. Nuclear Regulatory Commission. Four U.S. national laboratories and the U.S. Geological Survey collected most of the field data and interpreted the results. These laboratories commissioned independent reviews of their results, as did the DOE, often as formal independent peer reviews. Since the start of data collection for site characterization, the DOE has engaged in informal consultation with the Nuclear Regulatory Commission, as contemplated by the Nuclear Waste Policy Act. Also, the amendment to the Act in 1987 created the nuclear Waste Technical Review Board, which provides reviews of the Program's technical work.

The DOE is following the path recommended by nearly all the world's organizations of nuclear waste experts. Among these groups are the United Nations' International Atomic Energy Agency and the Nuclear Energy Agency of the International Organization for Economic Cooperation and Development. In 1990, the National Research Council of the National Academy of Sciences specifically noted that there is a worldwide consensus that deep geologic disposal, the approach being followed by the United States, is the best option for disposing of high-level radioactive waste.

How does the DOE manage uncertainties inherent in modeling a repository's processes over thousands of years?

Most uncertainties in the natural features and processes that were unidentified at the beginning of the project have been eliminated through extensive testing. When it is not possible, or not practical, to obtain the desirable data, scientists incorporate a range of likely values, or they use conservative assumptions and values that project results that are worse than those actually expected.

For over 20 years, some of America's top scientists and engineers have been studying Yucca Mountain to determine whether it is a suitable site for a geologic repository for high-level radioactive waste. The breadth and depth of these studies have been unparalleled in scope. As a result, Yucca Mountain's natural features and processes, and their potential interaction with radioactive waste, are probably better understood than those of any other site in the world.

The data from these studies are used in analyses that project the performance over time of the entire geologic disposal system. These performance analyses also help scientists determine any additional data that would increase the level of confidence in the projections. As much as possible, the desired data are then derived by performing additional tests. When it is not possible, or not practical, to obtain all of the desirable data, scientists incorporate a range of likely values, or they use conservative assumptions and values that project worse results than those that are actually expected. These methods of managing uncertainties increase the level of confidence in the projections, as do studies of comparable situations in nature (natural analogues).

Conservative assumptions and values can be seen in how the DOE assessed the performance of the two different cylinders of the waste package. In the current design, the outer wall of the waste package would be made of the highly corrosion-resistant Alloy 22. This material (along with about 13,000 other materials) was tested in a variety of solutions and temperatures to determine its corrosion rate. To address the possibility that heat from the waste might speed up the corrosion process, analysts assumed that waste-induced heat in the repository would cause the Alloy 22 to corrode 2.5 times faster than the normal actually observed rate. Likewise, to account for the possibility that microbes might speed up corrosion, they added another 2 times to the alloy's calculated corrosion rate. The corrosion rate might speed up some under repository conditions, but experts are confident that Alloy 22 will not corrode 4.5 times faster in the repository than in the laboratory. The assessments treat the stainless steel inner wall even more conservatively

by assuming its absence, or that it instantly and completely corrodes away once the Alloy 22 loses its integrity. In reality, 2-inch-thick stainless steel, standing alone, would likely resist corrosion for tens of thousands of years.

Another approach the DOE uses to increase confidence in its assessment of the repository's performance is to compare a repository's intended function with what has happened in the past in similar, i.e., analogous, situations in nature or man made conditions. For example, scientists have discovered many very old, highly preserved packrat middens (refuse heaps, used by packrats as their nest as well). Packrats compose their middens of twigs, debris, and their own droppings, all held together by their own dried urine. Such biologic remains quickly decompose if exposed to much water. Yet in underground burrows throughout the desert Southwest, scientists have found completely intact packrat middens that are up to 50,000 years old. Such is the power of an undisturbed arid environment to preserve.

To further enhance confidence, the DOE's plans for the repository incorporate a flexible design. In the flexible design, operating parameters can be varied to produce an emplacement environment with temperatures either above or below the boiling point of water. A repository operated below the boiling point of water may reduce uncertainties associated with complex heat-sensitive processes. The design also incorporates features so that the wastes will be fully retrievable, should new packaging or emplacement techniques warrant retrofitting.

