SUMMER/FALL 1994

OCRWM BULLETIN

A Report from the U.S. Department of Energy's Office of Civilian Radioactive Waste Management

DEPARTMENT OF ENERGY SEEKS PUBLIC COMMENT ON WASTE ACCEPTANCE ISSUES

The Department of Energy has issued a Notice of Inquiry (NOI) that seeks to address the concerns of affected parties regarding the continued storage of spent nuclear fuel at reactor sites beyond 1998.

The Nuclear Waste Policy Act of 1982, as amended (the Act), provides a comprehensive framework for disposal of commercial spent nuclear fuel and high-level radioactive waste. Section 302 of the Act established the Nuclear Waste Fund and required owners and generators of spent nuclear fuel and high-level radioactive waste to pay fees into the Fund sufficient to ensure the full-cost recovery of all program expenditures. Section 302(a) authorized the Secretary of Energy to enter into contracts with the owners and generators of spent nuclear fuel and high-level radioactive waste of domestic origin for the acceptance and disposal of such wastes.

Section 302(a)(5) further stipulated that these contracts shall provide for the Department to take title to the spent nuclear fuel and high-level radioactive waste as expeditiously as practicable following commencement of operation of a repository and that, in return for the payment of fees established by this section, the Secretary, beginning not later than January 31, 1998, will dispose of these wastes.

The Department of Energy is mandated under the Act to site, design, construct, and operate the Nation's first geologic repository for the permanent isolation of spent nuclear fuel. When the Act was passed, the Department envisioned that a geologic repository would be in operation and prepared to begin acceptance of spent nuclear fuel by January 31, 1998. Experience, however, has shown that there are significant challenges associated with siting a geologic repository facility.

Through the recently issued NOI, the Department seeks to elicit comments from affected parties on:

- The Department's preliminary view that it does not have a statutory obligation to accept spent nuclear fuel in 1998 in the absence of an operational repository or suitable storage facility constructed under the Nuclear Waste Policy Act

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In This Issue

Published by the U.S. Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM). The *OCRWM Bulletin* is available to users of INFOLINK about one week before publication. To be placed on the *Bulletin* mailing list, make address corrections, obtain information about the national program, or order copies of the *Bulletin* or the new publications listed in the *Bulletin*, please contact the OCRWM Information Center, P.O. Box 44375, Washington, DC 20026, 1-800-225-6972 or 202-488-5513 in Washington, DC. You may also write to DOE, OCRWM, Office of Human Resources and Administration, RW-10, 1000 Independence Ave., SW, Washington, DC 20585.

OCRWM DIRECTOR GIVES CONGRESS A PROGRAM UPDATE

On August 3, 1994, the Office of Civilian Radioactive Waste Management (OCRWM) Director, Dr. Daniel Dreyfus, testified regarding the status of the nuclear waste program before the Subcommittee on Energy and Power, Committee on Energy and Commerce, U.S. House of Representatives. Highlights of his testimony follow.

Current Situation

Dreyfus stated that OCRWM identified a problem of internal consistency between the activities that were actually being carried out and the expectations for accomplishments. The problem can be considered in three components (OCRWM has taken steps to address each one):

"First with regard to site characterization activities at Yucca Mountain, the funding that was being provided was not adequate to support the work plan that we were embarked upon....

"The second component of the problem is the perception, and the reality, that program management needs improvement....

"The third component of the problem is the need to confront the issues of waste acceptance and interim storage. Here, too, the activities recently being pursued have become inconsistent with expectations for accomplishment...."

Excerpts of Dreyfus' statements on each of these three components follow:

Repository Site Characterization

"Based on our assessment of the Yucca Mountain Project, we are currently discussing a revised program of work, consistent with the proposed funding, with the Congress, our regulators, and other stakeholders.... The Administration has proposed a greatly increased funding profile for Fiscal Year 1995 and beyond that will support this new, more effective project of site characterization [see chart, left]. Funding would be provided from two sources (1) annual appropriations, and (2) proposed mandatory spending from a special fund." (For more details on funding, refer to the Spring 1994 issue of the *OCRWM Bulletin*.)

"Increased funding alone, however, will not regain the Yucca Mountain schedule.... A Proposed Program Approach was developed to bring the planned activities into conformity with the Fiscal Year 1995 budget request and out-year funding expectations, and to determine realistic estimates of schedules and costs:...

"The Proposed Program Approach will provide for a Technical Site Suitability Determination and a Draft Environmental Impact Statement in 1998. The scoping process for preparation of the Draft Environmental Impact Statement will be initiated in 1995. The Final Environmental Impact Statement will be completed in 2000, and a Site

"Congress" continued on page 3

OCRWM FY 1995 Congressional Budget Request

(Comparable Dollars in Millions)

Budget Element	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999
Yucca Mountain Site Characterization Project	242	260	381	470	510	511	515
Advanced Technology for Near-Term Storage							
–Spent Fuel Storage	16	15	30	29	32	50	68
–Transportation System	19	14	21	23	26	30	21
–Waste Acceptance	3	3	6	7	9	10	11
Subtotal	38	32	57	59	67	90	100
Program Management and Compliance	95	88	94	101	107	112	117
Subtotal, Nuclear Waste Activities	375	380	532	630	684	713	732
Civilian Waste R&D	4.6	0.7	0.7	0.7	0.7	0.7	0.7
Total Program (rounded to millions)	380	381	533	631	685	714	733
Funding							
• Nuclear Waste Fund							
–Base Appropriation	275	260	255	265	276	287	298
–Special Account	—	—	148	236	279	297	305
Subtotal	275	260	403	501	555	584	603
• Defense Nuclear Waste Disposal Approp.	100	120	129	129	129	129	129
• Civilian Waste R&D (Energy Supply R&D)	4.6	0.7	0.7	0.7	0.7	0.7	0.7
Total Program (rounded to millions)	380	381	533	631	685	714	733
Utility Fees	437	391	551	585	591	592	600

DISCLAIMER

DISCLAIMER

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"Congress" continued from page 2

Recommendation Report will be provided to the President later that year.

"Repository licensing is an incremental process beginning with submittal of the License Application for construction authorization in 2001, an updated application for a license to receive and possess spent nuclear fuel and high-level waste in 2008, and a final application for a license amendment to close the repository during or before 2110.... If we are successful in obtaining the funding and achieving acceptance of our proposed program of work, a repository could be capable of emplacing spent fuel in 2010...."

Program Management

"Based on our review there is substantial room for improvement [of program management]. We have been taking aggressive action to make more effective use of the resources we have available to us and to better integrate program activities.

"The Federal staff at Yucca Mountain has been reorganized to define clear lines of responsibility and accountability related to project goals. The contractor establishment is being restructured to reflect the same philosophy. The program's Headquarters organization has also been realigned to place emphasis on the near-term issues of waste acceptance and the major management needs of overall program integration. We are putting our talent and human resources where the critical needs are. We are backing this reorganization up with strong human resource considerations and business management improvements." (See related article in this issue for additional details.)

Near-Term Management of Commercial Spent Fuel

"...Until commercial spent nuclear fuel can be moved to either a centralized interim storage facility or a repository, we anticipate it will remain at reactor sites.... Because of the lead time involved, at-reactor storage decisions are imminent for many utilities.... To reduce the uncertainty confronting these storage decisions, it is essential that the Federal waste management program be given clearly defined objectives, and be funded at a level that will enable us to carry out these objectives....

"Siting a repository continues to be a critical need and the ultimate goal of our program. Without a repository, all interim storage issues become far more difficult, but we must also define an appropriate strategy for interim management of spent nuclear fuel until a repository is available.... In the 1987 Amendment to the Nuclear Waste Policy Act, the Congress limited the Department's authority to site an interim storage facility.... A voluntary process for siting a monitored retrievable storage facility was instituted.... To date, we have no voluntary host for a Federal facility.... The Department's options to address near-term storage, therefore, are severely limited. The Department is implementing plans for a standardized multipurpose canister to support spent nuclear fuel transportation, storage, and disposal [for more details see the Special Issue of the *OCRWM Bulletin*, August 1994]. Its availability, however, will not fully address the economic, equity, and technical considerations of extended at-reactor storage....

"On May 25, 1994, the Department of Energy formally issued a Notice of Inquiry (NOI) to invite the views of interested parties and to advance the consensus-building process [see related article in this *Bulletin* for more details].... The Department of Energy cannot act alone to define the strategy that should be taken to solve the near-term waste management problem.... I think that the Department and Congress have an obligation to advance the process."

Consideration of Legislation

"...The Administration proposed that appropriations continue to be made from the Nuclear Waste Fund and the Defense Nuclear Waste Disposal account, but that an additional portion of each year's utility fee receipts be made available for the intended purpose of funding the Civilian Radioactive Waste Management program and providing a viable approach regarding nuclear waste storage and disposal.... Adequate funding will be a critical component of any policy that is chosen for both short- and long-term management.

"With respect to legislation for assisting efforts to develop a permanent disposal facility (or facilities) and ensuring that waste is safely stored in the interim, the Administration is not preparing legislation at this time and has not developed a position on legislative proposals or concepts that have been discussed in public or reported in the press. We view the Notice of Inquiry that we issued on May 25, 1994, as an important element in the determination of the need for and content of such legislation..."

Defense Waste

"If the [Yucca Mountain] site is found suitable and receives a license, our current planning basis calls for the disposal of 7,000 metric tons of high-level waste from the defense program, out of a total statutory

"Congress" continued on page 4

"Congress" continued from page 3

limit for the first repository of 70,000 metric tons prior to the operation of a second repository. The 7,000 metric tons translates to 13,500 canisters of high-level radioactive waste....

"In 1985, the President determined that the high-level waste produced at the Hanford Plant, the Savannah River site, and the Idaho National Engineering Laboratory could be emplaced with the commercial waste in a repository.... The Department's most recent evaluation of the quantities of high-level radioactive waste indicates that as many as 50,000 canisters may require disposal....

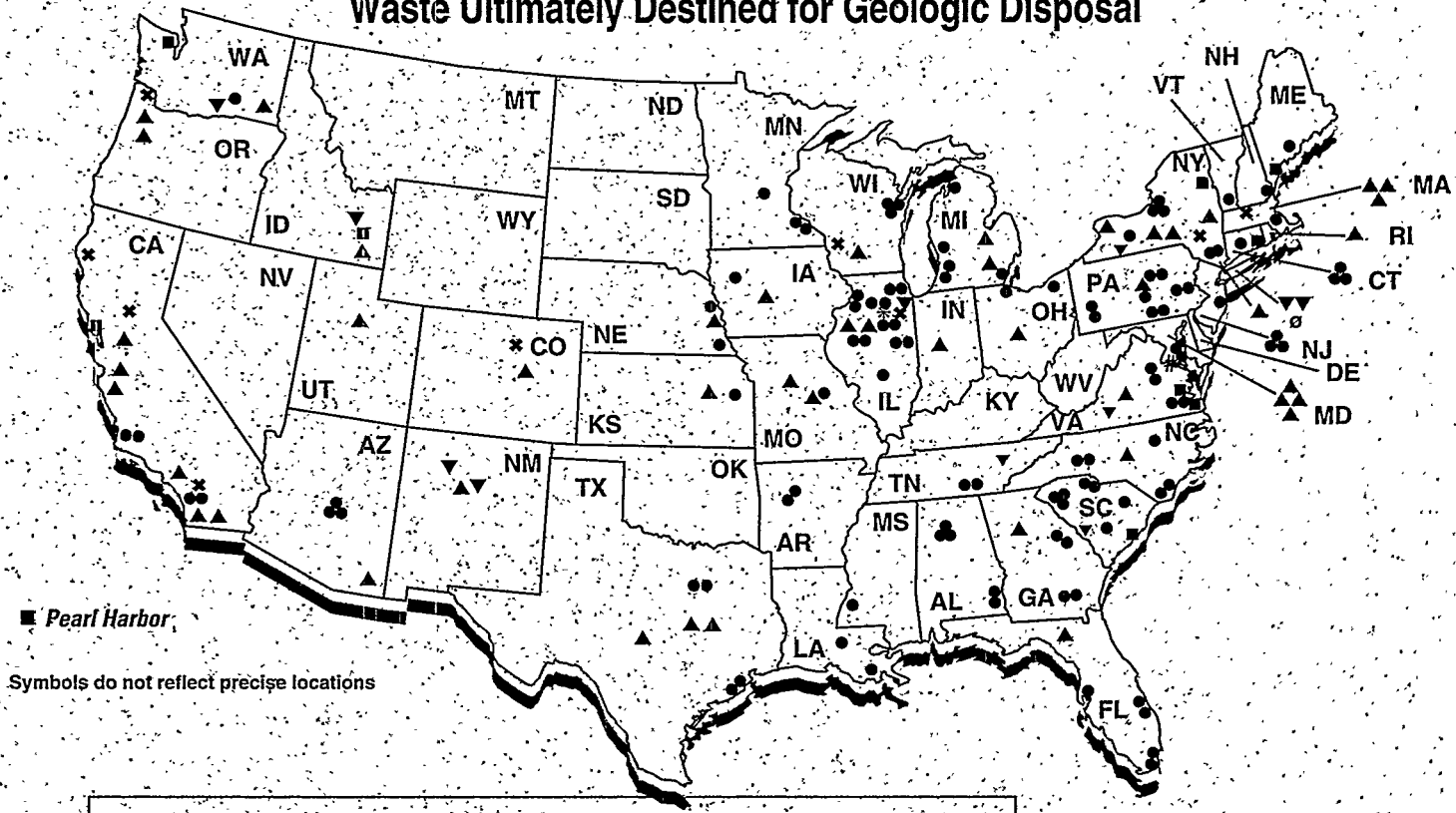
"There are additional miscellaneous wastes that should eventually be emplaced in a geologic repository.... The amount of miscellaneous waste is relatively small...we estimate the total amount of miscellaneous waste to be less than 3,000 metric tons...." (See map below.)

