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Fact Sheet for the Chairman,
Subcommittee on Energy and Power,
Committee on Energy and Commerce,
House of Representatives



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March 1987

NUCLEAR WASTE

Status of DOE's Nuclear Waste Site Characterization Activities



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testing necessary for the selection of the site is completed (1992 for Nevada, 1993 for the other two sites); however, DOE officials stated that, realistically, the phase will end when NRC issues a license to construct a repository. In January 1987 DOE estimated that date would be extended 5 years to 1998.

Status of site
characterization activities

Since the site characterization phase began, OCRWM and the three DOE project offices responsible for the candidate sites have focused on developing site characterization plans. The act requires that DOE issue these plans, which are intended to guide the work at each site, and that NRC and the affected states and Indian tribes review the plans before exploratory shafts can be constructed at the sites. DOE estimates that the Nevada and Washington site plans will be complete in mid-1987, but that the Texas site plan will not be issued until about March 1988. Some preliminary work has been done at the two federally owned sites at Nevada and Washington. No on-site research has been conducted at the Texas site.

During our review we noted that each site has unique technical issues that need to be resolved:

- The Hanford site is located in south-central Washington State on the DOE Hanford Reservation near Richland and about 5 miles from the Columbia River. The host rock is basalt lava, a hard, molten material created by the solidification of lava. The primary technical issues to be resolved concern DOE's ability to construct a repository 3,000 feet deep in rock with the hydrogeologic characteristics of this basalt, and the potential for radioactive groundwater contamination reaching the Columbia River. Also, critics of the program state that, since a shaft the depth of the planned exploratory shaft has never been drilled in basalt, unforeseen construction problems may arise. (See p. 14.)
- The Yucca Mountain site is located on federal land in southern Nevada. The host rock is tuff, a hard, compacted volcanic ash. The primary technical issue to be resolved during site characterization concerns the



Resources, Community, and
Economic Development Division

B-202377

March 20, 1987

The Honorable Philip R. Sharp
Chairman, Subcommittee on Energy
and Power
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

On October 14, 1986, former Chairman, Edward J. Markey, requested that we determine the status of the Department of Energy's (DOE) planned site characterization activities under the Nuclear Waste Policy Act of 1982. At a briefing of his staff on January 5, 1987, they requested that we prepare this fact sheet summarizing the results of our review and highlighting long-range characterization issues.

The Nuclear Waste Policy Act of 1982 (Public Law 97-425) established a comprehensive national program to construct geologic repositories for the permanent disposal of high-level radioactive nuclear waste. The act established within DOE the Office of Civilian Radioactive Waste Management (OCRWM) to carry out its provisions. It also established procedures for selecting potential repository sites and conducting detailed geological and other tests, called site characterization, to determine the suitability of each site as a repository. The main objectives of the site characterization phase are to (1) determine which of the candidate sites are suited to become the nation's first repository and (2) develop information necessary for the construction license application to the Nuclear Regulatory Commission (NRC) as required by the act.

On May 28, 1986, the Secretary recommended, and the President selected, three sites located in Washington, Nevada, and Texas for site characterization activities. In January 1987 DOE extended the completion date for the repository from 1998 to 2003, thus extending some site characterization milestone dates by 5 years. According to DOE officials, the site characterization phase of the program formally began when the three sites were selected. The site characterization phase will end officially when

possibility of groundwater movement through the repository along pathways caused by geologic faults. DOE has obtained site-specific data from drill holes, trenches, and pits in and around the site through earlier work. (See p. 19.)

- The Deaf Smith site is in the southern high plains of the Texas Panhandle. The host rock is a sequence of bedded rock salt, a sedimentary rock formed by the evaporation of water from a saline solution. A primary concern is the possibility of contaminating fresh water aquifers overlying the approximately 2,400-foot-deep candidate repository. The method DOE selected for sinking exploratory shafts requires (1) freezing the ground to a depth of 1,000 feet to control water migration and (2) using conventional mining techniques. Since land on which the site facilities will be built is still privately owned, DOE has agreed to have the U.S. Corps of Engineers acquire land for site characterization during 1987. No site work has been performed to date and the responsible project office has yet to move to Texas. DOE officials are confident, however, that because of the availability of existing data on salt mining this site will "catch up" to the Hanford site by the end of the phase, but both will be a year behind Yucca Mountain. (See p. 23.)

Emerging issues

Based on conversations with DOE headquarters and project office officials, we identified issues that affect the total program and warrant ongoing congressional attention.

- DOE is currently unable to accurately estimate the site characterization completion date and costs. DOE has revised estimated completion dates several times since the act was passed: the latest dates are 1992 for Yucca Mountain and 1993 for the other two sites. The act required NRC, after site characterization was complete, to approve or disapprove a repository construction authorization by January 1989, or within 4 years after submission of such application. DOE now estimates that it will submit its application by March 1995 and NRC will approve the application by April 1998. According to DOE officials, existing cost estimates are very tentative and

likely to change because (1) site characterization costs will be greatly affected by the amount of time needed to complete this phase and (2) site characterization plans have not yet been completed. (See p. 29.)

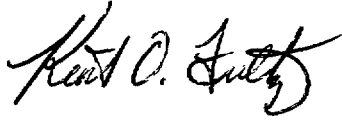
- DOE's relationship with NRC has been limited and relations with affected states and Indian tribes continue to be difficult. (See p. 34.)
- OCRWM is developing a comprehensive quality assurance program--a crucial part of preparing a viable license application. It has already issued stop work orders to nine contractors because of various quality issues. (See p. 37.)

Sections 1 through 5 of the fact sheet discuss in detail the status of site characterization activities and the areas highlighted above. To determine the status of site characterization activities at each site, we reviewed pertinent documents and correspondence available at DOE headquarters, including the (1) annotated outline for the site characterization plan, (2) issues hierarchy document which delineates the 4 key issues and 40 other issues to be addressed during site characterization, and (3) DOE's January 1987 draft Mission Plan Amendment. We interviewed DOE, NRC, and National Academy of Sciences officials in Washington, D.C., and visited each of the three DOE project offices in Richland, Washington; Las Vegas, Nevada; and Columbus, Ohio. At the project offices we interviewed officials responsible for each aspect of site characterization, including exploratory shaft design, licensing activities, quality assurance, and site characterization plan development. We also interviewed the on-site NRC representatives at the Las Vegas and Richland project offices. Most of our work was performed in November and December 1986. If you have further questions, please contact me at (202) 275-1441.

B-202377

Major contributors to this fact sheet are listed in appendix I.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Keith O. Fultz". The signature is written in a cursive style with a large, sweeping initial "K".

Keith O. Fultz
Associate Director

C o n t e n t s

		<u>Page</u>
SECTION		
1	SITE CHARACTERIZATION REQUIREMENTS AND ACTIVITIES	8
	Background	8
	Site characterization	8
	Site characterization plans	10
2	THE HANFORD SITE	14
	Background	14
	Site characterization activities	15
	Issues peculiar to the Hanford site	18
3	THE YUCCA MOUNTAIN SITE	19
	Background	19
	Site characterization activities	19
	Issues peculiar to the Yucca Mountain site	21
4	THE DEAF SMITH SITE	23
	Background	23
	Site characterization activities	23
	Issues peculiar to the Deaf Smith site	26
5	PROGRAMWIDE SITE CHARACTERIZATION ISSUES	29
	Definite time and cost estimates for site characterization not available	29
	Site characterization institutional issues	34
	Quality assurance	37
APPENDIX		
I	Major contributors to this fact sheet	41
FIGURE		
1.1	Recommended repository sites	13
TABLE		
5.1	Schedule for site characterization	31
5.2	Costs of site characterization	33

ABBREVIATIONS

DOE Department of Energy
NAS National Academy of Sciences
NRC Nuclear Regulatory Commission
NWPA Nuclear Waste Policy Act
OCRWM Office of Civilian Radioactive Waste Management

SECTION 1

SITE CHARACTERIZATION REQUIREMENTS AND ACTIVITIES

BACKGROUND

On January 7, 1983, the Congress enacted the Nuclear Waste Policy Act of 1982 (NWPAs) to establish a definite federal policy for nuclear waste management and to ensure the safe storage and permanent disposal of high-level nuclear waste. NWPAs lays out procedures for the Department of Energy (DOE) to provide for siting and testing two deep-underground geologic repositories, and for licensing, constructing, and operating the first repository. NWPAs also established a time schedule and step-by-step process by which the President, the Congress, affected states and Indian tribes, DOE, the Nuclear Regulatory Commission (NRC), and other federal agencies are to cooperate in developing the repositories for the disposal of nuclear waste.