Thorough performance confirmation testing and monitoring could last up to 300 years after the start of waste emplacement, followed by an indefinite period of monitoring. This testing and monitoring will ensure that the health and safety of the inhabitants in the vicinity of Yucca Mountain is protected.

Does the DOE plan to monitor the repository after its closure?

Yes. Federal law requires DOE to monitor the repository both before and after closure. Monitoring after closure of the repository will last for an indefinitely period of time.

The DOE has made a decision to keep the repository open for 100 years, without precluding the capability to keep it open for up to 300 years. Keeping the repository open means that the underground storage areas can be directly inspected and the waste packages readily retrieved, were that necessary. Thorough performance confirmation testing and monitoring will be performed during this operational period. In addition, the DOE must design and implement a postclosure monitoring program that complies with Nuclear Regulatory Commission regulations at 10 CFR Part 63. Before the DOE could close the repository, it would have to submit to the Nuclear Regulatory Commission an application to amend the license to permit the closure. The application would include, among other things, a description of the postclosure monitoring program.

The application also would describe the DOE's proposal for continued monitoring to prevent any activity that would pose an unreasonable risk of breaching the repository's engineered barriers, or that would increase the exposure to the public beyond the limits imposed by the Environmental Protection Agency and the Nuclear Regulatory Commission. In its application to close the repository, the DOE would define the details of this program. These requirements for a license amendment for closure, combined with the additional experience and knowledge gained during the intervening years, would allow the DOE to take full advantage of any new information, insights, or technologies that had developed since the start of repository operations.

Will taxpayers subsidize large utilities for the disposal of high-level radioactive waste?

The Nuclear Waste Policy Act established the nuclear waste fund, whereby the consumers of electricity generated by commercial nuclear power plants pay a fee based on how much power they use. This fund, which is managed by Congress, covers the costs of site characterization and the disposal of commercial spent nuclear fuel.

The taxpayers are not subsidizing the utilities. The federal government's policy is that utilities' customers who receive the benefits of electricity generated by nuclear means should pay the costs of site characterization for the future disposal of commercial spent nuclear fuel, whether disposal occurs at Yucca Mountain or elsewhere. For wastes generated by the federal government, the federal budget pays the costs of site characterization and for the disposal of waste forms.

As required by the Nuclear Waste Policy Act, the consumers of electricity generated by commercial nuclear power plants pay a fee based on how much nuclear-generated power they use. This fee is 1.0 mil per kilowatt-hour of nuclear-generated electricity (i.e., one tenth of one cent per thousand watts supplied continuously for one hour. A kilowatt-hour is the amount of electricity required to run ten 100-watt light bulbs for one hour.) The fees are then paid by the electric utilities into the Nuclear Waste Fund, held in account for the repository program by the U.S. Treasury. Each year Congress appropriates money from this fund for the repository program. If the program goes forward, the utilities' customers will continue to pay most of the costs of constructing, operating, and closing a repository.

Costs associated with disposing of wastes generated by defense-related activities are covered by the federal budget. Such waste forms include excess plutonium, treated high-level waste from weapons production, and naval spent fuel all of which require geologic disposal, as much as commercial spent nuclear fuel.

The Nuclear Waste Policy Act required the DOE to have a repository or related facility sited, constructed, operational, and accepting commercial spent nuclear fuel by January 31, 1998. Because that deadline was not met, several electric utilities with nuclear power plants have sued the United States for breach of contract. The U.S. Court of Appeals for the District of Columbia Circuit has ruled that the DOE had an unconditional obligation, reciprocal of the utilities' obligation to pay the prescribed fees, to begin spent fuel disposal by January 31, 1998.

What is the waste storage capacity of Yucca Mountain?

Yucca Mountain could physically handle all the waste currently projected to be generated in the United States. In order for more than 70,000 metric tons to be emplaced in Yucca Mountain, Congress must act.

By 2040 the United States could generate about 120,000 metric tons of high-level waste. However, current law limits the repository to 70,000 metric tons of heavy metal, or until such time as a second repository is in operation.