"The Department of Energy will be in a better position to determine the need for a second geologic repository between 2007 and 2010, as required in the 1987 Amendment to the Nuclear Policy Act..."

Conclusion

"This is a critical time for the program. The Administration has assigned a high priority to the management and disposal of the Nation's spent nuclear fuel and high-level waste. The program intends to carry out its mission in a way that will assure public health and safety, protect the environment, foster public confidence, and be economically viable. We look forward to cooperating with the Congress in the further development and implementation of an effective and feasible program."

Locations of Spent Nuclear Fuel and High-Level Radioactive Waste Ultimately Destined for Geologic Disposal



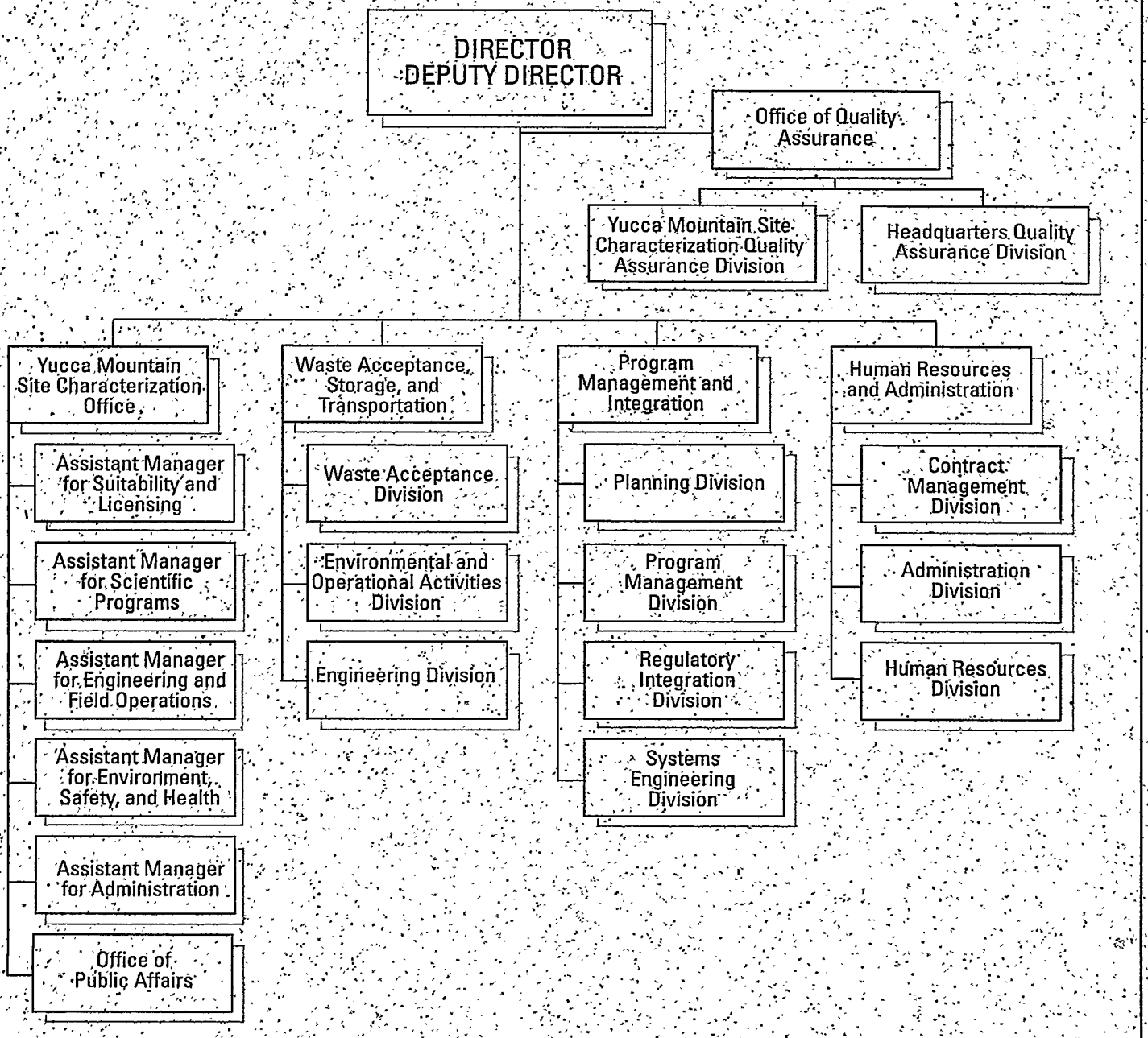
OCRWM REALIGNS ITS ORGANIZATION

The Office of Civilian Radioactive Waste Management (OCRWM) has adopted a new organizational structure that will provide an optimal framework for carrying out the program and improve its responsiveness to stakeholders' needs.

The new Headquarters structure (see below) places emphasis on the near-term issues of waste acceptance and storage, as well as promoting overall program integration. Earlier this year, the Yucca Mountain Site Characterization Office was reorganized to strengthen its ability to complete the scientific activities necessary to determine site suitability. In conjunction with the reorganization, improvements in business management systems and human resources development are also being initiated.

"Realign" continued on page 15

Organization of the Office of Civilian Radioactive Waste Management



DOE SPONSORS STAKEHOLDER MEETING

On Saturday, May 21, 1994, the Department of Energy's Office of Civilian Radioactive Waste Management (OCRWM) sponsored a stakeholders' meeting in Las Vegas, Nevada. Approximately 250 people attended, representing a broad spectrum of interests and viewpoints, including Federal, State, local and tribal government organizations, the utility industry, citizen groups, environmental organizations, labor unions, scientific and trade publications, special interest groups, and Departmental staff and contractors.

Dr. Daniel Dreyfus, Director of OCRWM, welcomed participants to the meeting. He reviewed the purposes and topics of the meeting, and emphasized that the meeting was structured to provide an interactive discussion so that participants could share their comments and concerns with the Department regarding OCRWM's proposed program approach and provide input on the site suitability process.

The Department received valuable input on a wide range of important matters. Several issues are being examined or re-examined based on input received at the meeting. These issues include:

- How to conduct the Environmental Impact Studies, and whether a Programmatic Environmental Impact Study should be performed
- How scientific investigations might be re-prioritized if the Proposed Program Approach is implemented
- What the appropriate length of the repository pre-closure period is
- To what extent, if any, the Department should fund invitational travel for stakeholders
- How the format of stakeholder forums can be broadened.

As part of the stakeholders' meeting agenda, Dr. Dreyfus introduced Shirley Thomas, the Department's Ombudsperson. The Ombudperson's Office was established under the direction of Secretary of Energy Hazel R. O'Leary. The function of this Office is to provide an opportunity for employees and stakeholders to confer with a neutral party to discuss concerns, recommendations, and complaints.

Ms. Thomas explained that the Ombudsperson's Office would not circumvent normal channels of issue resolution. She encouraged parties to attempt first to solve problems internally, utilizing existing available resources. Only when personal outreach has been exhausted should the Ombudsperson be contacted. The Office of the Ombudsperson is located in the James Forrestal Building, Room 5B-110, 1000 Independence Avenue, SW, Washington, DC 20585. The telephone number is (202) 586-2903.

When assistance is solicited, the Office of the Ombudsperson will explore alternative approaches to accomplish a positive resolution, act as a mediator in the resolution process, and explore other internal operations that may impact positive resolution. The Office should not be contacted when cases have been lodged as formal complaints, appeals, grievances, or are in the process of litigation.

Subsequent to the stakeholders' meeting, a new organizational structure for OCRWM was established effective July 11, 1994 (see related article in this *Bulletin*). With this reorganization, the technical and institutional skills of OCRWM staff have been integrated throughout the program. Stakeholder access to the storage and transportation aspects of the program will be maintained through Linda Desell, who has been designated Director of the Environmental and Operational Activities Division. At the Yucca Mountain Site Characterization Office, Greg Cook, Director of Public Affairs, manages the development and coordination of community relations and public involvement activities.

OCRWM'S TRANSPORTATION COORDINATION GROUP CONVENES IN NEVADA

The ninth Transportation Coordination Group (TCG) meeting—a meeting designed to inform participants of the OCRWM program's progress—was held in Las Vegas, Nevada, June 7 and 8, 1994. Approximately 200 stakeholders attended. At the meeting, transportation stakeholders were briefed on the program status and policies of the Office of Civilian Radioactive Waste Management (OCRWM), and feedback was received on stakeholders' ongoing activities.

During the meeting, Linda Desell, Director of the Environmental and Operational Activities Division, described OCRWM's organizational realignment (see related article in this *Bulletin*). Desell emphasized that the realignment would not adversely affect stakeholder interactions. "There will be many opportunities for continued stakeholder involvement through current activities such as Cooperative Agreement Group and TCG meetings," she said, "especially with the recent issuance of the Multipurpose Canister Request for Proposal. There will be scoping meetings and information meetings held exclusively to gain stakeholder input."

Representatives of Federal monitored retrievable storage and private interim storage siting efforts participated in a panel discussion to report on the status of their activities. The Mescalero Apache Tribe is continuing its privatization pursuits, and now has representatives from over 30 utilities participating in its program. Other non-Federal interim storage interests are being pursued by the New Corporation, a small business group involved in monitored retrievable storage activity in Fremont County, Wyoming. The South Carolina Research Authority is interested in a facility for spent nuclear fuel generated in South Carolina, and the Tonkawa Tribe of Oklahoma updated the status of its monitored retrievable storage activities. The Fort McDermitt Paiute Shoshone Nation of Oregon and the Skull Valley Goshutes of Utah expressed a continued interest in a Federal monitored retrievable storage facility.

Another panel at the meeting discussed full-scale cask testing, a subject in which the stakeholders have an ongoing interest. OCRWM will contract with an independent party to work with interested stakeholders to develop a plan to determine if, and how, full-scale cask testing could be implemented.

OCRWM staff provided an overview of the preliminary draft OCRWM Transportation Plan that was distributed at the meeting. Comments on the Plan were requested within 60 to 90 days. The document replaces the Transportation Institutional and Business Plans of 1986. Stakeholders were also briefed on other topics of interest, such as the current status of cask design, the ongoing legal-weight truck testing being conducted on a test track, transportation risk-management strategy development, and the development of Department-wide routing criteria.