In February 1983 DOE, relying on prior work, formally identified nine areas in six states as potentially acceptable sites for the first permanent repository for high-level nuclear waste. NWPAs required the Secretary of Energy to recommend to the President by January 1, 1985, three sites for further geologic study, called site characterization studies. DOE nominated five sites in May 1986, accompanied by final environmental assessments as required by NWPAs, and recommended three of the sites to the President. On May 28, 1986, the President approved the three recommended sites at Yucca Mountain, Nevada; Hanford, Washington; and Deaf Smith County, Texas. (See map on p. 13.)

SITE CHARACTERIZATION

According to DOE the site characterization phase of the nuclear waste program began immediately following the President's decision naming the three candidate sites. NWPAs defines site characterization primarily as

" . . . activities, whether in the laboratory or in the field, undertaken to establish the geologic condition and the ranges of the parameters of a candidate site relevant to the location of a repository, including borings, surface excavations, excavations of exploratory shafts, limited subsurface lateral excavations and borings, and in-situ testing needed to evaluate the suitability of a candidate site for the location of a repository"

According to a mid-1986 DOE estimate, the site characterization phase was expected to last about 5 years and cost as much as \$1 billion for each site (in 1985 dollars). From 200 to 500 people will be employed at each site at the peak of site characterization

activity. DOE's January 1987 draft Mission Plan Amendment states that the site characterization phase will end in 1992 for Yucca Mountain and 1993 for the other two sites. The draft amendment also extends the completion date for the first repository from 1998 to 2003.

The main objectives of site characterization work are to (1) determine if a candidate site will provide safe and permanent disposal for nuclear waste, (2) develop data to be used in the decision process to determine which site the Secretary of Energy shall recommend as the first site should DOE judge more than one of the candidate sites to be suitable, and (3) collect the data and information needed to support a construction license application to the Nuclear Regulatory Commission at the end of the site characterization phase. DOE officials stated that the site characterization phase would not realistically end until NRC issues a license to construct a repository.

The site characterization phase of the geologic repository program includes two kinds of activities: (1) a program of extensive field and laboratory testing and studies to collect and evaluate geologic, hydrologic, and geochemical information and (2) other studies that assess the potential environmental and socioeconomic impacts of repository development and operation. The environmental and socioeconomic studies will be used along with data from the field and laboratory studies to prepare an environmental impact statement for the site finally selected for the repository. In this fact sheet, "site characterization" refers primarily to on-site geological activities.

The field program will consist of surface-based activities (such as geologic mapping, geophysical surveys, and seismologic and hydrologic studies), as well as activities conducted by means of deep and shallow boreholes that will be used for ground water monitoring, core extraction, laboratory testing, and studies of the earth's geological structure, chemical composition, and underground water. Activities will also be conducted in the host rock at repository depth through construction and use of exploratory shafts and underground test facilities. DOE is planning to sink two exploratory shafts at each candidate site, the first primarily for conducting tests, the second primarily for the safety of operating personnel. However, the Congress did not provide funding for shaft construction during fiscal year 1987. Studies of the host rock and surrounding strata will assess the effect of the in-situ environment on the waste package, ability of the host rock to contain radionuclides, and their ability to retard radionuclides by chemical interaction.

NWPA requires that, following the President's recommendation of a repository site and the Congress' approval of that site, the Secretary shall submit an application to the NRC for a construction authorization for a repository. The act requires NRC to issue a

final decision approving or disapproving a repository construction authorization by January 1989 or within 4 years after such application is made. Under NWPA, NRC has the responsibility to promulgate technical requirements and criteria to apply to the application for a construction license of the repository, as well as licenses for receiving and possessing high-level radioactive wastes at the repository. In June 1983 NRC issued its waste disposal regulations contained in 10 CFR Part 60 entitled "Disposal of High-Level Radioactive Wastes in Geologic Repositories Technical Criteria." NWPA also gave NRC a pre-license consultation role prior to the application filing so that when the application is filed it can be promptly and timely reviewed. In January 1987 DOE estimated that the NRC would issue a license by April 1998.

SITE CHARACTERIZATION PLANS

Some research and development activities that can generally be described as site characterization work have been done at the Yucca Mountain and Hanford sites, which are both located on federally owned land. However, site characterization activities associated with the exploratory shafts are contingent upon DOE's completion of a site characterization plan for each of the three sites. NWPA requires the preparation of such plans before exploratory shaft construction is initiated at any candidate repository site. The plans are also required by the NRC licensing procedures for the disposal of high-level waste as contained in 10 CFR Part 60.

The site plans are intended to be umbrella documents that will (1) provide mechanisms for identifying the specific issues at a proposed repository site and (2) identify specific research needed to obtain data for resolving those issues at an early time in order to avoid delays in the licensing process. The plans will therefore become the focus for discussions with NRC on site-specific issues and test programs during the site characterization phase. NRC's regulatory guidelines provided guidance for DOE's February 1985 annotated outline for site characterization plans. The outline describes the plan in two parts: Part A (chaps. 1-7) is to describe the site, waste package, and repository design; Part B (chap. 8) is to describe the site characterization program, including the issues to be resolved, information needed, planned tests and analyses, milestones, and quality assurance program. On the basis of a review of the outline, NRC agreed that its use could result in the preparation of adequate plans.

OCRWM and the three DOE project offices located in Columbus, Ohio; Las Vegas, Nevada; and Richland, Washington have been working on the site characterization plans since about December 1985, although prior to May 1986 they were preoccupied with finalizing the environmental assessments and the candidate site decision process. OCRWM has also prepared an issues hierarchy document delineating the 4 key issues of regulatory concern and 40 other

issues to be addressed during site characterization. The four key issues are:

- Will the mined geologic disposal system at the site isolate the radioactive waste from the accessible environment after closure in accordance with the requirements set forth in 40 CFR Part 191, 10 CFR Part 60, and 10 CFR Part 960?
- Will the projected releases of radioactive materials to restricted and unrestricted areas and the resulting radiation exposures of the general public and workers during repository operation, closure, and decommissioning at the site meet applicable safety requirements set forth in 10 CFR Part 60, 10 CFR Part 20, 10 CFR Part 960, and 40 CFR Part 191?
- Can the mined geologic disposal system at the site be sited, constructed, operated, closed, and decommissioned, and can the associated transportation system be sited, constructed, and operated so that the quality of the environment will be protected and waste-transportation operations can be conducted without causing unacceptable risks to public health or safety?
- Will the construction, operation (including retrieval), closure, and decommissioning of the mined geological disposal system be feasible at the site on the basis of reasonably available technology, and will the associated costs be reasonable in accordance with the requirements set forth in 10 CFR Part 960?

A performance allocation strategy has been developed within OCRWM to focus and prioritize the testing program described in each of the site characterization plans. Performance allocation involves identifying how various portions of the repository program, such as waste form, waste package, engineered barriers, and host rock, will be relied on to meet applicable regulation requirements. Testing will be focused on those particular aspects to determine if they will meet individual objectives and contribute to the overall requirements of the repository.