The DOE is following the directions provided by Congress in the Nuclear Waste Policy Act on the disposal limits of the first repository. Several options are available to Congress for the disposal of the remaining amounts of high-level radioactive waste. Examples of options include the development of a second repository in a state other than Nevada or New Mexico, or changing the Nuclear Waste Policy Act to allow the first repository to take more than 70,000 metric tons, until a second repository is available.

In its Environmental Impact Statement for Yucca Mountain, the DOE is required to evaluate a range of conditions. Therefore, the Environmental Impact Statement identifies several areas that could be used for disposal of additional volumes of radioactive waste, should the law be changed.

The amount of radioactive waste that can be safely disposed of at Yucca Mountain is directly related to the size of the rock area having specific essential safety attributes and the amount of waste placed within that area (this is called the areal mass loading). The current repository design uses an areal mass loading of about 62 metric tons per acre. Using this same loading ratio and the areas identified in the Environmental Impact Statement, Yucca Mountain could accommodate more than 120,000 metric tons of heavy metal.

What alternative technologies might eliminate the need for a repository?

For the foreseeable future, there are no technologies that would eliminate the need for a repository. Options for the management of high-level wastes have been evaluated, but all produce high-level radioactive waste as byproducts that must be disposed of in a repository to protect public health and safety.

Alternative technologies and options have been and will continue to be evaluated for the responsible management of high-level radioactive waste.

Many nations reprocess their spent nuclear fuel, which reduces the volume of high-level radioactive waste. Liquid high-level radioactive waste, however, is a by-product of reprocessing. Prior to transport or disposal, this new amount of liquid waste must be vitrified, a process by which the waste is combined with sand and other materials and melted together to form a stable glass. This waste also must be disposed of in a repository to ensure the protection of public health and safety.

The DOE supports, and continues to fund, further research and development of accelerator transmutation of nuclear wastes, a process that could reduce the amount of long half-life actinides (a type of radionuclide) in the commercial spent fuel. High-level radioactive waste, which is a by-product of this process, also requires disposal in a repository to ensure the protection of public health and safety.

A repository at Yucca Mountain would centralize the disposal of high-level radioactive waste, while maintaining the option to retrieve it. With the waste retrievable, we preserve future generations' options to take advantage of alternative technologies, while protecting the health and safety of the public.

What are some of the public policy issues associated with a repository the Secretary is considering?

Probably the most compelling is the protection of health and safety of millions of Americans in almost every state. In addition, a repository would also protect national security and support a balanced energy policy.

They boil down to safety and security. If Yucca Mountain is chosen as the repository site, it will be because that action will enhance the safety and security of the material to be disposed there.

Protecting Public Health and Safety and Preserving the Quality of the Environment

At present, spent nuclear fuel and high-level radioactive waste are temporarily stored at 131 locations in 39 states. Most of these storage sites are near population centers, and because nuclear reactors require abundant water, these sites are also located near rivers, lakes, and seacoasts. Analyses indicate that these stored materials, if left where they are indefinitely, could become a serious hazard to nearby populations and the environment. If not perpetually maintained and safeguarded, this material could travel through groundwater and surface water runoff to rivers and streams that people use for domestic and agricultural purposes. Should this occur, 20 major waterways and all seacoasts could be adversely impacted. Currently, 30.5 million people are served by municipal water systems with intakes along the potentially affected portions of these waterways. Over the 10,000-year regulatory compliance period, without a geologic repository, trillions of dollars would be required to maintain facilities and thousands of lives would be impacted.

Local residents' safety and health and the environment are also protected. The Environmental Protection Agency and Nuclear Regulatory Commission regulations address the performance of a repository by setting radiation protection standards that protect the public, workers, and the environment. The DOE has evaluated the ability of the natural and engineered barrier systems to isolate radioactive materials from the environment. These studies and analyses indicate that the health and safety of all those individuals living in the vicinity of the repository would be protected.