The final day of the meeting included a tour of Yucca Mountain. After a visit to the Information Center, meeting participants visited Yucca Mountain and observed workers assembling the Tunnel Boring Machine.

NEW PUBLICATIONS

Locations of Spent Nuclear Fuel and High-Level Radioactive Waste Ultimately Destined for Geologic Disposal, DOE/RW-0447, September 1994.
This document provides a matrix showing the locations of spent nuclear fuel and high-level radioactive waste ultimately destined for geologic disposal. In this matrix, the locations of commercial reactors, non-DOE research reactors, Navy reactor fuel, and DOE-owned spent nuclear fuel and high-level radioactive waste are shown for each of the contiguous United States.

Multi-Purpose Canister Evaluation: A Systems Engineering Approach, DOE/RW-0445, September 1994
This report summarizes Department of Energy efforts to investigate various container systems for handling, transporting, storing, and disposing of spent nuclear fuel assemblies in the Civilian Radioactive Waste Management System. Systems engineering evaluations of several alternative container concepts are included that were investigated in determining the most appropriate system to implement throughout the Civilian Radioactive Waste Management System. Comparisons are made to show why the multi-purpose canister system was selected as the preferred concept.

DOE'S TRANSPORTATION EXTERNAL COORDINATION GROUP MEETS IN DENVER

On July 12-14, 1994, the Transportation External Coordination Working Group (TEC/WG) met in Denver, Colorado. The TEC/WG is one of the mechanisms established by the Department of Energy (DOE) to bring together organizations that have a radioactive-related or other hazardous materials-related transportation role, responsibility, or interest. The TEC/WG was created by formal agreement between the Office of Environmental Management and the Office of Civilian Radioactive Waste Management. The agreement was recently revised to include other DOE program offices that have a radioactive materials-related transportation role or responsibility.

The Department interacts with the TEC/WG representatives to obtain input for program needs assessment, development and management, and to enhance its capability to carry out transportation emergency preparedness and safety activities specifically related to radioactive materials shipments. Working Group members represent organizations of State, local, and Tribal governments as well as professional, technical, and industry associations.

The meeting comprised a mix of plenary and breakout sessions. Plenary-session topics included an update on DOE transportation programs, a report from the Western Governors' Association on its involvement in planning the Cesium-137 Capsule Return Program, a report on a national survey measuring public perceptions of transportation risks, and a U.S. Department of Transportation briefing on the Hazardous Materials Transportation Act and the State and Tribal Grants Program. The plenary session on the DOE transportation program included updates from two programs new to TEC/WG: the Idaho Environmental Impact Statement Project on Spent Nuclear Fuel and the Federal Facility Compliance Act Program.

Most of the meeting was devoted to breakout sessions relating to (1) general planning, (2) safe routine transport, (3) inspection and enforcement, (4) emergency management, (5) training, (6) technical assistance, and (7) public information and education.

For more information on the TEC/WG, contact Wendy Morgan, Waste Policy Institute, (703) 231-9873.

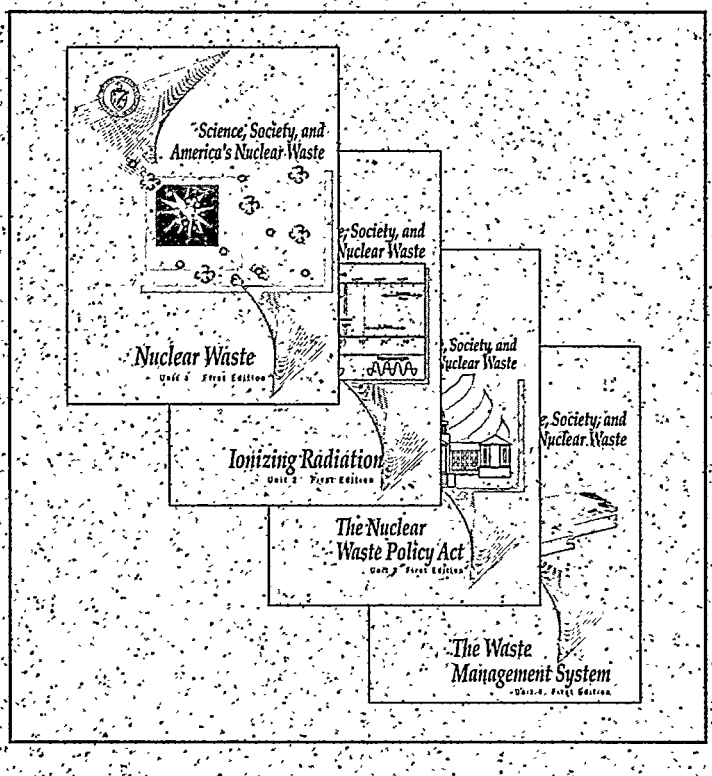
Highlights of the TEC/WG Breakout Sessions

- An agreement that the emerging issue of environmental justice has implications for hazardous materials transportation and that DOE will take action to articulate those implications
- An agreement on a definition for safe, routine transportation (the definition will be used to assist DOE in implementing relevant portions of the Nuclear Waste Policy Act)
- Acceptance of DOE's approach to route selection guidance as outlined in the draft document, *Strategy for Development of a Route Selection Guidance Document for DOE Unclassified Highway Route Controlled Quantities Shipments*
- Validation of two DOE initiatives to enhance emergency medical preparedness by improving the distribution of information related to radioactive materials.

EDUCATORS NATIONWIDE PARTICIPATE IN TEACHER TELECONFERENCE

On Friday, July 29, teachers in 48 States participated in the Office of Civilian Radioactive Waste Management's (OCRWM) third national teacher teleconference workshop. The 2-hour teleconference, broadcast live from the University of Tennessee, also included participation from 3 utility companies and cable systems in 28 States. The cable systems provided teachers and other interested parties across the country the opportunity to view the teleconference from their homes. Fifteen additional cable systems and a number of teachers have requested videotapes of the teleconference to broadcast at a future date.

The main focus of the teleconference was to supply educators with factual information on issues related to the development of a high-level radioactive waste management system. The conference began with Ned Elkins, Deputy Technical Project Officer for Los Alamos National Laboratory on the Yucca Mountain Project, and Lee Renegar, Manager, M&O Construction Management, describing and giving updates on activities related to Yucca Mountain's Exploratory Studies Facility and the "Yucca Mucker," a Tunnel Boring Machine being used at Yucca Mountain. Following the updates, Lesli Norris, a biology and chemistry teacher in Henderson, Nevada, and Fred Holtzclaw, a science teacher in Oak Ridge, Tennessee, discussed the ways in which they have been using OCRWM's *Science, Society, and America's Nuclear Waste*, a four-unit secondary curriculum that provides information about scientific and societal issues related to high-level radioactive waste management. Students at Green Valley High School in Henderson, Nevada, were shown using the curriculum in a laboratory setting. During the teleconference, scientists of diverse disciplines spoke of the many ongoing scientific studies being done at Yucca Mountain. Susan Jones, Assistant Manager for Scientific Programs at the Yucca Mountain Site Characterization Office, described geological, hydrological, and geochemical testing; Jim Brune of the University of Nevada in Reno discussed seismological investigations being made at Yucca Mountain; and Jeanne Nesbit and Dale Ambros of the Yucca Mountain Scientific Programs spoke on volcanology and meteorology studies.



A segment on environmental and cultural studies at Yucca Mountain outlined the environmental regulations, permits, and audits involved with site characterization. Another segment described the cultural resources program, which contains an archeology component and interactions with Native Americans concerned with preserving the environment surrounding Yucca Mountain.

A "live-from-Yucca-Mountain" segment included discussions by Physical Scientist, April Gil, who described the Sample Management Facility, which stores the Yucca Mountain rock samples being studied, and Ned Elkins, who described the testing being done at the Exploratory Studies Facility.

The teleconference concluded with a "call-in" session, during which viewers were invited to dial in toll-free to ask questions of Ginger King, External Relations Advisor to the Director of the Department of Energy's OCRWM; Dr. Jeremy Boak, a Los Alamos National Laboratory scientist; and Fred Holtzclaw and Lesli Norris. Questions came from viewers in New Mexico, Pennsylvania, Connecticut, Texas, and Massachusetts, and ranged from the mining effects at Yucca Mountain and the overall impact of nuclear technology to how the curriculum would work in a unified science classroom.

The four-unit curriculum is available to educators upon request free-of-charge by contacting the national OCRWM Information Center at 1-800-225-6972 or in Washington, D.C., (202) 488-5513.

TRAINING PROVIDED ON OCRWM DATABASE

In response to requests, during the week of July 18, 1994, INFOLINK training sessions were held for staff of affected units of local governments in Nevada and California. Eighteen representatives from White Pine, Lincoln, Eureka, Lander, Clark, Mineral, Nye, and Esmeralda Counties in Nevada, and Inyo County in California, attended the training sessions to find out how INFOLINK, a computerized database, can help them gain easy access to OCRWM information. The 3-hour sessions included exercises in (1) logging on and off the database, (2) reading bulletin-board items, and (3) searching for and ordering OCRWM documents. Solicited suggestions from trainees on possible ways of enhancing the database are being considered to upgrade the system. The upgrade, scheduled for completion in July 1995, will be more user-friendly, and will update INFOLINK with current computer technology.

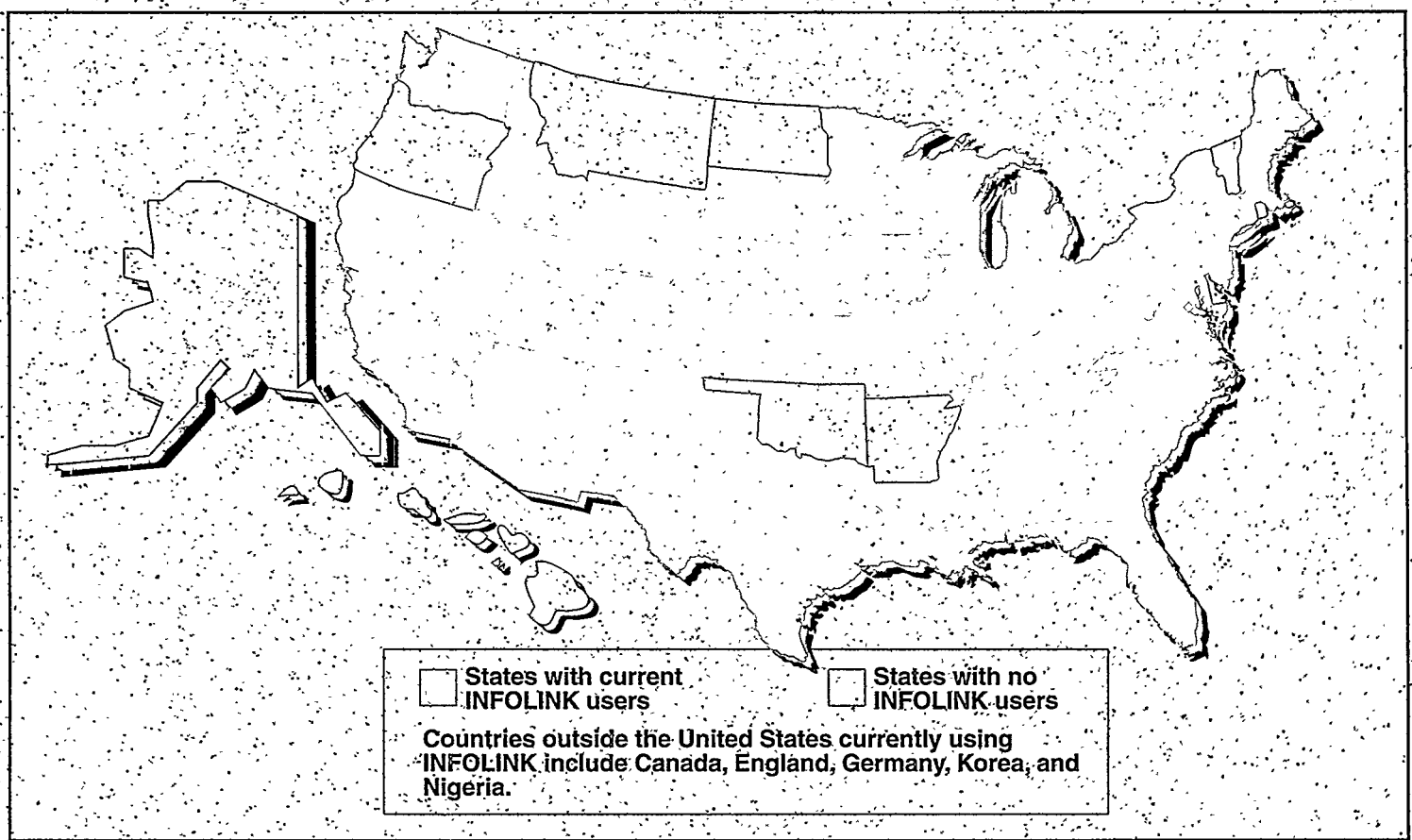
Currently, there are INFOLINK users (account holders) located in 40 States and abroad (see map below). Users include educators, utilities, industry, State and local governments, Native American representatives, private individuals, and Federal Agencies.