NRC and DOE met in May 1986 to decide on the level of detail to be included in the site characterization plans to manage the development of the plans in a timely and reasonable manner. It was agreed that (1) each plan would present a complete description of the site characterization program and would be supported by separate documents consisting of references, study plans, and test procedures and (2) detailed test descriptions and procedures would be provided in study plans about 6 months before the activity would be conducted.

Project offices are responsible for the site characterization plans being written primarily by contractors. Project offices have developed management plans to coordinate writing and assembling the plans. Project office officials told us in November and December 1986 that they expect to complete the Yucca Mountain site plan in April 1987, the Hanford site plan in July 1987, and the Texas site plan in mid-1988. The Deaf Smith site plan will require more time to prepare because the Columbus project office was busy preparing environmental assessments for each of the prospective salt sites earlier in the siting process, while the other offices had only one to prepare. The other two project offices have the additional advantage of investigating a candidate site that is located on federally owned land where some site work has been done, while the Columbus project office is hampered by the need to acquire access to land.

Figure 1.1: Recommended Repository Sites



SECTION 2

THE HANFORD SITE

BACKGROUND

The potential Hanford site repository location is situated on the 570-square-mile DOE Hanford reservation near Richland, Washington. For over two decades, DOE and its predecessor agencies have investigated the Hanford reservation's geologic and hydrologic characteristics to determine its suitability for long-term nuclear waste storage. During the 1960's and early 1970's, studies focused on suitable methods for storing and disposing of defense wastes generated at Hanford.

In 1977 DOE established the Basalt Waste Isolation Project office to study the feasibility of siting, constructing, and operating a national, high-level nuclear waste repository in the basalt lava flows underlying Hanford. Two major factors led to the selection of the Hanford site. First, the Hanford site is situated in the center of a region covered by the Columbia River Basalt Group, which is made up of about 50 layers of basalt, a dense, fine-grained volcanic rock. Second, the Hanford site is a federally owned area that at that time had been committed to nuclear activities for over 30 years.

Between 1977 and 1982, DOE and its predecessor agencies conducted studies to determine the geologic and hydrologic characteristics of the Hanford site to assess the feasibility of disposing of high-level wastes in basalt and to determine the technology needed to design and construct waste packages and a repository in such medium. Beginning in 1978, a site-screening effort was initiated to identify a possible repository location. Such identification was necessary so that design studies and planning for in-situ testing could proceed on the basis of a single location in the basalt. Various selection criteria were applied and a number of boreholes were drilled from which data were obtained. In June 1985 a basalt layer (Cohasset flow) located about 3,000 feet below the surface was selected as the reference repository location and is the primary focus of ongoing studies. The Cohasset flow is about 250 feet thick. Groundwater exists in confined and unconfined aquifers, the configuration and discharge of which are still under consideration. Some concerned parties believe the unconfined aquifers discharge into the Columbia River.

The repository site is located in the west-central part of the Hanford site in south-central Washington. The Columbia River flows through the northern part of the Hanford reservation--about 5 miles from the repository location at its closest point--and forms part of the reservation's eastern boundary. The Yakima River touches a portion of the southern boundary. At its closest the Yakima river is about 15 miles from the proposed repository location. The

cities of Richland, Pasco, and Kennewick, situated on the Columbia River downstream from Hanford, have a combined population of about 90,000 people.

The Assistant Manager for Commercial Nuclear Waste in DOE's Richland Operations Office is the project manager responsible for all phases of the Hanford repository work, including site characterization and repository design. The project office is assisted in this effort by five major contractors and numerous subcontractors. As of September 30, 1986, about 40 DOE project office staff were being assisted by about 865 contractor staff. Since the late 1970's, Rockwell Hanford Operations has been the lead contractor responsible for coordinating the technical work of all contractors at Hanford. The Westinghouse Hanford Company will assume this responsibility under a DOE decision to change Hanford contractors. Although the new contract goes into effect October 1, 1987, Westinghouse Hanford Company will phase in starting April 1, 1987.

SITE CHARACTERIZATION ACTIVITIES

Site characterization activities, some of which were initiated prior to the act, are underway at the Hanford site. Some of these activities, however, were curtailed in May 1986 when the project office imposed a stop work order on the lead contractor to correct quality assurance weaknesses. (See section 5.) According to project office officials, other activities, such as groundwater and seismic data collection and analysis, were permitted to continue because stopping them would have created gaps in hydrology and geology monitoring data.

According to a listing prepared for the project office by Rockwell Hanford, 27 specific field and laboratory site characterization activities were in progress when the President approved the Hanford site for characterization on May 28, 1986. The activities included

- daily and weekly monitoring of groundwater boreholes tapped into various confined and unconfined aquifers under Hanford;
- collection and analysis of seismic data needed to help predict the possible impact of future earthquakes at the site;
- laboratory analysis of water from boreholes and aquifers needed to establish baseline hydrochemical data before site characterization testing affects the natural system; and
- laboratory testing of waste package materials.

According to the same document, since May 28, 1986, the project office has planned to start 22 site characterization activities before issuing the site characterization plan. These activities include

- installing groundwater monitoring equipment above and below the proposed repository location to help determine the direction of groundwater flow;
- testing various rock support materials that may be used in the exploratory shaft facility;
- collecting seismic data in the immediate area of the exploratory shaft site; and
- variously testing waste package packing material.

As of the end of December 1986, none of these had been started.

Status of the site characterization plan

According to project office documents, the final Hanford site characterization plan is expected to be released to the public by July 1987. This represents about a 7-month delay from DOE's earlier March 1986 estimate that it would be complete by January 1987. The project office attributes the delay in part to new guidance from DOE headquarters that requires additional work, such as developing detailed study plans for all studies to be performed. Headquarters officials said the principal reason for the delay was the added time required for joint headquarters and project office efforts to develop strategies for resolving design, performance, and characterization issues.

Project office officials told us that when complete the plan will total about 6,000 pages. In addition, 71 study plans, which describe in detail investigations that will be completed during site characterization, will be prepared. According to project office officials, 53 of the study plans (totaling about 4,000 pages) are expected to be released with the site characterization plan, while the remainder will be completed at least 6 months before testing covered by those plans begins. This is to allow time for NRC, state, and tribal review. Project office officials told us that the plan is being authored by 65 people and reviewed by 100 other people.

Following NRC guidance, the plan is divided into two major parts. The first part describes the proposed repository location, the waste package, and repository design. The second part (chap. 8), the key part of the plan, presents the planned site characterization program and includes the rationale for the program; issues to be resolved; planned tests, analyses, and

studies; quality assurance activities; milestones, schedules, and decision points; planned site preparation activities; and decontamination and decommissioning activities related to the repository. Project office officials told us that drafts of four chapters in the first part (covering geology, geochemistry, climatology, and geomechanics) and three sections in the second part (quality assurance, planned site preparation activities, and decontamination and decommissioning) will be sent to the state and affected tribes by the end of April 1987. The project office plans to take formal comments from all concerned parties on the plan during a 90-day period following its issuance in July 1987.

Status of exploratory shaft design

DOE plans to drill two approximately 3,400-foot exploratory shafts at Hanford using one of the world's largest drill rigs. Once at depth, test rooms and tunnels will be constructed to permit testing of the Cohasset flow. The shafts will be lined with water-tight steel casing and sealed in place with a cement grout. The casing of the first shaft will be 6 feet in diameter. As of December 1986, a decision had not been reached on the diameter for the second shaft. However, DOE's January 1987 draft Mission Plan Amendment states that the second shaft will be 10 or 12 feet. A decision is expected in March 1987.