Environmental cleanup of Cold War weapons facilities, the production of nuclear weapons during World War II and the Cold War resulted in a legacy of high-level radioactive waste and spent nuclear fuel that is currently stored in Washington, South Carolina, Colorado, and Idaho. Large volumes of high-level radioactive waste were created in the past when spent nuclear fuel was reprocessed to extract plutonium for weapons use. The high-level waste left over from that process exists in liquid and solid

forms. Federal sites where this liquid waste has been stored, and in some instances has leaked from holding tanks, require varying degrees of remediation. The cleanup and decommissioning of the former weapons production sites will require permanent disposal of all these materials.

Protecting the Nation

Protecting the Nation from acts of terrorism. Fundamentally, deep geologic disposal of radioactive waste is safe from acts of sabotage or terrorism. No reasonably conceivable attack at the surface of a repository could have a significant impact on the high-level waste contained in very long-lasting metal containers some 1,000 feet underground in solid rock. In addition, the Yucca Mountain site is remotely located on federal land, with restricted access because of its proximity to the Nevada Test Site, where the United States has conducted over 900 nuclear weapons tests. Yucca Mountain is also surrounded on three sides by the Nellis Air Force Range, which has restricted airspace and, the site already has a highly trained and effective rapid-response security force.

Supporting the U.S. Navy Nuclear Fleet. Approximately one in three of the nation's large naval vessels are powered by nuclear reactors. These vessels generate a small but strategic amount of high-level waste. Radioactive waste from naval operations is currently being stored at the Idaho National Environmental and Engineering Laboratory and awaiting final disposal. This waste must be disposed of in order to maintain our naval capability, now and in the future.

Dismantling nuclear weapons. The end of the Cold War has brought the welcome challenge of disposing of approximately 55 tons of surplus weapons-usable plutonium. Some of this nuclear materials would be secure in the geologic repository, where unauthorized removal would be very difficult, even if access control were lost. By permanently disposing of surplus nuclear weapons materials, the United States encourages other nations to do the same.

Fuel from research reactors. The DOE has provided fuel for use in research reactors in both U.S. and foreign universities and laboratories. To support nuclear nonproliferation objectives, these research facilities are required to return the spent nuclear fuel to DOE. These domestic and foreign spent fuels are being stored at Savannah River, South Carolina, and at the Idaho National Engineering and Environmental Laboratory, while awaiting disposal in a repository.

Providing support to a balanced energy policy

On average, one out of five American homes, farms, factories, businesses, schools, hospitals, and universities is dependent on electricity generated by nuclear power plants. Regions that produce steel, automobiles, and durable goods purchased throughout the United States rely heavily on nuclear power, to hold down production costs while supporting America's clean energy demand by contributing to clean air quality.

Some existing and relicensed facilities are limited in the amount of spent nuclear fuel they can store onsite. When the limits are reached, these reactors will have no choice but to close down prematurely. Moreover, the costs for additional onsite dry spent fuel storage have been rising rapidly.

Why have DOE's siting regulations changed?

DOE changed its siting guidelines to be consistent with the congressionally amended Nuclear Waste Policy Act and the Environmental Protection Agency and the Nuclear Regulatory Commission licensing requirements and approach.

DOE issued the revised siting guidelines (10 CFR Part 963) because the purpose of the original ones (to compare several different candidate sites) was made obsolete when Congress required consideration of only one site, and because the guidelines were required to reflect standards adopted in 2001 by the NRC and the EPA, and because intervening expert scientific evaluation by the National Academy of Sciences and other independent scientific organizations indicated that the site evaluation method specified in the original guidelines was an inferior one from the standpoint of assuring maximum public safety.

The Nuclear Waste Policy Act of 1982 directed the Secretary of Energy to nominate multiple potential sites for development as the nation's first repository and to issue general guidelines for considering candidate sites for site characterization. DOE issued such guidelines in 1984, following and consistent with generally applicable geologic repository licensing regulations promulgated by the NRC at 10 CFR Part 60. The NRC regulations included criteria to differentiate among multiple sites, and were based on then-current regulatory approaches and scientific knowledge. The DOE's Part 960 guidelines were consistent with 10 CFR Part 60 and included site considerations related to the comparative advantages among multiple sites located in different geologic media.