The INFOLINK system, first developed in 1986, was originally used to track the development of OCRWM documents and to catalog the documents as they became available for distribution. Eventually, an ordering component was added to allow users to search for, read abstracts of, and directly order OCRWM publications. Online versions of the Publications Catalog, the *OCRWM Bulletin Index*, and the Bulletin Board were also added.

Through INFOLINK, users can:

- Access current information on the OCRWM program, including press releases, speeches, testimonies, reports, and studies
- Place orders for OCRWM publications
- Review information on OCRWM products and on selected technical and public information documents that relate to the Civilian High-Level Radioactive Waste Management Program
- Reference past and present issues of the *OCRWM Bulletin*

To obtain an account on INFOLINK, contact the national OCRWM Information Center at 1-800-225-6972, or in Washington, D.C., at 488-5513.



OCRWM CALENDAR

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

Summer/Fall Edition

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1994

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OCTOBER

WEEKEND	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
1 Energy Council '94 Perdido Beach, AL (9/29-10/2) European Nuclear Society Conf/Exch, Lyon, France 2	3	National Congress of Am Indians, San Diego, CA 4	5	6	7
8 IAEA Symposium on Spent Fuel Storage, Vienna, Austria 9	COLUMBUS DAY HOLIDAY 10	11	NWTRB Full Board Meeting, Las Vegas, NV NRC/DOE Mtg on QA Las Vegas, NV 12	National Science Teachers Assoc Area Conv, Portland, OR 13	14
15 16	NRC/ACNW, Las Vegas, NV [YMP Tour] NEA Perf Assessment Adv Group, Paris, France 17	[Working Group] 18	[Committee Meeting] NRC/ACNW, Rockville, MD 19	OCRWM Director's Prog Meeting/ Video Conference, Vienna, VA 20	21
22 YMP Open House/Tour Las Vegas, NV (P) NRC Technical Exchange Las Vegas, NV (Tent) Materials Rsch Society Meeting, Kyoto, Japan	Deadline for technical response to the MPC RFP IAEA International Conference Paris, France 24	25	OCRWM Program Mgmt Review/ Video Conf, Las Vegas, NV 26	27	28
29 30	Commercial Vehicle Safety Alliance Omaha, NE 31	1	2	3	4

OCRWM-sponsored meeting codes: **(P)** Public Participation Meeting **(O)** Open to the Public [Name] OCRWM Speaker

1994 NOVEMBER

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WEEKEND	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
	Commercial Vehicle Safety Alliance Omaha, NE →	→ 1	2	Council of State Governments–Midwest, Chicago, IL → 3	→ 4
5 6	NRC Technical Exchange, Las Vegas, NV → Cost Proposal for MPC Technical Response 7	NRC/ACNW, Rockville, MD → ELECTION DAY 8	9	10	DOE/PNC Meeting Tokyo, Japan → VETERANS DAY 11
12 DOE/PNC Meeting Tokyo, Japan (contd) → American Nuclear Society Winter Mtg, Washington, DC → Natl Congress of Am Indians Annual Mtg, Denver, CO 13	NARUC Annual Convention Reno, NV → 14	National Conference of State Legislatures, Salt Lake, UT (Tent) → 15	16	NWTRB SG&G/HG&G Joint Panel Mtg, Washington, DC → 17	→ 18
19 20	21	22	23	THANKSGIVING 24	25
26 27	28	NRC Technical Exchange, Denver, CO → 29	30	1	2

OCRWM-sponsored meeting codes: **(P)** Public Participation Meeting **(O)** Open to the Public [Name] OCRWM Speaker

1994

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DECEMBER

WEEKEND	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
		NRC Technical Exchange, Denver, CO →	→	→ 1	2
3 / 4	5	Southern States Energy Board, Asheville, NC → 6	→ 7	8	Affected Unit of Gov Bi-Monthly Mtg Las Vegas, NV 9
10 / 11	12	13	NRC/ACNW 70th Mtg Rockville, MD → 14	→ 15	16
17 / 18	19	20	21	22	23
24 / CHRISTMAS 25	CHRISTMAS HOLIDAY 26	27	28	29	30

OCRWM-sponsored meeting codes: **(P)** Public Participation Meeting **(O)** Open to the Public [Name] OCRWM Speaker

"Realign" continued from page 5

The major components of the realigned organization, and some of their principal functional responsibilities, are highlighted below:

Yucca Mountain Site Characterization Office

Acting Manager - Robert M. Nelson

Responsible for directing the Yucca Mountain Project and for the scientific evaluations needed to determine whether the Yucca Mountain candidate site is suitable for a geologic repository and for waste-package and repository design and development. Directs development and implementation of strategies related to the evaluation of the suitability of the Yucca Mountain site in compliance with Federal regulatory requirements. Conducts a program of coordination and external interface with interested parties, including State, county, and local government officials and agencies, in addition to a public education and information program. Serves as the focal point for, and represents the Department of Energy in, State, local, and media interactions.

Office of Waste Acceptance, Storage and Transportation

Acting Director - Samuel Rousso

Responsible for managing the design, certification, and production of multipurpose canisters, and preparing the license application to the Nuclear Regulatory Commission for any OCRWM-operated storage facility. Also responsible for developing implementation policies and strategies and conducting all management and programmatic functions needed to produce the waste acceptance subsystem in compliance with applicable laws and regulations. Has responsibility for developing and operating a comprehensive system to transport spent nuclear fuel and high-level radioactive waste to appropriate Federal waste management facilities. Implements institutional activities associated with transportation system development and operations, and is responsible for policy and institutional relationships between the Office and State and local government entities, national-level organizations, the professional community, and special interest groups concerned with waste acceptance, storage, and transportation.

Office of Program Management and Integration

Acting Director - Ronald A. Milner

Responsible for integrating the development and implementation of OCRWM's strategic planning program, preparing and executing OCRWM budgets, coordinating with numerous groups and institutions, maintaining critical program documents, and establishing policy and coordinating systems engineering activities at the program level.

Office of Human Resources and Administration

*Acting Director - James C. Bresee**

Responsible for personnel management activities, managing the procurement/business activities of all OCRWM contracts program-wide, information resource management activities, financial management of the Nuclear Waste Fund, liaison with external audit organizations, education and information activities. Also responsible for managing OCRWM's Total Quality Management and Customer Advocacy initiatives.

Office of Quality Assurance

Acting Director - Donald G. Horton

Responsible for managing, executing, coordinating, integrating, and overseeing OCRWM-wide quality assurance activities; conducting internal audits at both Headquarters and the site locations associated with the program; performing quality surveillances of Federal and contractor records; identifying deficiencies and preparing corrective action reports; providing administrative management of the Quality Concerns Management System reporting; managing and developing evaluation/investigation, and resolution systems; providing coordination and oversight of program-wide self-assessment activities; and providing regulatory compliance oversight in the implementation of safety and health performance strategies.

"Comment" continued from page 1

- The need for an interim, away-from-reactor storage facility prior to repository operations
- Options for offsetting, through the use of the Nuclear Waste Fund, a portion of the financial burden that may be incurred by utilities in continuing to store spent nuclear fuel at nuclear reactor sites beyond 1998.

The Department remains committed to pursuing the permanent disposal of spent nuclear fuel and developing a strategy to address the utilities' interim storage needs.

* Temporarily, Jerome D. Saltzman is serving as Acting Deputy Director, Office of Program Management and Integration. When that position is permanently filled, he will become Director, Office of Human Resources and Administration.

NATIONAL OCRWM 1994 EXHIBIT SCHEDULE

Florida Association of Science Teachers Annual Conference - October 11-12, Sarasota, FL

National Science Teachers Association Area Convention - October 13-15, Portland, OR

National Indian Education Association - October 15-19, St. Paul, MN

Science Teachers Association of Texas Annual Conference - October 20-22, Beaumont, TX

Maryland Association of Science Teachers Annual Conference - October 21-22, Westminster, MD

Geological Society of America Annual Meeting - October 24-27, Seattle, WA

National Science Teachers Association Area Convention - November 3-5, Minneapolis, MN

South Carolina Science Teachers Association Annual Conference - November 4-5, Myrtle Beach, SC

Massachusetts Association of Science Teachers - November 8-10, Framingham, MA

North Carolina Science Teachers Association Annual Conference November 10-11, Raleigh, NC

National Council for the Social Studies - November 11-14, Phoenix, AZ

American Nuclear Society Winter Meeting - November 13-18, Washington, DC

National Science Teachers Association - December 15-17, Las Vegas, NV

OCRWM OUTREACH

The Civilian Radioactive Waste Information Center System was established to provide easy access to information on plans and activities within the waste management program. To contact the Information Center, please call 1-800-225-NWPA (6972) or 488-5513 in Washington, D.C.

READER RESPONSE CARD

A reader response card is enclosed with every *OCRWM Bulletin*.
The purpose of this card is to encourage communication between readers of the *OCRWM Bulletin* and OCRWM.
Your views, comments, and suggestions are appreciated.

Comments: _____

_____

Name: _____

Address: _____

City: _____ State: _____ Zip: _____ - _____

Affiliation: _____

Please detach this card and mail to:
James C. Bresee • Office of Human Resources and Administration • Office of Civilian Radioactive Waste Management • U.S. Department of Energy • 1000 Independence Avenue, SW • Mail Stop RW-10 • Washington, DC 20585

Of Mountains & Science

YUCCA MOUNTAIN PROJECT Studies

Summer/Fall 1994

The Proposed Program Approach from the Office of Civilian Radioactive Waste Management

The Office of Civilian Radioactive Waste Management (OCRWM) has proposed a restructured program to ensure that:

- the realities of near-term management of commercial spent nuclear fuel are addressed by resolving the waste acceptance issue and defining the Department of Energy's (DOE's) role for near-term storage;
- efficient, measurable progress toward determining the suitability of the Yucca Mountain site for a permanent repository is made;
- the technical approach and schedule are realistic and consistent with the increased funding levels proposed by the administration and with expectations of stakeholders, including Congress; and
- if the site is suitable, that the program is able to proceed with the environmental impact statement, site recommendation, and licensing and construction of a repository.

Participants at a stakeholder meeting like this one in Las Vegas, NV, are being asked to contribute ideas to help DOE better focus the management of the Yucca Mountain Project.

The proposed program approach is consistent with the recent Administration Funding Proposal. It is an

Continued on page 64

At a Glance

- Project workers spent their summer assembling the new tunnel boring machine. Now the shakedown begins. *See page 58.*
- Folks were drilling tunnels long before they entrusted the job to mechanical moles. How? *Find out on page 59.*
- Discovery Day participants make their own volcanoes. *See page 60.*
- YMP volunteers use a Saturday to build a playground for a North Las Vegas community. *See page 61.*
- Can you make an omelet without breaking eggs? *Find out on page 62.*

Project hydrologists suspect water table higher—but not by much

Earlier this year, hydrologists found water in a borehole only 400 meters (1,300 feet) below the northern part of Yucca Mountain. At first, scientists suspected they had tapped fluids from a previous drilling effort. Now, they feel more certain that this water is a mixture of naturally occurring water that seeped down from the surface and fluids from the previous drilling effort that then mixed together.