DOE officials stated that the Hanford drill rig was purchased in 1985 for \$2.7 million and will be used to drill additional shafts needed for ventilation and other utilities if Hanford is selected as the repository location. The 100-foot starter hole for the first exploratory shaft began in November 1982, but further drilling was delayed pending completion of NWPA requirements, such as developing an environmental assessment and a site characterization plan.¹

Drilling of the first shaft is scheduled to resume in March 1988 and be completed in about March 1989, but several site characterization activities could affect start-up and drilling operations. Project office officials told us that the most critical activity to the exploratory shaft schedule is the timely start and completion of large-scale hydraulic tests--tests designed to determine groundwater flow direction near the repository location. According to these officials, since drilling the exploratory shaft is likely to disturb the groundwater, the large-scale hydraulic tests are to be completed before the shaft enters the deeper basalt. In addition, several months must pass after

¹According to project office officials, the drill rig was leased until 1985, when DOE decided to purchase it with a sell-back arrangement should Hanford not be selected for site characterization.

test boreholes are drilled to allow the groundwater to stabilize before tests can begin. Work on the large-scale hydraulic test was halted by the stop work order in May 1986 (see section 5); however, project office officials said they hope to have quality assurance procedures completed so work can begin in March 1987.

ISSUES PECULIAR TO
THE HANFORD SITE

The key technical issues to be resolved at the Hanford site concerns whether the groundwater flow can be determined and whether a repository can be constructed at a depth of 3,000 feet in this basalt. State and local representatives are most concerned that radioactivity will escape the proposed repository via groundwater seeping through the fractured basalt rock and eventually reach the Columbia River system. According to DOE officials, identifying and modeling the complex groundwater system underlying the repository site will prove to be a difficult challenge. Once the exploratory shafts are constructed, engineers at the site must also take extra care to prevent groundwater from seeping down the shafts to the repository depth, thereby altering and invalidating technical data collected at that level. Critics of the program point out that shafts have never been constructed to such depths in basalt and, therefore, unforeseen construction problems are likely to occur. DOE officials acknowledge that such problems may occur; however, they are confident in their technical capabilities to handle any situations that arise.

SECTION 3

THE YUCCA MOUNTAIN SITE

BACKGROUND

In 1976 DOE identified the Nevada Test Site area, about 85 miles northwest of Las Vegas, as a potentially acceptable area for a mined geologic repository. DOE officials said the area was selected (1) because the land belongs to DOE and was already dedicated to nuclear activities and (2) for technical reasons, such as a deep water table (about 1,700 feet), a closed hydrological basin, and many natural barriers. In February 1983 DOE identified Yucca Mountain, which lies on federally administered land adjacent to the Nevada Test Site, as one of nine sites considered potentially acceptable for a repository. On May 28, 1986, the President approved Yucca Mountain for site characterization.

Yucca Mountain is the only one of the three candidate sites where the proposed repository would be above the existing groundwater table. The rock body at repository depth (about 1,200 feet) is a thick (330-575 feet), highly sorptive volcanic material called tuff. The site is remotely located in Nye County with a population density of .5 person per square mile.

The Nevada Waste Management Project Office, located in Las Vegas, administers the repository project (called the Nevada Nuclear Waste Storage Investigations Project) for OCRWM and is responsible for conducting site characterization and evaluating the Yucca Mountain site. The project office has a number of contractors to perform work related to site characterization. Scientific and engineering investigations and evaluations are being conceived, developed, and executed by the U.S. Geological Survey and three DOE-owned, contractor-operated laboratories (Los Alamos National Laboratory, Sandia National Laboratories, and Lawrence Livermore National Laboratory). Science Applications International Corporation is providing technical and management support services to the project office and environmental studies related to site characterization. Tests are conducted at the Nevada Test Site using on-site contractors who follow established procedures. The project office is responsible for day-to-day direction of the project.

SITE CHARACTERIZATION ACTIVITIES

Since 1977 over 170 drill holes, trenches, and pits have been emplaced or constructed to obtain site-specific data. However, activities at the site since May 1986 have been limited to (1) monitoring seismic, hydrologic, and various geologic instruments and (2) mapping and sampling at some of the trenches. No new site characterization activities have been initiated at the site since May, largely due to stop work orders (see section 5) and

the time and manpower needed to develop adequate documentation to finalize the site characterization plan.

Status of the site characterization plan

The most pressing activity at the Nevada Waste Management Project Office currently is the development of the site characterization plan. To coordinate preparation of the plan, the project office formed a site characterization plan management group and developed a management plan that established the organizational structure and responsibilities and the necessary coordination for plan schedule, preparation, and development. The management group is to ensure that provisions in the management plan are accurately and efficiently completed in accordance with pertinent guidance, such as OCRWM's annotated outline for the site characterization plan.

The project office has assigned five contractors (Sandia, Los Alamos, and Lawrence Livermore National Laboratories, the U.S. Geological Survey, and Science Applications International Corporation) to write various chapters or sections of the plan; Science Applications International Corporation is also tasked with integrating the various written products. The initial draft text is submitted to the integrating contractor, and then to the management group which coordinates production, reviews, and revises each section and chapter. Each section and chapter is reviewed for technical content and consistency with the OCRWM requirements. According to project office officials, the completed draft plan will be submitted to OCRWM headquarters for review in early 1987.

Headquarters officials said that when the site characterization plan is completed a conceptual design report and study plans associated with construction of exploratory shaft facilities will be provided with it. According to project office officials, the conceptual design report will answer repository cost and schedule questions that are too detailed to include in the repository chapter (chap. 6) of the plan. About 100 study plans have been identified, but some of them may be consolidated. However, as of early December 1986, the project office had not begun to write the study plans.

Project office officials said that the Nevada site characterization plan should be finalized by April 27, 1987, the estimated completion date.

Status of exploratory shaft design

Yucca Mountain is the only site where the proposed repository would be (1) above the existing groundwater table and (2) accessible through inclined tunnels rather than through vertical shafts. The exploratory shafts at Yucca Mountain will

consist of one 12-foot diameter shaft to transport people, materials, and equipment and one shaft of about 6-foot diameter for ventilation and egress from underground areas. The project office is considering replacing the 6-foot shaft with another 12-foot shaft. Both shafts will extend beyond the proposed depth of the repository, and underground testing areas will be excavated from breakout rooms at three levels from the initial 12-foot shaft.

The 12-foot shaft is to be mined to a depth of about 1,480 feet using conventional mining techniques. The operation will be careful not to introduce much water during the drilling process so as not to disturb the moisture content of the rock. Project office officials state that shaft construction, barring any delays, should begin about May 1988.

ISSUES PECULIAR TO THE YUCCA MOUNTAIN SITE

The Nevada Nuclear Waste Project Office is faced with a number of technical issues that are different from those being experienced at the other two sites. Two issues are (1) concerns about faulting and seismicity in the area and (2) possible damage to the host rock during exploratory shaft construction.

According to project office, state, and NRC officials, the primary technical question to be addressed at Yucca Mountain concerns faulting and seismicity. State officials claim that Yucca Mountain is geologically unsafe due to potential earthquakes. In the event of an earthquake, the faults could become water conduits to the repository and the groundwater would then become contaminated. Project office officials maintain that the state's conclusions are based on studies of surrounding higher areas that have snow-capped mountains producing large amounts of water infiltration. DOE's environmental assessment for the Yucca Mountain site states that reasonably available seismic design technology is expected to be sufficient to safely construct, operate, and close a repository. It also states that the anticipated nature and rates of fault movement or other ground motion are not expected to adversely affect the construction of the exploratory shaft or repository.

Another technical issue facing the Yucca Mountain site is the degree of care needed to ensure that testing does not alter the characteristics of the host rock or scientific measurements. DOE officials said they must be careful not to change the natural conditions of the unsaturated rock zone in which tests are working. The environmental assessment states that chemicals introduced into the exploratory shaft must be controlled and minimized; a minimum amount of water must be used in the exploratory shaft, especially during the experimental phase; and mining and drilling must be done under dry conditions, to the greatest extent possible. This is to minimize water so that the integration of water in tuff will not

adversely affect the condition of the unsaturated zone. This process, however, may create health problems caused by high-silica dust, requiring a special ventilation system. Further, unlike the other two candidate sites, DOE is planning a horizontal entrance tunnel to the repository location at Yucca Mountain. Therefore, considerably more tunneling will be required. Studies must be done to determine what long-term effects the added tunnels will have on the host rock.