In 1987, Congress amended the Nuclear Waste Policy Act and directed DOE to characterize only the Yucca Mountain site. Following this action, Congress enacted the Energy Policy Act of 1992 which, among other things, directed the EPA to promulgate Yucca Mountain site-specific public health and safety standards, and directed the NRC to conform its licensing regulations to be consistent with these EPA site-specific standards. As a result, in 2001 both EPA and NRC promulgated regulations governing public health and safety standards and licensing requirements, respectively, that are specific to a geologic repository at Yucca Mountain and comport with current regulatory approaches and scientific knowledge.

The advances in scientific knowledge made in the intervening period between 1984 and 2001 prompted the prevailing view by independent scientific and technical organizations, including the National Academy of Sciences and the International Atomic Energy

Agency, that a total system performance analysis approach would yield a greater assurance of repository safety than the sub-system analysis approach contained in the original guidelines. The guidelines therefore were revised to reflect the newer and safer approach.

Consistent with the EPA and NRC, in November 2001 DOE adopted site suitability regulations at 10 CFR Part 963 that are specific to the Yucca Mountain site and reflect current regulatory requirements and scientific knowledge.

What are the responsibilities of the Department in the repository development process?

The Department was assigned responsibility to manage the disposal of high level waste and spent fuel. The Secretary must recommend to the President whether or not the United States should initiate the next steps of the formal process determining the acceptability of Yucca Mountain as a permanent repository for the disposal of these wastes.

By law, Congress assigned the primary responsibility for implementing this national policy to the Department of Energy. Congress also identified certain actions specifically to be undertaken by the Secretary of Energy. Particularly, the Secretary must recommend to the President whether or not the United States should initiate the next steps laid out by Congress, possibly leading to the beginning of the formal process determining the acceptability of Yucca Mountain as a permanent repository for the disposal of these wastes.

To make a positive recommendation, the Secretary is required to determine whether Yucca Mountain is suitable to serve as a repository and then whether, together with other considerations, such a recommendation is appropriate. The Secretary's decision must follow the completion of several specific requirements of the NWPA. The Secretary must conduct such site characterization necessary to evaluate the suitability of Yucca Mountain to serve as a repository. The Secretary must hold hearings in the vicinity of the site to inform the residents and to receive comments on his consideration of whether to recommend the site. If the Secretary finds the site suitable, he then must decide whether to recommend it to the President for development as a permanent repository.

The Secretary's decision and recommendation will consider the suitability criteria of the siting guidelines at 10 CFR Part 963. The considerations will be based on evaluation of the results of a *Preclosure Safety Evaluation* for the period of operations before closure and a *Total System Performance Assessment* for the period following closure. The Secretary's evaluation of suitability will be based on a critical examination of the results of the application of the suitability criteria at 10 CFR 963. These suitability criteria reflect both the systems and processes, and the models used to simulate them, that are important to the performance of the repository.

If the Secretary recommends Yucca Mountain for development to the President, he must include with the recommendation, and make available to the public, a comprehensive statement of the basis for such recommendation. If at any time the Secretary decides not to recommend the Yucca Mountain site, he must report to Congress within six months his

recommendations for further action to assure safe, permanent disposal of spent nuclear fuel and high-level radioactive waste.

What are the next steps of the repository development process following a recommendation by the Secretary?

The President may recommend the Yucca Mountain site to Congress if he considers it qualified for application to the NRC for authorization to construct a repository. Before construction or waste emplacement could begin, the DOE must submit an application, go through a public adjudicatory hearing, and receive an authorization to construct from the NRC, which has the statutory responsibility to ensure that any repository constructed at Yucca Mountain would meet stringent tests of safety.

Following a recommendation by the Secretary, the President may recommend the Yucca Mountain site to Congress if he considers it qualified for application to the NRC for authorization to construct a repository. If the President submits a recommendation to Congress, he must also submit to Congress a copy of the statement of the basis for the Secretary's recommendation.