Traces of drilling fluids were identified in what hydrologists now believe is a vertically isolated water body. This water is called "perched water" because it lies suspended above the water table. Scientists believe the water here did not well up from the water table.

Hydrologists also have reexamined their early assumptions about

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Tunnel boring machine begins lengthy shakedown

Some Project workers spent part of their 1994 spring and summer assembling the custom-designed tunnel boring machine (TBM). This machine will excavate portions of a 14- to 22-kilometer (8- to 14-mile) underground laboratory at Yucca Mountain. The Project will not run the TBM at its full capacity until the spring of 1995.

The TBM is a unique machine that functions as a self-contained tunnel-processing plant. Impressive in size and capability, the TBM is just one of many pieces of equipment used for site characterization. Its job is to give scientists the opportunity to inspect geological conditions inside Yucca Mountain.

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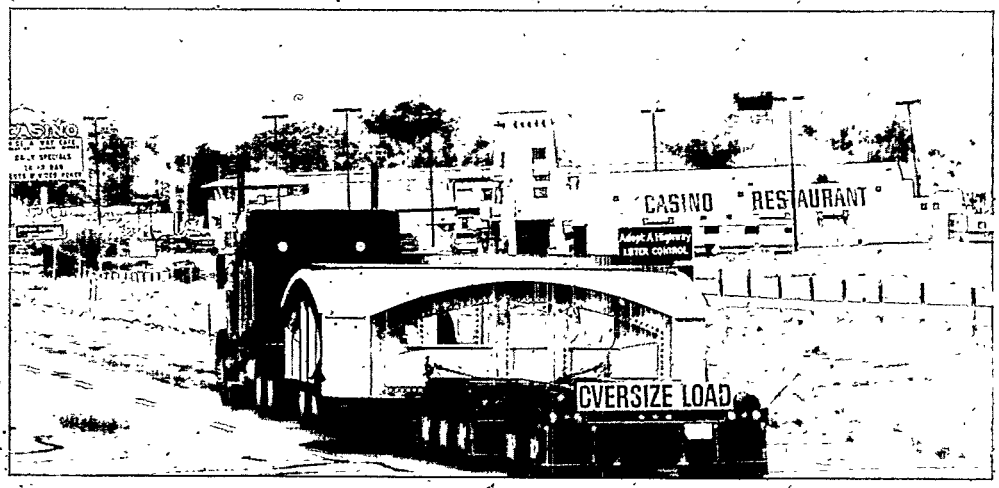

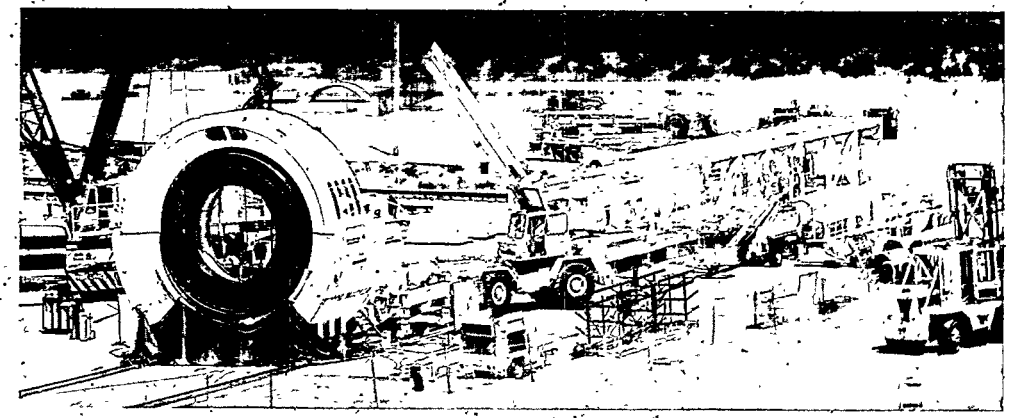

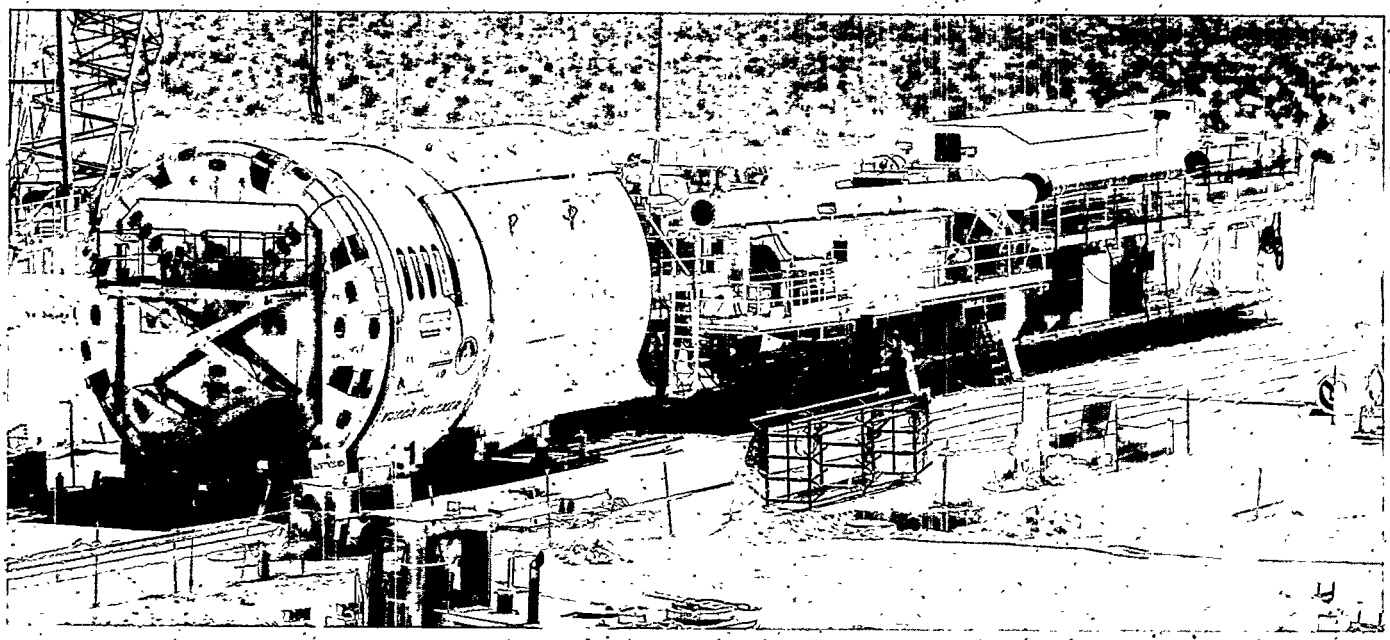

The center cutter section of the TBM (A) winds its way down US-95 through Indian Springs, Nevada, en route to the TBM assembly pad at Yucca Mountain. Upon arrival (B&C), the TBM parts were uncrated, assembled and tested.

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Tunnel boring machine begins shakedown

Tunnel boring remains the most efficient method, and ultimately the most environmentally sound and physically safe method, for gaining access to this kind of underground environment (see sidebar). When England and France agreed to build the English Channel Tunnel in 1986 — the first land link between Britain and the European continent since the Ice Age — they used tunnel boring machines to do the job.

Although the massive TBM arrived in crates aboard a truck convoy, fitting its pieces together did not present a major hurdle. The workers responsible for doing this had participated in disassembling the TBM at the plant where it was designed, manufactured and assembled. They not only worked from phone-book-sized manuals, but also watched videotapes of the first assembly for reference. This let them revisit each stage of the process as needed while assembling the machine outside where it will begin work.

The TBM and all its trailing equipment weighs 860 tons, and measures 140 meters (460 feet) in length. A clear picture of its performance cannot emerge until it is subjected to the full load created by tunnel excavation.

Before committing the TBM to its three-year underground journey, personnel must install all the ground support facilities and utilities that will sustain it. Those engineers responsible for overseeing the TBM's assembly and operation have broken their pre-operational shake-

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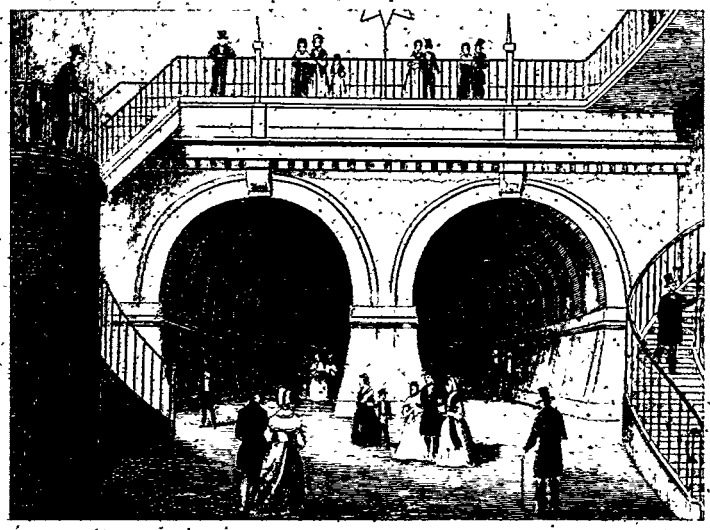
Tunnel boring machines: The next step in an age-old technology

The tunnel boring machine (TBM) slated to carve out an underground geological laboratory under Yucca Mountain represents the natural evolution of a technology that extends back into pre-history. Armed with what one observer from the English Channel Tunnel, or "Chunnel," called "the biggest dentures you ever saw," this machine is more like a self-contained tunnel processing plant, than, say, a mechanical mole.

In some ways, TBMs offer a quantum leap in tunnel excavating capabilities. But in others, whether in use at Yucca Mountain, the Nevada Test Site or under the English Channel, these machines are just the logical outgrowth of a technology whose roots go back to paleolithic times.



The completion of the Thames Tunnel in London provides an opportunity for a Victorian outing, circa 1845. (Photo courtesy of Franklin Watts Photo Archives)

Back to hammers and chisels

The idea of an automated tunnel drilling machine represents a major leap in human technology and ability. But people have been digging tunnels for a long time. The earliest tunneling went on during paleolithic times, when cave dwellers sought to extend their living spaces. The urge to add another room, it turns out, spans the ages. The ancient Babylonians dug irrigation tunnels. The Greeks tunneled to drain marshes and build aqueducts. Egyptians and Native Americans tunneled to make tombs and temple rooms.

Yet the Romans, who were renowned for their engineering abilities, used hammers and chisels for tunneling. They would generally roast the rock walls of their tunnels with fire. They also would occasionally douse them with water to make them brittle and to create cracks at which they could chip away. This was how Roman engineers built the Pausilippo Tunnel in 36 BC, linking Pozzuoli with Naples.

Workers on this Roman tunnel cut a 7.5-meter-diameter (25-foot) tunnel 1,500 meters (4,800 feet) through hard volcanic rock. Coincidentally, this is the same diameter as the prospective geologic laboratory under Yucca Mountain. Workers toiled in what must have been, given the fires they burned inside the tunnels and the sulfurous steam

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Discovery Day participants blow their tops with do-it-yourself volcanoes

What do you get when you mix papier mâché and an empty pill bottle? Would you believe a geologic structure capable of unleashing an awesome force in the form of hot molten rock?

Okay, so it wasn't even the volcano in front of the Mirage Hotel in Las Vegas. But if you attended the Second Annual Geology Discovery Day at the Yucca Mountain Science Center in Las Vegas, you might have used these items to make an impressive little volcano of your own.

Amazing what a dash of baking soda can do!

Eight-year-old Stephen Grose, one of the children there, not only made a model of a volcano, but learned that lava is formed when rocks deep underground melt. The volcanoes made at the Yucca Mountain Science Center erupted only with the help of baking soda, vinegar and red food dye. But children and adults alike enjoyed building and learning about volcanoes with Jeanne Nesbit, a Yucca Mountain Project geologist.