Another issue that will be addressed during site characterization at Yucca Mountain is whether underground springs existed in that area in the past. In one area adjacent to the proposed repository, DOE has not been able to determine whether past water movement resulted from groundwater draining through the rock from the surface or hot springs bubbling up from beneath the surface. NRC officials said that the existence of underground springs in the past would raise many questions about the adequacy of a repository to safely contain radioactive material.

SECTION 4

THE DEAF SMITH SITE

BACKGROUND

In February 1983 DOE identified a location in Deaf Smith County, Texas, as one of nine potentially acceptable sites for a mined geologic repository. The location was subsequently narrowed to nine square miles. Later, DOE determined the Deaf Smith site to be one of three preferred sites, and on May 28, 1986, the President recommended the site for further detailed site characterization study.

The Deaf Smith site is in the southern high plains of the Texas Panhandle. (See map on p. 13.) The privately owned land is flat, fertile cropland, although there is some range land at the site and in its vicinity. The site is rural with an average population density of four people per square mile.

The host rock of the repository is a sequence of bedded rock salt about 160 feet thick. The proposed repository level is about 2,400 to 2,500 feet below the surface. Beneath the southern high plains lies an unconfined aquifer that consists of the Ogallala Formation and the Dockum Group. The proposed repository would be about 1,000 feet beneath the aquifer, which provides irrigation water for the region's agricultural production.

DOE's Salt Repository Project Office, located in Columbus, Ohio, was responsible for evaluating each of the seven salt sites throughout the candidate site selection process and is now responsible for characterizing the Deaf Smith site. DOE officials expect the project office to relocate to Texas before the end of 1987.

SITE CHARACTERIZATION ACTIVITIES

Unlike the other two sites, no on-site technical studies have been conducted at the Deaf Smith site, although some regional data have been collected. Little has been done because the land is privately owned and, according to project office officials, DOE has never authorized site-specific studies for salt sites.

Land acquisition

The project office is in the initial stages of the land acquisition process necessary for site characterization. The project office has determined that it will need to purchase 61 acres of the proposed site for the exploratory shaft facility and to obtain some access to all nine square miles for other studies, including engineering design boreholes. The project office intends to acquire the land by using the services of the U.S. Army Corps of

Engineers. In September 1986, through a memorandum of understanding, DOE agreed to have the Corps use existing data to conduct a preliminary planning analysis, which will identify land access options. This analysis was to be completed in the second quarter of fiscal year 1987.

The project office plans to hold meetings with the landowners and local officials in February 1987, to prepare for the Corps' conducting an on-site appraisal. The Corps will then prepare a real estate planning report that will require about 6 weeks to complete. The project office will then prepare a land acquisition plan, which, once approved by headquarters (estimated to be about May 15, 1987), will authorize the Corps to begin the land acquisition process. The Corps, in conducting its activities, is to follow all applicable federal regulations and orders.

The project office estimated in December 1986 that acquiring the initial 61 acres would be completed by early August 1987--if there are no condemnation procedures. They recognize, however, that some access agreements may require such procedures, lengthening the process by at least 3 months.

A project office budget official told us that his office had budgeted about \$4 million in fiscal year 1987 for land acquisition. In his view, this should be adequate to cover land needed for site characterization activities.

The Texas nuclear waste state representative told us that he has concerns about the land acquisition process. For example, he wants to ensure that the Texas landowners have the right of first refusal to buy back the land if the Texas site is not selected. Project office officials told us that their attorneys are looking into this possibility, but that this may be very difficult to arrange under federal property disposition procedures. Also, the representative told us that Texas, as evidenced by an October 1986 letter from Senator Bentsen to the Secretary of Energy, has linked the language in the 1987 budget continuing resolution, which did not provide funds for drilling an exploratory shaft, to all Texas site-specific activities, including land acquisition. The Texas representative indicated that, if land acquisition activities are initiated, the state and/or individual landowners would seek a court injunction to bar such activities. The Secretary of Energy stated that the restriction of funds does not prohibit other types of site-specific activities that may be undertaken in fiscal year 1987, although funding for such activities has been reduced.

Status of site characterization plan

According to project office officials, the formal process for the Deaf Smith site characterization plan began on December 1, 1986, and is now on a 66- to 68-week track with the plan projected

to be completed in March 1988. The project office has assigned over 30 selected persons, primarily contract employees, to author various chapters or sections of the plan; however, actual drafting of the plan is not expected to begin until March 1987.

Meanwhile, the project office is defining how the plan will be written, preparing detailed outlines of all sections of the plan, and coordinating and cross-referencing all information that will be included. During preparation of the plan, project office employees will be reviewing and monitoring the drafts to make certain that agreed-upon detailed outlines are followed and base-line information is included. Base-line information is derived from information found in the environmental assessment and supporting references and includes technical information for all future design and modeling efforts. Project office officials said that the March 1988 plan completion date can be met as long as there are no major interruptions, such as moving the project office to Texas during the writing phase or making major changes to plan requirements due to lessons learned from the Nevada and Hanford plans.

The Deaf Smith site characterization plan will include all the information discussed in section 1. Attachments to the plan will include investigation plans defining information-gathering for technical categories that need more detailed study plans to answer technical questions concerning the site. According to headquarters officials, study plans associated with the construction of exploratory shaft facilities must also accompany the site characterization plan. Project office officials said that, as of December 2, 1986, about 22 investigation categories and 32 study plans had been identified.

Site characterization activities in the field will be performed by three prime contractors and an integration and support services contractor. Parsons-Redpath will be responsible for constructing the exploratory shafts. A contractor will be selected by April 1987 to perform geologic, hydrologic, geochemical and rock mechanics testing, engineering development, and environmental/socioeconomic work at the site. The third contractor, the Texas Bureau of Economic Geology, will support the new contractor in geologic and hydrologic studies. An integration and support services contractor for the site will also be selected during the second quarter of fiscal year 1987. This contractor will maintain an in-depth understanding of the project and an overview of the entire OCRWM program; it will (1) ensure that project work is adequately defined, planned, budgeted, scheduled and executed and (2) be responsible for assisting in integrating work of national laboratories, other federal agencies, and other contractors. The two new contracts were previously one contract administered by the Battelle Memorial Institute. DOE decided to award two separate contracts because of a possible conflict of interest of one

contractor performing technical work and being responsible for total support and integration.

Status of exploratory shaft design

In August 1984 OCRWM's Office of Geologic Repositories provided guidance to the Salt Repository Project Office that the Deaf Smith exploratory shafts would be a 10-foot finished diameter drilled first shaft and a 6-foot finished diameter drilled second shaft. In October 1984 the project office recommended changing to two 12-foot finished diameter conventionally sunk shafts, i.e., the drill-and-blast method. The shafts would be sunk about 2,600 feet. The project office maintained that the change would (1) provide additional margin for compliance with safety, (2) enhance flexibility in constructing and operating the facility, (3) be significantly cheaper, and (4) meet schedule considerations.

In November 1984 a "freeze method" using conventional mining was selected to sink the shafts. This method freezes the ground to a depth of about 1,000 feet to control water migration and to stabilize the ground sufficiently for shaft penetration. The shafts are then mined using conventional techniques. The Texas nuclear waste representative said that he is convinced that the freezing and drill-and-blast method presents serious health and safety concerns. He stated that DOE is pursuing it because delays are less likely and because the method is less costly than the large-drill-bit method.

In December 1985 the preliminary shaft design was completed, and in February 1986 the final design was initiated. It was not yet complete in December 1986. If the site is selected as the first repository, the shafts will be used in constructing the repository; however, no decision has been made concerning the shafts' role, if any, in the operation of the repository.

ISSUES PECULIAR TO THE DEAF SMITH SITE

Some unique concerns exist about the Deaf Smith site. These concerns include the site's lagging schedule when compared with the other sites and the need to move the project office to Texas.