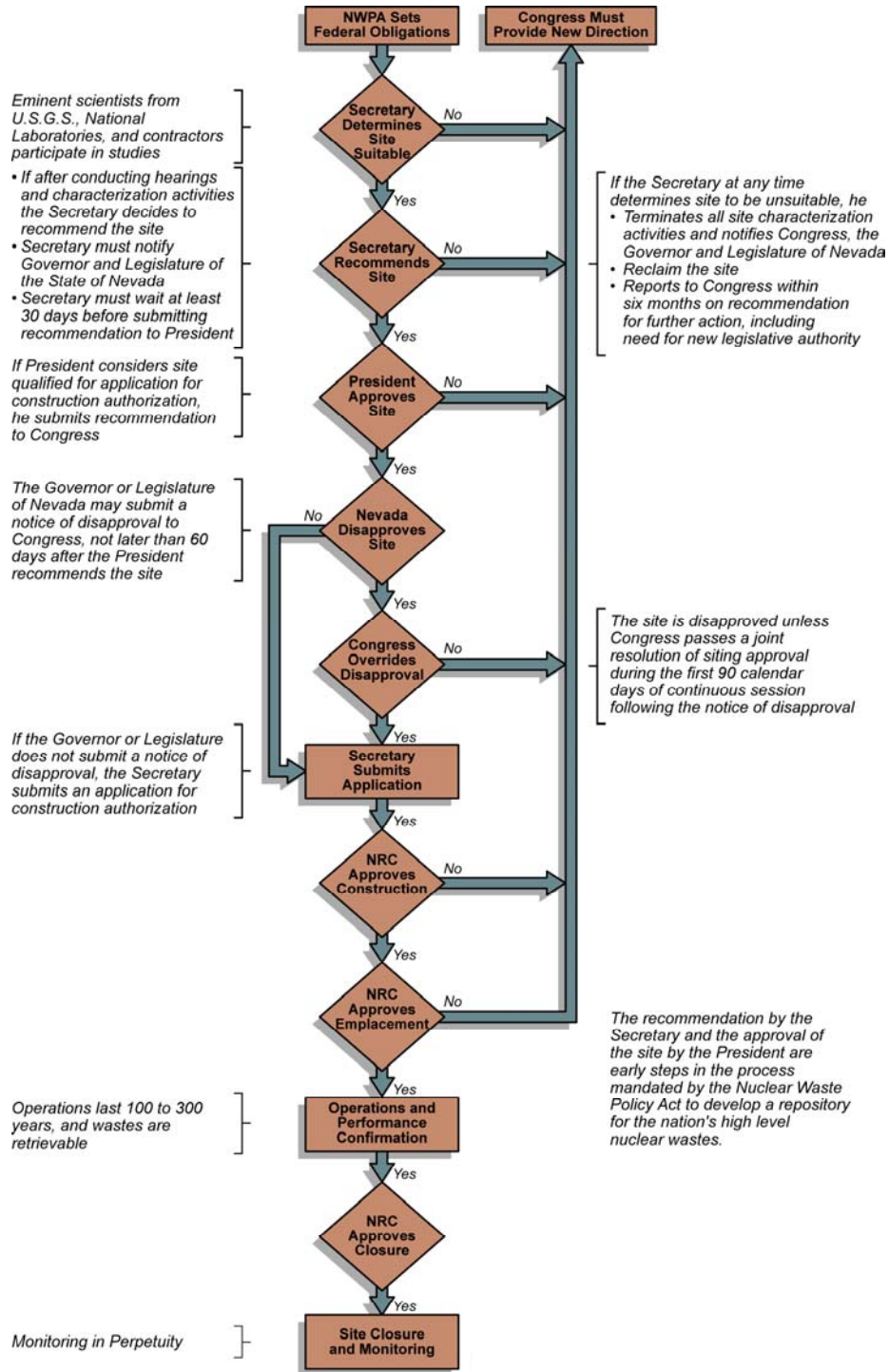
Additional steps in the repository siting and development process as required by the Nuclear Waste Policy Act are shown in the attached figure.