Discovery Day offers those attending the event an opportunity to speak with Project scientists, view exhibits and have fun with geology-related activities. This April, more than 130 members of the public attended, and more are expected at the next Geology Discovery Day.

Learning about erosion can be wearing

Visitors at the Science Center's Geology Discovery Day heard scientists talk about rocks and minerals. The visitors also saw a stream table that demonstrates erosion and the process of land formation using flowing water, sand and a wave maker.

The flow of information did not end with the exhibits and demonstrations. For instance, children and parents alike learned about fossils and how they are formed by participating in a hands-on presentation. Under the careful instruction of geologist April Gil, participants made fossil molds using clay to form impressions of fossils or shells, and plaster of Paris to form the mold.

At other stations, visitors used rollers and blocks to build an earthquake-proof structure. Outdoors, guests panned for gold with prospectors, who supplied the gold and materials needed to demonstrate their craft.

Picky, Picky. Yucca Mountain Project Sample Management Facility geologist Dave Merritt sorts through rocks, minerals and testing tools with some new friends.

"Science Mom" says kids love it

Madelaine Raffa, a fifth-grade teacher and self-described "Science Mom," said, "My kids love it — they've learned something, and it's like Disneyland here."

> *"It allows for families to spend the day exploring science and learning together. Parents and kids alike get to talk directly to scientists and see what they do."*

Melinda d'Ouville, manager of the Yucca Mountain Science Center, attributes the success of the day to its underlying idea — getting families interested in science. "It allows for families to spend the day exploring science and learning together," she observed. "Parents and kids alike get to talk directly to scientists and see what they do."

Geology Discovery Days not only offer a unique learning opportunity for the public but a rewarding experience for the scientists and staff involved as well. Dave Merritt, a geologist with the Project, summed it up when he said, "I enjoyed watching the kids' eyes get big as they said, 'I didn't know that!'"

Lava Dabba Doo! Project geologist Jeanne Nesbitt instructs Discovery Day participants on the art of making your own volcano.

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YMP volunteers barn-raise a new playground

Managers usually push paper, chop through red tape and lay down procedures. Or so some people who work for them might tell you. But on a Saturday morning early last May, about 40 senior managers from the Yucca Mountain Project's managing and operating (M&O) contractor as well as other representatives, moved out from behind their desks to push wheelbarrows, shovel wood chips, lay concrete and assemble playground equipment. Their mission at Petitti Park in North Las Vegas was to build a new playground filled with swing sets, spring-mounted animals for riding, and a large play-structure with five slides, activity panels, decks and crawl tubes.

Elbow grease: Volunteers from the Yucca Mountain Project put more than a little elbow grease into the task of building a new neighborhood playground. The result (*inset*) — cheers and huzzas from a tough corps of young critics.

Work on the playground began at 9 a.m., after the volunteers received instruction from representatives of Dave Bang Associates on how to assemble the playground. The M&O managers were assigned the various building tasks in three-person units.

> *"This is going to be cool. I wish they'd hurry!"*

By 10 a.m., not surprisingly, a group of children gathered outside the fence to watch the playground emerge on the formerly empty field next to Bridger Junior High. Seven-year-old Jerry watched eagerly as the jungle gym took shape.

"I just want to go in and play, but they're not finished," he said. "They're doing good, but if I helped it would be faster."

"This is going to be cool," agreed Jerry's friend Ismael. "I wish they'd hurry. I'm going to play on the slide that goes round and round."

As the time for the opening drew near, parents joined their children by the fence. Nearby resident Henry Elwanger watched the construction with his four children, all whom were equally eager to get inside.

"It's great that they'd come out and do something like this for the community," he said. "These kids need a good place to play. I just hope we can keep it nice for them."

Hank Osterhoudt, the M&O's acting manager for public affairs, said that the site was chosen because there were no other playgrounds in the area.

> *"I felt this tugging, and I leaned down, and this little boy put his arms around my neck, gave me a kiss, and said, 'Thank you for building this playground.'"*

"When they arrived Saturday morning, the volunteers were uniformly impressed with the need for a playground in the area," Osterhoudt said.

"The mayor of North Las Vegas (James Seastrand) couldn't believe we had chosen this spot to build the playground. We could've built it in a more affluent neighborhood or in a better-known park and gone for the publicity, I suppose. But we wanted to build where the need was greatest — where there were lots of kids and no place for them to play."

Playground represents a cooperative effort

The playground project was a cooperative venture involving the Project M&O contractor team. This included people from TRW, Duke Engineering Services, B&W Fuel Company, Fluor Daniel Inc., Morrison

Continued on page 72

Elementary schoolers seek ingenious ways to *not* make an omelette

Building a device that would protect a raw egg from a 30-meter (100-foot) drop off a firetruck ladder did not immediately appeal to the students at Gordon McCaw Elementary School in Las Vegas.

Perhaps the point of the exercise seemed elusive, something maybe PBS's science weirdo Beakman might have dreamed up. But once they realized that this was a science project — one that carried with it the potential to make a major league mess — the participation level began growing faster than a fox sneaking through a chicken coop.

The result was the Second Annual Egg Drop Contest held on April 22, 1994, at the Jaycee State Park in Las Vegas, Nevada. Approximately 400 elementary school students from five area schools participated. Of the 219 egg-drop devices submitted for a high dive, 53 did what they were designed to do. Of these, four winners were chosen, based not only upon the survival of the egg, but also ingenuity. With eggs, as in real life, if you gotta take a fall, do it with style.

The Egg Drop contest is sponsored by the Yucca Mountain Project in conjunction with KLAS TV to help promote scientific thinking among young people. To win it, one must design the smallest device possible, using no commercial packing, that can protect and preserve a raw egg during the course of its fall. The more ingeniously you do it, the better.

This year's eggs took the plunge with the help of the Las Vegas Fire Department, which donated the use of a firetruck whose ladder became a diving platform.

The Annual Egg Drop Contest, say Project organizers, fosters scientific skills, parental involvement in science activities, and a creative environment for students to learn about how scientists work.

The Egg & I: Spectators gather around the main launch platform — a Las Vegas Fire Department firetruck ladder — while participants (inset) sift through a mound of peanut butter cushioning to determine whether their intrepid egg survived.

Would you believe shock-proof Jell-o and peanut butter?

The innovative ideas participants brought to the design of some of these devices added zest to the contest. Cushioning materials used in some designs included peanut butter and even Jell-O. Some students took another approach, using parachutes of various designs.

As happened last year, the event was emceed by former KLAS Channel 8 weatherman Mark Pfister. Pfister's coverage of last year's egg drop helped him win a regional Emmy Award.

McCaw Elementary School prepared for the competition by holding a few preliminary drops. The school principal, Dr. Janet Dobry, observed that: "The great thing about this project is that it excites the kids while getting them thinking about gravity and shock absorption."

While this competition is fun for the students, it also serves as a motivational tool. To arrive at a design, participants have to resort to the scientific method. According to Rick Rogers, a teacher at McCaw, the students learn the meaning of the term "modify" as they test and rework their devices. They also learn that it's okay if the device they invent doesn't work as planned. They were willing to take a risk. Often, their mistakes got them thinking about how they might do better next year.

Jim Blink, a Yucca Mountain Project scientist with the Lawrence Livermore National Laboratory, is a key coordinator of the Egg Drop Contest. Blink spends much of the year going into elementary schools to teach the rudiments of physics. He finds the Egg Drop Contest an ideal way to get his pupils to make use of their new knowledge.

Blink says that while there were only four official winners, in reality, all the participants were winners, "as they demonstrated their creativity, enthusiasm, and scientific skills."

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Nevada Science Fair hooks students on scientific method

A crack at a blue ribbon is not the only thing students stand to gain from participating in the Southern Nevada Science Fair. Students also develop valuable research and critical thinking skills. The hope is the students may benefit not only as they go through school, but later on, as they enter the business world.

Dr. Rafael Davin is the chairperson of the Science Fair Committee responsible for organizing the event, and a teacher at Durango High School in Las Vegas. He says that learning how to use the scientific method becomes an invaluable lesson for students who must one day enter the professional world. Learning to discuss their ideas and to make them appealing is an important marketing skill that will be needed in the workplace.

The 33rd Annual Southern Nevada Science Fair was held at the Cashman Field Convention Center in Las Vegas, Nevada, from March 21 through 23, 1994. The Fair was co-sponsored by the Clark County School District and the Yucca Mountain Project. The annual Science Fair contributes to the educational goals of this country by providing a vehicle for students to explore and broaden their knowledge of the various sciences.

A fifth-grader explores sound

The enthusiasm this experience sparks becomes evident when talking to Joe Castro, a fifth-grade student at Wooley Elementary School. Joe's interest in school took root when he learned to use a computer. His idea for a science project came while watching a program on the Discovery Channel about how sound affects the learning process. Joe's curiosity and interest were unleashed.

Yucca Mountain Project scientists volunteer their time to give students feedback on their science projects.

Placing students in classrooms sonically infused with rap music, classical music or silence, Joe subjected them to tests of memory and measured their recall rates. He used his computer to chart his results and to write his report.

While he didn't win an award for his efforts at the Southern Nevada Science Fair, he did take home a blue ribbon from the Clark County State Fair held in Logandale, Nevada. Joe plans to participate again next year, and will investigate his topic even further.

"This experiment was just a small chip (off the topic). Next year I'm going to do more on the same subject," he said.

Cathy Grimes, a science teacher at Wooley Elementary, says Joe's enthusiasm was not unusual among the students participating in the elementary division of the Science Fair. With approximately 600 students, Wooley experienced a participation rate of more than 50 percent. The school's elementary division eventually submitted many of the Southern Nevada Science Fair exhibit entries.

Grimes hopes to see a group project division for the elementary schools created next year. She feels this would mirror what is taking place in the scientific community.

"Science is going from working alone to more of a collaborative effort," she said.

Science Fair builds self-esteem

The Science Fair competition also builds self-esteem among participants. Las Vegas' Gibson Middle School, whose students were first-time participants, benefited from this aspect of the competition.

"The students, even those who didn't win, have the feeling of self-pride and success that comes from

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The Proposed Program Approach

attempt to bring the program back to the original intent of the legislative and regulatory framework.

For the repository element of the program, the underlying basis for the DOE decisions reflected in the proposed program approach was the realization that the expectations that have been built up over the years cannot be satisfied solely by science.

The Site Characterization Plan (SCP), issued in 1988, described an extensive testing, design, and performance assessment program that reflected such expectations. Since then, as a result of expectations both within and outside the DOE, the program has grown to such an extent that it has been the subject of severe criticism from Congress.

The original intent of the Nuclear Waste Policy Act (NWPA) and the Nuclear Regulatory Commission (NRC) rule, 10 CFR Part 60, was for a program of site characterization that provided sufficient information for the decisions by the DOE on site suitability and site recommendation, and by the NRC on construction authorization, with the realization that some residual uncertainties would exist. The decisions to be made by the NRC with regard to licensing repository operations and authorizing repository closure would be supported by the knowledge gained during construction and operations, respectively.

The underlying rationale is consistent with some of the recommendations of the National Academy of Sciences, contained in their 1990 report, "Rethinking High-Level Waste." That report stressed the point that it is not practical to assume that all information would be available prior to constructing the repository.

Part of the process for developing the proposed program approach included a preliminary evaluation of various scenarios. One of those scenarios (referred to as the "Level Funding Outlook") assumed that OCRWM would receive funding at the level that has been received over the past several years. This funding profile would be insufficient to support development of geologic disposal capability as contemplated in the NWPA, as amended, particularly if the multipurpose canisters were provided at program expense to accommodate interim storage.

The stakeholders meetings are a continuation of long-term efforts to involve and inform the public.

The restructured program under the proposed program approach requires no changes to the NWPA, as amended, but does anticipate a new Environmental Protection Agency (EPA) standard for a repository and conforming changes to the NRC rule, 10 CFR Part 60, as required by the Energy Policy Act of 1992. Revisions to the DOE standard contract for spent fuel acceptance, 10 CFR Part 961, also may be required.