Deaf Smith site characterization schedule lags behind the other two sites

Columbus project office officials stated that, because they have been responsible for site selection work on all seven potential salt sites, as compared to the other two project offices' one site each, they were not able to concentrate on the Deaf Smith site until June 1986. Also, unlike the other two sites, DOE has conducted no on-site work at Deaf Smith. Because of these factors

the Deaf Smith site characterization schedule lags behind the other two sites and, according to DOE officials, could fall further behind.

The site characterization plan for the Deaf Smith site is scheduled to be completed a year later than both the Hanford and Yucca Mountain plans. Land acquisition could cause even further delays; these have not been factored into the Deaf Smith site characterization schedule. As discussed earlier, if condemnation proceedings are initiated, project office officials said another 3 months could be added to the time needed for acquisition, and additional lawsuits could extend that time even more. DOE's January 1987 draft Mission Plan Amendment recognizes that land acquisition may take more time than originally planned. In addition, the state of Texas has a shaft drilling permit law that could cause further delays, depending on how DOE decides to comply with the law. This law could lead to extra effort on DOE's part and possibly more lawsuits, meaning more potential delays and expenses. DOE's draft Mission Plan Amendment states that obtaining permits to sink shafts will require at least 18 months after acquisition of the land. DOE officials said that DOE will meet the intent of the Texas law and that consultation with state officials will determine the mechanism for compliance. The draft Mission Plan Amendment said that permitting and land acquisition will be the primary initial activities for the Deaf Smith site.

Because the NWPA states that three sites are to be characterized, it appears that a repository selection decision will not be made until each of the three has been determined to be acceptable or unacceptable. The possibility exists that the Deaf Smith site will lag considerably behind the other two, thereby pacing or delaying the total program. OCRWM headquarters and project office officials maintain, however, that much more "corporate" knowledge exists about mining salt. They are confident the Deaf Smith site will "catch up" with the other two sites once field work is initiated.

Moving the Salt Repository Project Office to Texas

The Deaf Smith site is the only candidate site without an on-site project office. Project office officials indicated that this has had and will continue to have several negative effects on the program:

- Project office personnel do not know if or when a move will be made to Texas, causing staff morale problems.
- When the move is finally made, some project office as well as contract staff are likely to leave the program.

- Local public opposition to the program is not likely to decrease until DOE has a continuing local presence.
- Logistical problems associated with the move could delay site characterization activities.

According to project office officials, the project office can move to Texas at any time once the decision is made to do so.

SECTION 5

PROGRAMWIDE SITE CHARACTERIZATION ISSUES

In addition to those concerns specifically associated with an individual candidate repository site, three other issues could have a major impact on the overall successful conduct of site characterization activities. These are

- DOE's current inability to estimate the length and cost of the site characterization phase of the waste program,
- the need for DOE to enhance and develop effective institutional relationships with the affected states and tribes and with NRC, and
- the need to develop a credible programwide quality assurance program.

DEFINITE TIME AND COST ESTIMATES FOR SITE CHARACTERIZATION NOT AVAILABLE

According to DOE officials, site characterization officially began with the President's selection of the three candidate sites. No significant field work has started at any of the three sites since then. The project offices have focused primarily on completing the site characterization plans, and most new work has been prevented by stop work orders resulting from questions about quality control. In addition, no site work can be done at the Deaf Smith site until the land is acquired, and DOE cannot begin sinking exploratory shafts at any of the sites (1) until the site characterization plan for the site is completed and (2) because the Congress specified that funds are not to be used for such activities during fiscal year 1987. (According to DOE officials, it is unlikely that DOE would have been ready to begin the shafts in 1987 if such work had been funded because of the need to first complete the plans and other preliminary work.)

Once the site characterization plans are completed and public hearings held, DOE should be ready to sink exploratory shafts and to start actual site tests and research. DOE estimated in January 1987 that the site characterization phase will last 6 to 7 years beginning in May 1986 (DOE's previous estimate was 5 years); site characterization will end when DOE completes the testing necessary for selecting the repository site and preparing the draft environmental impact statement. All site characterization work is now scheduled to be complete by 1993. Various DOE, NRC, and state officials pointed out in November and December 1986 that there are uncertainties as to when site characterization ends and that at least two other interpretations have been used: (1) when DOE submits a license application to NRC and (2) when NRC approves a license application to construct a repository, which, according to

the act, can be as long as 4 years after submission. Applying different definitions could technically further extend the period for site characterization.

In early 1986 DOE estimated that site characterization would be completed by 1991. However, NRC, state, and many DOE officials we spoke to in November and December 1986 told us that the site characterization phase could not be completed until 1993 or 1994. The January 1987 draft Mission Plan Amendment estimates that site characterization will not be completed until 1992 for Yucca Mountain and 1993 for the other two sites (see table 5.1). These projections are 1 to 2 years later than DOE's 1986 estimates and 2-1/2 to 3-1/2 years later than DOE estimates made in 1985.

DOE has acknowledged in the past that it cannot predict time frames with reasonable certainty because of unknown variables such as technical, legal, economic, and political factors. We pointed out specific examples of these in the sections describing problems at each of the sites. The DOE draft Mission Plan Amendment takes some of these factors into account--such as recognizing that more time will be needed to gain access to and control of land at the Deaf Smith site--when revising estimates for completing the site characterization phase. According to DOE officials, whether revised estimates allow enough time for these factors remains to be seen. They state that the current schedule depends not only on the factors above, but also on adequate funding to meet budget requirements (latest estimate is \$725 million for fiscal year 1988) upon which the schedule is based. The schedule may slip even more, they indicated, if the program experiences budget reductions like the approximate \$200 million fiscal year 1987 reduction.

Table 5.1: Schedule for Site Characterization

<u>Milestone</u>	<u>Milestones estimated as of</u>		
	<u>1985</u>	<u>1986^a</u>	<u>1987^c</u>
Start site characterization phase	Jan. 1986	May 1986	May 1986
Issue site characterization plan			
Yucca Mountain	Mar. 1986	April 1987	mid-1987
Hanford	Mar. 1986	July 1987	mid-1987
Deaf Smith	Oct. 1986	Mar. 1988	Mar. 1988
End site characterization phase ^b			
Yucca Mountain	Sept. 1989	Dec. 1991	Mar. 1992
Hanford	Sept. 1989	Dec. 1991	Mar. 1993
Deaf Smith	Sept. 1989	Dec. 1991	Mar. 1993
Submit license application to NRC	June 1991	June 1991	Mar. 1995
Receive construction authorization from NRC	Sept. 1993	Sept. 1993	Mar. 1998

^a1986 dates were obtained from various DOE documents and interviews with DOE officials during 1986.

^bDOE defines the end of the site characterization phase as the completion of testing necessary for selecting the repository site and preparing the draft environmental impact statement.

^cJanuary 1987 estimated milestones.

Source: DOE.

According to DOE officials, not only will funding affect the timing of site characterization, but timing can also affect the cost of site characterization and the program in general. They stated that the longer site characterization continues, the more it will cost. DOE's frequent changing of the ending date for site characterization work also means that existing cost estimates for the phase are very tentative. In mid-1986 the OCRWM director stated that site characterization would cost about \$1 billion per site. However, in November and December 1986 and January 1987, when we asked OCRWM headquarters officials and the project offices to provide us with a breakdown of projected site characterization costs and costs to date, we were told that such data were not readily available because site characterization activities had not

yet been defined for cost purposes. In early February 1987, however, OCRWM headquarters officials did provide us with projected estimated costs based on OCRWM's April 1986 total system life-cycle costs analysis and DOE's 1987 budget submission. As table 5.2 shows, the estimated site characterization costs for each of the three sites range from about \$650 million to about \$806 million in fiscal year 1985 dollars.