This recommendation to the President that the Department seek a license to construct a repository is an intermediate step. Before construction or waste emplacement could begin, the DOE must submit an application, go through a public adjudicatory hearing, and receive an authorization to construct from the NRC, which has the statutory responsibility to ensure that any repository constructed at Yucca Mountain would meet stringent tests of safety. The hearing conducted by the NRC would be an extensive construction licensing proceeding, focusing on public health and safety. This hearing for a license is expected to take a minimum of three years. Opposing viewpoints will be heard in the proceeding, which will be conducted by an administrative court. Following authorization, the DOE would have to complete initial construction, and receive an additional license from the NRC before any wastes could be received or emplaced.

The DOE would be subject as well to NRC oversight as a condition of the license to operate a repository. Through this license, NRC would impose on DOE certain conditions for operation, and requirements to collect data to ensure that the repository was functioning as described in the licensing documents. The DOE likely would have to continue to study important issues to help provide confidence in an ultimate decision to close the repository. For example, the NRC could require the DOE to collect many more years of data about corrosion behavior of waste package metals, or how heat effects

movement of water through the mountain. Operation of the repository would also be subject to congressional oversight and annual authorization through the budget process.

Figure 1: Nuclear Waste Policy Act Process Steps



Where are the wastes that would be placed in a repository?

High-level radioactive waste and spent nuclear fuel from the use of nuclear materials to produce electricity, power naval vessels, and make nuclear weapons have accumulated since the mid-1940s. These materials are currently located at 131 sites in 39 states in temporary storage facilities awaiting final disposal

The U.S. Navy's nuclear-powered vessels, the nation's past production and ongoing dismantlement of nuclear weapons, the commercial generation of 20 percent of the country's electricity, and many research and development activities produce high-level radioactive waste. These materials have accumulated since the mid-1940s and are currently located at 131 sites in 39 states in temporary storage facilities awaiting final disposal. Most of these storage sites are near population centers, and because nuclear reactors require abundant water, these sites are also located near rivers, lakes, and seacoasts. The United States has been accumulating high-level radioactive waste and spent nuclear fuel for more than a half century through the use of nuclear materials to produce electricity, power naval vessels, and make nuclear weapons.

As early as 1957, a National Academy of Sciences report to the Atomic Energy Commission suggested burying radioactive waste in geologic formations. The National Research Council of the National Academy of Sciences noted in 1990 that there is a worldwide scientific consensus that deep geological disposal, the approach being followed by the United States, is the best option for disposing of high-level radioactive waste.

How can DOE move forward with a site recommendation if there are a number of technical items yet to complete for the NRC?

The NRC provided a sufficiency letter to DOE on Nov. 13, 2001 that included certain work remaining for license application, not site recommendation. DOE has assessed the potential impacts of the actions yet to be completed and believes that the additional work will not affect the conclusion on whether the site is likely to meet the radiation protection standards.

The NRC provided a sufficiency letter to DOE on Nov. 13, 2001 that included certain work remaining for license application, not site recommendation. In consultation with the NRC staff concerning *licensing*, the Department agreed it would obtain certain additional information relating to nine “key technical issues” to support a license application. To resolve these key technical issues, DOE agreed to undertake 293 activities that would close the issues to NRC’s satisfaction in that context.

The NRC has never stated that this was work that the Department needed to complete before *site recommendation*. To the contrary, in its letter to the Department that the NWSA specifies the Department must have in order to proceed with site recommendation, it listed all of these issues as “closed pending” and none of them were “open.” Closed pending means the NRC staff had confidence that the DOE proposed approach, together with the agreement to provide additional information, acceptably addressed the NRC’s issue such that no additional information beyond that provided or agreed to would likely be required for a license application. On the other hand, an open item would mean the NRC identified questions regarding the DOE approach or information that had not yet been acceptably addressed, and no additional information was agreed to by DOE.

It is DOE’s judgment that over one-third of the necessary actions to fulfill the agreements items have been completed. DOE has submitted that work product to the NRC for its review. The nature of the remaining work consists of documentation (improve technical positions and provide additional plans and procedures) and confirmation (enhance understanding with additional testing or analysis or additional corroboration of data or models). DOE believes, based on its existing suite of site recommendation documentation and analyses, that the potential impacts of the additional work will not significantly affect the conclusion on whether the site is likely to meet the radiation protection standards.