The details of the proposed program approach are still being developed and stakeholder involvement is continuing as part of this process.

Key components of the approach

Key components of the approach are as follows:

- emphasis on resolution of the waste acceptance issue through a dialogue with utilities and other stakeholders addressing the expectations for DOE acceptance of spent fuel starting in 1998;
- development and integration into all program elements of a MPC concept, including storage, transportation and disposal overpacks, to facilitate pre-disposal storage at any location; and
- site characterization activities focused to advance measurable progress toward a DOE decision

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The Proposed Program Approach

about the suitability of the Yucca Mountain site.

Major differences from the previous approach

The DOE will continue to support the efforts of the Nuclear Waste Negotiator to identify potential volunteer hosts for development of a Monitored Retrievable Storage facility. Funding for development of this facility will not be requested until a host site is identified.

A system will be developed to provide standardization and simplification of storage technologies, based on the MPC concept. The MPC concept will provide an option for cost sharing of near-term storage with the utilities.

At Yucca Mountain, initial emphasis is placed on those investigations and engineering activities deemed necessary and sufficient to support a technical site suitability determination in 1998. The evaluation will be based on available data supported with calculations and models intended to bound the range of site conditions and system performance characteristics. Additional tests will be conducted wherever needed to support the evaluation of overall site suitability, and preparation of the environmental impact statement and license application for the repository.

The repository will be designed to permit waste retrieval for up to 100 years from the start of waste emplacement, rather than the 50-year retrieval period required by the NRC (10 CFR 60.111(b)). This design goal will provide assurance that the performance confirmation program required by the NRC (10 CFR Part 60, Subpart F) could be conducted over an extended period, if necessary, to acquire longer-term information from monitoring changes to the site caused by excavation, thermal-mechanical, and radiation effects. Longer-term monitoring may enhance confidence in the basis for the long-term predictions of compliance with the EPA standard.

The proposed program approach addresses the major program elements

Site characterization and site recommendation

Site characterization and engineering activities will be focused initially to support evaluation of the suitability of Yucca Mountain. If the site is found to be suitable, DOE will recommend to the President that the site be developed as a geologic repository.

Evaluations of the Yucca Mountain site against the qualifying and disqualifying conditions of the DOE siting guidelines in 10 CFR Part 960 will be conducted as site characterization data and analyses become available. These evaluations include the following:

- A DOE decision on technical site suitability is expected in 1998 and will be based upon an evaluation of the site and related design concepts to determine if the postclosure guidelines and those preclosure guidelines related to radiological safety and technical feasibility are satisfied. These evaluations will use the data available at the time, together with bounding calculations and models.
- The preclosure guidelines related to environmental quality, socioeconomic impacts, and transportation will be evaluated as part of the overall site suitability determination, based on information developed to support the National Environmental Policy Act (NEPA) process and preparation of the draft environmental impact statement. These evaluations would be based upon the advanced conceptual design for the repository and the waste package.

A final DOE decision to recommend the site is expected in 2000 and would be based upon the overall site suitability evaluation, completion of the environmental impact statement, and input received from stakeholders.

If, at any of these decision points, the site is found to be unsuitable, an alternative plan will be submitted to Congress within six months of the unsuitability declaration.

Waste acceptance

The key waste acceptance activities will address utility expectations resulting from currently projected waste acceptance schedules. They also will explore options and develop methods for offsetting a portion of the financial burden to the utilities associated with continued on-site storage of spent nuclear fuel at reactor sites after 1998.

DOE has initiated a dialogue with utilities and other stakeholders in an effort to reach mutual agreements on revised spent nuclear fuel acceptance expectations.

The standard contract with the utilities, as promulgated in 10 CFR Part 961, may require modification through a formal rule-making. A Notice of Inquiry (NOI) concerning waste acceptance was issued on May 25, 1994. The Notice of Inquiry solicits views of affected parties on: the 1998 waste acceptance date; the need for an interim away-from-reactor storage facility prior to repository operation; and options for offsetting a portion of the financial

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The Proposed Program Approach

burden that may be incurred by utilities in storing spent fuel at reactor sites after 1998.

Defense high-level waste also will be accepted for repository disposal, but such acceptance will not begin until after the repository begins acceptance of commercial spent nuclear fuel.

Multi-purpose canister development and procurement

DOE will develop the MPC concept to provide standardization and simplification among storage technologies and the potential for reduced handling and reduced worker exposure to radiation.

The program schedule would give DOE the option of providing MPCs to utilities at rates which are consistent with the 1992 Annual Capacity Report. This approach could provide some compensation to utilities for increased storage costs, but other means also will be considered.

DOE will provide certified designs for the components required to implement the MPC concept, and, subject to satisfying NEPA and a decision to deploy MPCs, could procure and furnish to utilities the canisters, transportation overpacks, and other supporting equipment. If agreed upon, DOE will also provide NRC-certified designs for a standard on-site storage module, a dry-transfer cask for spent nuclear fuel, and a standard MPC transfer cask.

Application will be filed on behalf of the DOE with the NRC for Certificates of Compliance under 10 CFR Parts 71 and 72 for the components of the MPC concept concerning transport and at-reactor storage, respectively. The requirements under the NEPA would be satisfied before the decision is made to fabricate and deploy MPCs.

The proposed schedule calls for the MPC Safety Analysis Report required for NRC certification to be completed in 1996, certification approval to fabricate in 1997, and availability of MPCs to the utilities in 1998.

MPCs would be developed in two different size configurations to be compatible with most reactor site capabilities. DOE also would develop high capacity truck casks to service reactor sites which cannot handle MPCs.

The utilities would continue ownership of the fuel while it remains stored at the reactor sites or other utility storage site(s). DOE will take title to the fuel only upon its removal from those sites for Federal storage or disposal.

Transportation

The proposed program approach would include: development of a transportation system for delivery of MPCs and supporting equipment to the utilities, providing procedures and training to the utilities for spent nuclear fuel and MPC handling and transfer, providing MPC transportation overpacks, and transporting the MPCs from the utility storage sites to the repository. The program also would develop high-capacity, legal-weight truck casks for reactor sites not capable of handling MPCs with transportation overpacks.

The proposed schedule calls for reactor-to-repository transportation to begin in 2010, upon receipt from the NRC of a license to receive and possess spent fuel at the repository.

The DOE will develop through rule-making and will implement a strategy, consistent with NWPA Section 180(c), to provide technical assistance and funds to States and Indian Tribes. Training will be provided to safety officials in the states and Indian reservations who maintain jurisdiction in areas through which OCRWM will transport spent nuclear fuel and high-level waste. Such assistance and funds would be made available three to five years prior to shipping.

National Environmental Policy Act process for repository development

The proposed activities include initiation of the NEPA process with the Notice of Intent and start of the public scoping process in 1995 to establish the issues to be addressed in the repository environmental impact statement. The proposed schedule calls for the draft environmental impact statement in 1998 and the final environmental impact statement in 2000.

The evaluations conducted to satisfy requirements under the NEPA and the DOE's implementing regulation, 10 CFR Part 1021, would be based on the repository advanced conceptual design. The NRC's requirements for development of an environmental impact statement (10 CFR Part 51) would be considered to facilitate adoption of the DOE's document by the NRC if a license application is submitted.

The final environmental impact statement will accompany the Site Recommendation Report to the President, as required by Section 114(f) of the NWPA.

Repository licensing process

If the Yucca Mountain site is found to be suitable, and a site recommendation is made and approved by the President and Congress, the DOE will submit a license application to the NRC.

Repository licensing under NRC regulations will be an incremental process, beginning with submittal of the initial license application for construction authorization (10 CFR 60.24(a) and 60.31), an updated application for a license to receive and possess spent nuclear fuel and high-

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The Proposed Program Approach

level waste (10 CFR 60.24(b) and 60.41), and a final application for a license amendment to close the repository (10 CFR 60.51). Additional applications for license amendments to permit changes in design or operating conditions may be submitted as needed (10 CFR 60.45 and 60.46).

The Safety Analysis Report supporting the license application for construction authorization would be based on a Title I (preliminary) design for the repository and a Title II (final pre-fabrication) design for the waste package. The focus would be on ensuring the safety of repository operations and providing high confidence in waste package containment.

Predictions about the long-term ability of the repository's engineered and natural barriers to contain and isolate spent nuclear fuel and high-level waste, based upon the available data and supported by bounding analyses and models, will be included in the initial license application.

These predictions, together with the other evidence to be presented, should be sufficient to allow the NRC to determine if a finding of "reasonable assurance" can be made that their objectives for the long-term performance of the repository system will be met. This determination will be made consistent with NRC requirements and expectations: 10 CFR 60.24(a) ("The application . . . shall be as complete as possible in the light of information that is reasonably available at the time of docketing.") and 10 CFR 60.101(b) (". . . the demonstration of compliance may take uncertainties and gaps in knowledge into account . . . .").

After submittal of the initial license application, testing and engineering activities will continue as required by the NRC in 10 CFR Part 60, Subpart F (Performance Confirmation Program), to confirm the basis for the long-term predictions of repository performance made in the license application, and to acquire data needed for more detailed design.

After construction is substantially complete and the NRC has issued the license to receive and possess spent nuclear fuel and high-level waste, the scientific work will be focused to obtain data on changes to the site caused by repository construction and by the effects of waste emplacement. The objective will be to ". . . evaluate the accuracy and adequacy of the information used to determine with reasonable assurance that the performance objectives for the period after permanent closure will be met." (10 CFR 60.2) These results will be used to confirm the basis for earlier predictions about containment and isolation and to test the models that will be relied upon for confirming the long-term predictions required to support a decision by the NRC to permit closure of the repository.

Under the proposed program approach, the repository would be designed to permit a retrieval period of up to 100 years from the date of first emplacement to ensure the opportunity to obtain test results and monitor repository behavior over an extended performance confirmation period, should that be necessary. The license application for an amendment to close the repository (10 CFR 60.51) will not be submitted until sufficient confirmatory test information is available to provide adequate confidence to support a decision to close the repository.

The proposed schedule calls for the license application for construction authorization to be submitted by DOE to the NRC in 2001, the updated application for a license to receive and possess spent nuclear fuel and high level waste in 2008, and the application for an amendment to permit closure in, or before, 2110.