Work breakdown structure category ^a	Fiscal year						Total
	1986 ^b	1987	1988	1989	1990	1991	
	(millions of 1985 dollars)						
Systems							
Hanford	3.6	8.2	8.4	8.5	8.5	5.5	42.7
Yucca Mountain	2.5	6.2	7.0	5.8	5.7	3.7	30.9
Deaf Smith	3.2	6.2	5.5	4.7	3.6	2.3	25.5
Waste package							
Hanford	9.7	19.2	18.2	18.6	12.0	-	77.7
Yucca Mountain	4.4	9.6	7.5	7.1	3.6	-	32.2
Deaf Smith	4.5	8.9	7.7	6.8	3.8	-	31.7
Site							
Hanford	14.8	37.4	37.2	28.5	24.9	8.2	151.0
Yucca Mountain	19.0	55.1	41.3	33.8	26.2	6.7	182.1
Deaf Smith	30.5	37.5	63.8	26.5	37.9	6.8	203.0
Repository							
Hanford	10.3	28.7	34.9	41.8	29.9	-	145.6
Yucca Mountain	7.2	20.7	29.5	32.3	23.1	-	112.8
Deaf Smith	14.1	32.0	45.9	42.3	24.5	-	158.8
Regulatory and institutional							
Hanford	6.3	12.8	14.5	17.5	18.2	5.5	74.8
Yucca Mountain	4.2	11.2	12.3	13.6	14.1	4.6	60.0
Deaf Smith	9.4	20.8	24.0	23.5	22.6	6.1	106.4
Exploratory shafts							
Hanford	8.6	38.9	58.3	35.1	44.6	2.4	187.9
Yucca Mountain	8.6	33.5	40.5	23.1	16.1	0.9	122.7
Deaf Smith	6.5	38.5	55.0	65.0	24.0	2.9	191.9
Test facilities							
Hanford	1.9	2.8	2.8	2.8	2.8	1.9	15.0
Yucca Mountain	.5	0.7	0.5	0.4	0.4	0.3	2.8
Deaf Smith	.6	1.3	1.2	0.6	0.6	0.4	4.7
Land acquisition							
Deaf Smith	5.6	7.2	3.5	3.4	3.5	2.3	25.5
Program management							
Hanford	4.2	8.6	8.4	8.4	8.4	5.5	43.5
Yucca Mountain	8.6	19.6	22.5	21.5	20.8	13.8	106.8
Deaf Smith	5.2	11.4	11.5	11.5	11.6	7.7	58.9
Total							
Hanford	59.4	156.6	182.7	161.2	149.3	29.0	738.2
Yucca Mountain	55.0	156.6	161.1	137.6	110.0	30.0	650.3
Deaf Smith	<u>79.6</u>	<u>163.8</u>	<u>218.1</u>	<u>184.3</u>	<u>132.1</u>	<u>28.5</u>	<u>806.4</u>
Program total	<u>194.0</u>	<u>477.0</u>	<u>561.9</u>	<u>483.1</u>	<u>391.4</u>	<u>87.5</u>	<u>2,194.9</u>

^aCategories used by DOE for budget and reporting purposes.

^bBecause the President approved candidate sites in May 1986, one-half of the 1986 costs were assumed to be part of the site characterization phase.

These figures assume that all first repository program costs (except for work performed on the selected site in 1990 and 1991) from May 28, 1986, through May 1991 would be site characterization costs. Project office officials agreed that this is a logical way to estimate costs; however, there are some questions as to whether some areas, such as waste package or institutional costs, should be included. They said the project offices could also provide estimates for the site characterization phase using budget estimates if someone defined exactly what costs were to be included. They said that any cost figures used would be based on a 1991 site characterization completion date. For example, the Salt Repository Project Office in Columbus estimated its costs to be approximately \$1.1 billion, rather than the \$806 million shown in table 5.2. Estimates were made by subtracting costs incurred through May 1986 from total estimated costs through 1991; however, any extensions of the 1991 date would necessarily raise the estimated costs.

In January 1987 DOE's draft Mission Plan Amendment estimated that the site characterization phase would be extended to 1992 for Yucca Mountain and 1993 for the other two sites. DOE officials stated that, due to these changes, cost estimates would increase and that DOE is currently in the process of re-estimating costs. The results of this effort will not be available until the spring of 1987. Project office and headquarters officials also stated that cost estimates should be better defined after the site characterization plans are completed.

SITE CHARACTERIZATION INSTITUTIONAL ISSUES

The parties most directly involved with DOE in the site characterization phase are the affected states and tribes and NRC. According to NWPA, DOE is to consult with affected states and tribes to the maximum extent practicable in conducting site characterization activities. Such consultation includes providing for review and comment of site characterization plans and conceptual repository designs. NWPA also requires DOE to provide site characterization data required for evaluating a suitable site so that NRC can authorize construction of such site. DOE is to consult with NRC throughout site characterization to inform NRC of progress. DOE's ability to maintain an effective, positive relationship with states, tribes, and NRC will play a crucial role in the overall success of the site characterization phase.

The National Academy of Sciences (NAS) or another independent party may also assume a critical role as an independent peer reviewer. DOE has already asked NAS to become involved as an advisor during site characterization. NAS has agreed but its role has not yet been defined.

States' and tribes' role during site characterization

States and tribes affected by the three candidate sites continue to be very critical of DOE's conduct of the entire nuclear waste program. State and tribal officials we spoke to complained that DOE has not kept them informed about the direction and extent of site characterization activities and that, as of December 1986, they had only seen very preliminary drafts of a few site characterization plan chapters. In addition, officials from Washington State and the Yakima and Umatilla Indian tribes charged that DOE had not met its responsibilities under the act to keep affected states and tribes adequately informed of program activities. According to them, informal efforts over the past several months to obtain information concerning ongoing and planned site characterization activities have been unsuccessful.

Nevada disagrees with DOE concerning its 1987 request for grant funds which DOE is authorized by NWPA to provide to states and Indian tribes affected by the program. In October 1986, Nevada requested about \$10.25 million in grant funds. Project office officials said that Nevada's previous estimate in February 1986 was \$5.6 million and that there was no warning that Nevada would ask for an increase. Because of overall program budget cuts, Nevada project office officials indicated that the approved grant will probably be closer to the amount Nevada requested in February. Nevada's position is that the higher funding level is necessary to conduct hydrology studies and to keep the state on a parallel track with DOE, especially in light of the site characterization plan, which Nevada will need to analyze in detail.

DOE headquarters and project office officials say that states and tribes will have an early opportunity to review all aspects of the site characterization plan and that every attempt will be made to respond to state and tribal concerns. (See our February 1987 report entitled Institutional Relations Under the Nuclear Waste Policy Act of 1982 (GAO/RCED-87-14) for a complete discussion of federal, state, and tribal relationships under the Nuclear Waste Policy Act.)

Nuclear Regulatory Commission

As discussed in section 1, the Nuclear Waste Policy Act mandates that NRC participate in pre-license consultation with DOE prior to DOE's submission of a license application to the Commission for review. To date, however, contact between NRC and DOE has been somewhat limited. DOE and NRC officials say they are working on improving their interaction in hopes of reducing future problems.

NRC's Office of Nuclear Material Safety and Safeguards is responsible for all nuclear waste programs, including the repository, waste transportation, and monitored retrievable storage. The Office's Division of Waste Management has dedicated a team to each of the three project offices to provide technical guidance and consultation and to review formal DOE documents. NRC's 1987 budget for the nuclear waste management program is about \$20 million (including salaries, travel, technical assistance, and research contract work) and about 100 people work on the repository program. NRC has on-site representatives at both the Hanford and Yucca Mountain sites. NRC officials recalled the representative from the Columbus project office in the fall of 1986; they have not reassigned a representative to Columbus and probably will not until an on-site office is established.

In our conversations with NRC waste officials, they emphasized the need to have early and frequent contact with the DOE staff to avoid licensing problems later on. However, they explained that DOE currently is so involved in preparing the site characterization plans that little interaction has occurred. NRC officials told us that while general "management" meetings and meetings on generic topics have been periodically held with DOE headquarters and project office officials, only two formal technical meetings, where a site-specific technical area is defined and standards are agreed to, have occurred since the end of 1985. DOE project office officials said that their efforts have been focused on the site characterization plan that the NRC will analyze and that no technical meetings have taken place because preparing for them takes as long as 6 staff-months.

In fact, DOE headquarters sent directions, dated July 25, 1986, to the Nevada project office to limit interactions with NRC to those required to clarify items in the site characterization plan or to complete portions of the plan. However, DOE project office officials also stated that there have been times when NRC officials have refused to meet. (NRC officials said they probably did refuse to meet during the 90-day period they were commenting on the environmental assessments.) Columbus project office officials said that their office needs NRC involvement and that it is difficult to interact without an on-site NRC representative.

NRC is also concerned with possible conflicts of interest because of the number of contractors who have become involved in the program. Many of NRC's contractors are competing for contracts under DOE's program. For this reason and because NRC feels a need for long-term continuity in technical assistance and research, NRC is establishing and will be the sole sponsor of the Center for Nuclear Waste Regulatory Analyses, a federally funded research and development center. NRC officials told us that they hope to have a contract for the center awarded by late 1987. This, NRC officials

hope, will make them more competitive with DOE for technical contractors.

NRC officials stated that NRC's next major involvement in the program will be to analyze the site characterization plans. DOE officials said that they will be expected to respond to any major criticisms in NRC's analysis; however, site characterization should proceed as scheduled. NRC officials said that they will need 6 months to review the plans.

Potential NAS involvement in the program

On July 25, 1986, the Director of OCRWM asked the President of NAS to have its Board on Radioactive Waste Management become involved in overseeing site characterization activities. He asked that NAS review the proper scope and content of future Board involvement, giving particular emphasis to site-specific and comparative evaluations through suitably constituted panels of the Board. He recognized and endorsed the need for NAS to have autonomy in formulating the nature of its participation.

NAS replied on August 14, 1986, that the Board would provide advice to OCRWM during site characterization and a written proposal outlining its role. An NAS official told us in December 1986 that the proposal would not be completed until late February 1987. Two state officials have expressed concerns that DOE may obtain NAS' endorsement of DOE-discovered information and thereby affect NAS' willingness to support denial of a license; however, NRC headquarters officials have no problems with NAS providing independent oversight of the program, and NAS officials stated that maintaining its independence would not be a problem.

QUALITY ASSURANCE

Licensing a geologic repository for high-level waste involves assessing whether the geologic setting and the engineered system will meet the performance objectives of 10 CFR Part 60. Important questions in licensing assessments are the relevance, adequacy, and completeness of data and analyses supplied in the license application. Assessments must provide reasonable assurance that long-term disposal of high-level waste will not provide unreasonable risks to the health and safety of the public. Therefore, 10 CFR Part 60 requires a quality assurance program to provide confidence in work performed in planning, designing, constructing, operating, and permanently closing a repository.

DOE is responsible for achieving and ensuring repository quality. It has the burden of proof in all licensing proceedings and is responsible for developing all required information. NRC is

to exercise sufficient, though limited, oversight during the pre-licensing site characterization phase to ensure that a license application meets all requirements. DOE and NRC are required to conduct pre-licensing consultation to aid in identifying and resolving issues prior to licensing. DOE must have an adequate quality assurance program during the site characterization phase to demonstrate quality and completeness of information used to apply for a license.

DOE has implemented a quality assurance program designed to fulfill DOE and NRC requirements and to better ensure licensability of any site selected for repository construction. OCRWM has an overall quality assurance policy document and has issued general guidelines for project offices. Project offices have developed their own quality assurance plans and manuals based on DOE, NRC, and OCRWM requirements. In turn, each DOE contractor is required to have an acceptable quality assurance program approved by DOE. The contractor is not to engage in any contracted activities that have quality assurance impacts until its program is approved. Once a program is approved, the contractor is required to perform its own quality assurance and control functions, such as audits, surveillances, inspections, confirmation testing, and non-destructive examinations. DOE and contractor quality assurance personnel monitor these quality functions by performing independent audits, surveillances, or inspections. In addition, quality assurance personnel from both OCRWM headquarters and the responsible DOE operations office monitor the project office's quality assurance program and its audit efforts. All audit reports (conducted by project offices or on their behalf) are to be submitted to headquarters and the responsible operations office.

Each of the project offices has a different organizational framework under which its quality assurance program operates. However, in general, each has a quality assurance manager responsible for day-to-day management and oversight of the quality assurance program; these responsibilities include preparing plans and procedures and auditing contractor programs. The managers rely heavily on contract consultants to perform most of these duties, and for the most part, each manager reports directly or indirectly to the responsible project office director. Unresolved quality assurance issues are elevated from project level to the responsible operations office and finally to OCRWM headquarters.

Stop work orders

Each of the three project offices has issued stop work orders to contractors in the past 3 years because of quality assurance-related activities. In each case the contractor is required to comply with requirements before restarting the work.

The Columbus project office has issued two stop work orders since the act was passed, one in 1984 to Pacific Northwest Laboratory and one in 1985 to Brookhaven National Laboratory. Work was stopped at Pacific Northwest due to the lack of an acceptable quality assurance program and at Brookhaven because it did not accept the project office's policy on publication of scientific results. Both have since resumed work.

During the first part of fiscal year 1986, the Nevada project office conducted a series of audits and surveillances. As a result, the project office issued stop work orders to the following six contractors for various reasons:

- U.S. Geological Survey did not perform in accordance with requirements established for quality assurance.
- Los Alamos, Lawrence Livermore, and Sandia National Laboratories and Science Applications International Corporation operated with either unapproved quality assurance level assignments or no assignments.
- Reynolds Electrical and Engineering Company, Incorporated, failed to practice and execute quality assurance at a level that satisfied regulatory requirements.

All these stop work orders are expected to be lifted by March 1987.

The lack of quality control has the potential to cause considerable problems. For example, Nevada DOE officials told us that the Geological Survey failed to properly document or maintain documentation of the core samples obtained from boreholes near the Yucca Mountain site. As a result, the project office may be unable to prove that "this core came from this hole at this depth," which means that tests performed on that core sample may not be able to be validated and, if not, might not be accepted by NRC in the licensing process. This could mean that many new core samples will have to be taken or existing boreholes revisited to help validate existing core samples.

On May 1, 1986, the Richland project office directed Rockwell Hanford to stop work on waste program activities. According to project office documents, audits and surveillances in early fiscal year 1986 identified inadequate quality assurance procedures, technical procedures, and staff training at the contractor level. According to the project office officials, the NRC headquarters staff and on-site representative had also expressed concern about these areas.

The stop work order issued to Rockwell was intended to focus efforts on implementing the appropriate quality control and

management systems needed to meet NRC licensing requirements. According to project office officials, about 1,300 work activities were reviewed and about half were stopped. Certain activities were exempted from the stop work order, such as (1) ongoing data-gathering activities whose interruption could result in loss of significant data; (2) management, operating, and quality assurance programs upgrades; (3) existing safety and maintenance activities; (4) site characterization plan preparation; and (5) activities considered essential to the project and imprudent to stop, e.g., contracts near completion. Project office officials hope to have the stop work order lifted at least partially by April 30, 1987, after NRC and affected states and tribes have an opportunity to review and comment on the restart.

MAJOR CONTRIBUTORS TO THIS FACT SHEET

Resources, Community, and Economic Development Division,
Washington, D.C.

Dwayne Weigel, Group Director
Ron Stouffer, Assignment Manager
Ken Goodmiller, Evaluator-in-Charge
Theresa Himbrick, Typist

Seattle Regional Office

Leonard Dowd, Regional Assignment Manager
Chris Herndobler, Site Senior
Peter Lossner, Staff Member

(301749)

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