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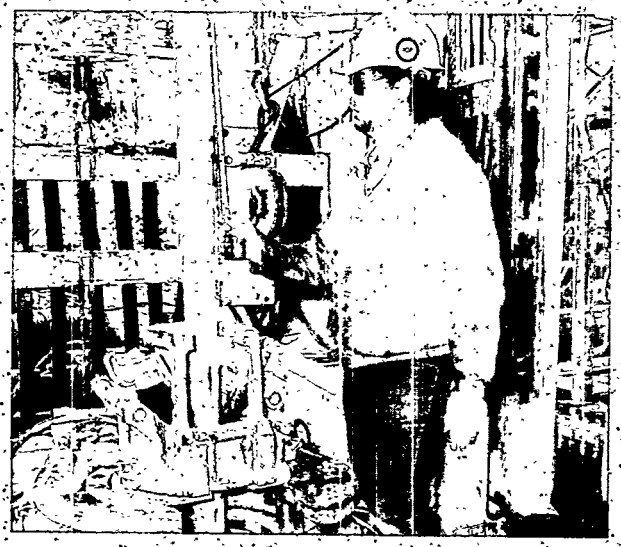
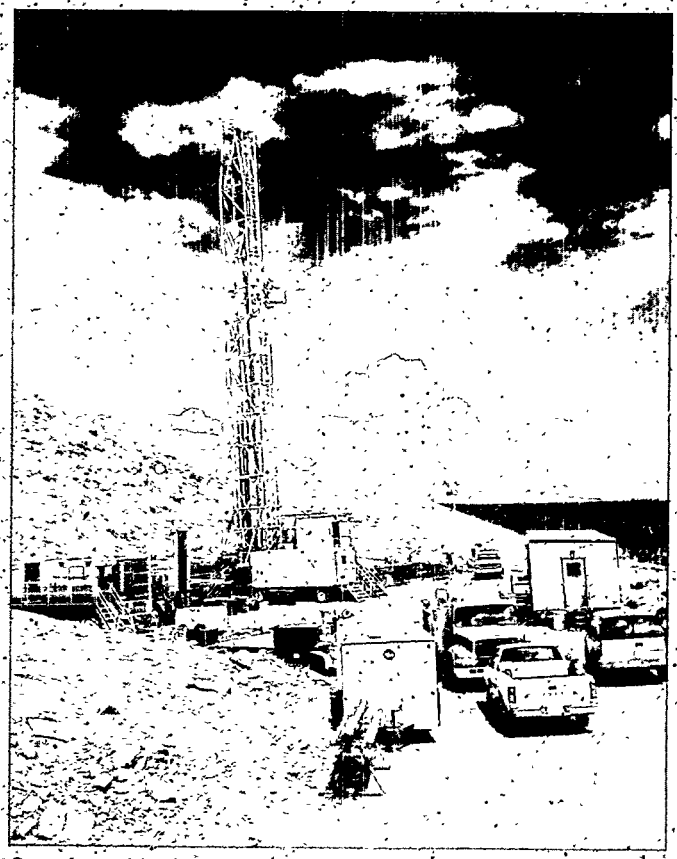
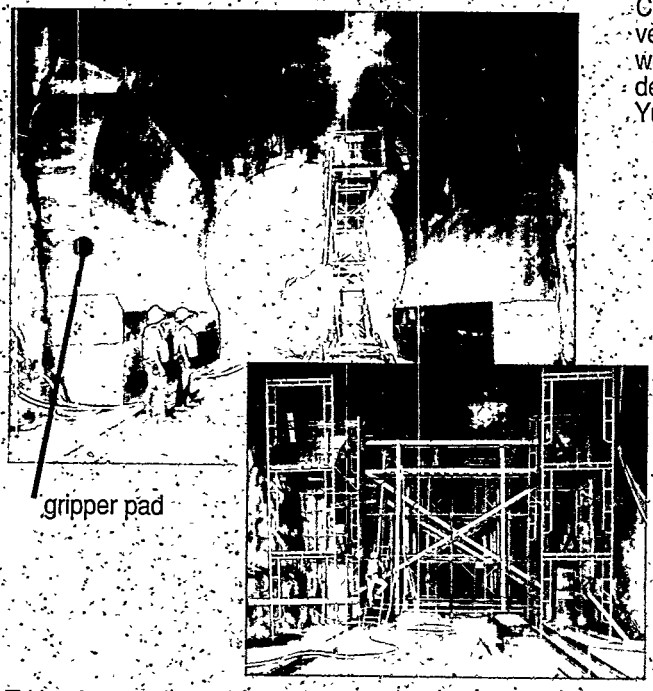
Recent work at Yucca Mountain



Yucca Mountain driller measures and marks the outer pipe in one-foot increments for depth control while drilling on the LM-300. The LM-300 is a one-of-a-kind drill rig designed to remove core samples or rock fragments without altering them. Conventional drilling techniques inject pressurized water or mud into the borehole, wetting surrounding areas. By pumping cooled air and controlling moisture in the borehole, the LM-300 keeps the rock as close as possible to its original condition.

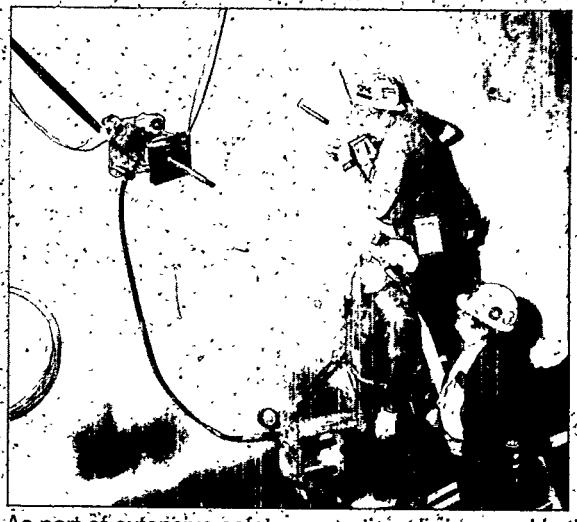


Core from this drill hole will be examined to learn more about vertical and lateral rock characteristics at Yucca Mountain, as well as hydrological properties. Data will help scientists determine how the geology and hydrology varies across the Yucca Mountain area.

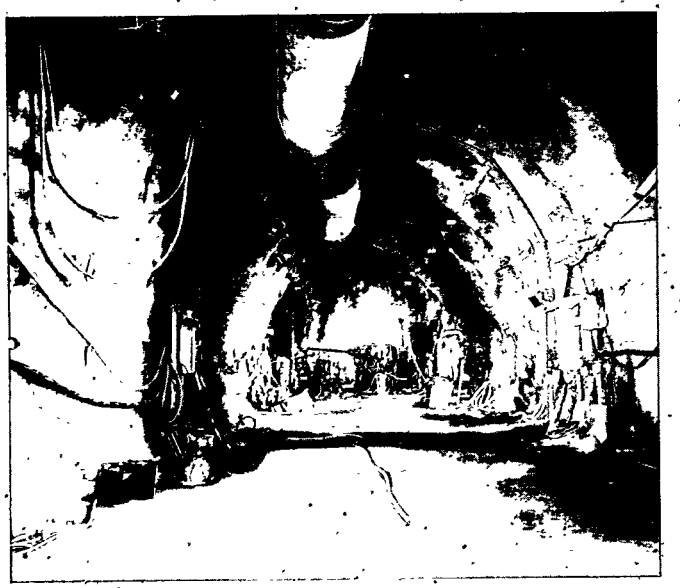


gripper pad

To begin tunneling, the tunnel boring machine needs gripper pads to press against and move it forward into the rock face. These pads were constructed in the ESF starter tunnel to help the TBM get on its way.



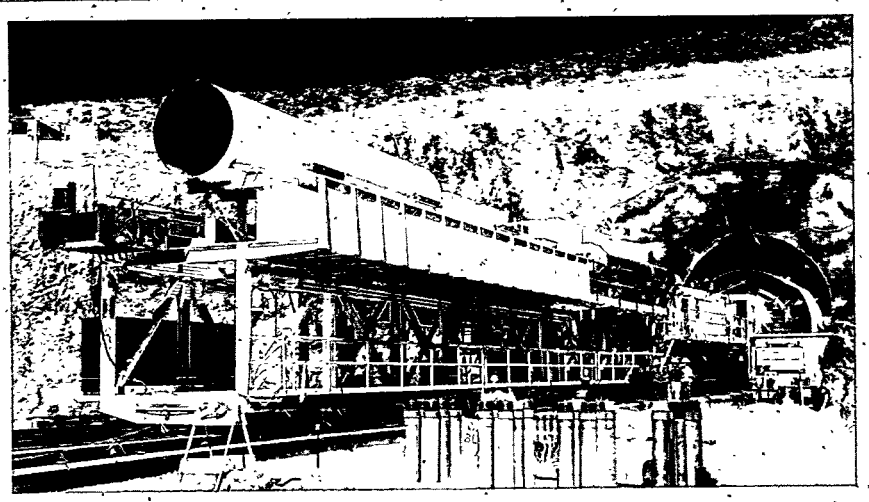
As part of extensive safety precautions being used in the construction of the Exploratory Studies Facility, these workers are testing the strength of rock bolts used in the tunnel walls. Here, a jack is being used to pull each bolt to its prescribed limit to ensure that the rock bolts can withstand certain stresses.



As portions of the Exploratory Studies Facility are constructed, scientists will be able to work in laboratories built 300 meters (1,000 feet) underground. A radial borehole test to measure how water and gases move through rock will be performed in the alcove, constructed off the main tunnel. Radial boreholes (drilled in a pattern like the rays of the sun) are drilled into the face of the alcove. Three boreholes will be used in the experiment. Vapor or water will be injected into the rock through the first borehole, and instruments in the remaining two will monitor how water or vapor moves through the rock and how quickly.

The construction of the radial borehole test offered scientists an opportunity to test a prototype instrument aimed at analyzing the cutting dust created by drilling operations. Laser-Induced Breakdown Spectroscopy (LIBS) uses small solid-state lasers to vaporize and excite the test material. The testing allowed scientists to familiarize themselves with the chemistry of the rock units and the operational aspects of coring and mining at the ESF. Scientists also were able to test a dust sampling approach, and to test packaging and power issues for the field-portable LIBS.

One question engineers need answered is, "When the tunnel boring machine burrows through some of the soft tuffs at Yucca Mountain, will the tunnel it creates be able to stand long enough to install a support system?" On the west side of Exile Hill, experiments at trench NRT-1 are testing the bearing capacity of the Rainier Mesa tuffs and the other soft tuffs on the west side of the Bow Ridge Fault. Information gained from these experiments will help answer the engineers' questions.



The Project's tunnel boring machine is pictured here at the north ramp entrance to the Exploratory Studies Facility. The tunnel boring machine will tunnel its way through Yucca Mountain, cutting a 7.5-meter (25-foot) hole in the rock. The machine will bore up to 22 kilometers (27,000 feet) of tunnels for the Exploratory Studies Facility's underground laboratories.

The Yucca Mountain Project Speaker Series in Nevada

"Acceptable Risk? Life, Earthquakes, Volcanoes and Everything Else."

Sunday, Oct. 23, 1994 — Pahrump, 2 p.m. Tuesday, Oct. 25, 1994 — Las Vegas, 7 p.m.

Speaker: Bruce Crowe, Ph.D., Volcanologist, Los Alamos National Laboratory

Something might or might not happen! What's an "acceptable risk" when it comes to conditions in Southern Nevada? And how do geologists make predictions as to the probability of geological events? How do they determine the chance of earthquakes shaking us awake in the morning, or of volcanoes disrupting our daily regimens? How do these risks compare with others we face in our daily lives?

Join Dr. Bruce Crowe, of Los Alamos National Laboratory, as he pursues these issues and explores the fact that Mother Nature offers no guarantees.

Speaker Series and more at these locations in Nevada

Need to do some research?

A science project?

Looking for a place of interest?

Visit the Yucca Mountain Science Center nearest you.

- Interactive and display exhibits providing information about energy and the Yucca Mountain Project.
- Science and energy education resource materials.
- Educational presentations for students and adults.
- Tours for schools and community groups.

Las Vegas – Yucca Mountain Science Center Phone: (702) 295-1312
Address: 4101-B Meadows Lane *(across from the Meadows Mall and adjacent to the YMCA)*

Pahrump – Yucca Mountain Science Center Phone: (702) 727-0896
Address: Pahrump Station/Hwy. 160

Beatty – Yucca Mountain Science Center Phone: (702) 553-2130
Address: U.S. 95 & State Route 374

Studies

In their own words...

A "Win-Win" Situation with Area 25's "Winn" Wilson

Winfred "Winn" Wilson acknowledges having more nicknames than he can sometimes remember. There's one that he's partial to, though, or at least, one he thinks suits him best: "The Mayor." The Mayor, that is, of the Nevada Test Site's Area 25.

Wilson has been working at the Test Site since 1979. He has been managing the 145 square kilometers (90 square miles) of Area 25 since 1989, when he left as lead design and construction engineer in charge of general plant projects for DOE/Nevada Test Site Operations.

A native of Covington, Virginia, Wilson holds a degree in architectural engineering from North Carolina Agricultural and Technical State University in Greensboro. His areas of expertise have been the design and construction of sewage ponds, rehabilitated and new facilities and, as he puts it, "buildings, buildings, buildings..."

Wilson is a 14-year veteran of the U.S. Air Force, which he left as a captain. He says one motivation in switching to a Department of Energy job was the opportunity to build upon his years of federal service. Another, though, was what he perceived as a chance to get out from under the desert sun. Alas, with fitting irony, DOE decided it would keep Wilson at the Test Site. Despite the two-hour commute he faces each day from Las Vegas, adding up to 14.5-hour work days, he isn't complaining.

"Mainly, I oversee the land, buildings and infrastructure used to support site characterization at Yucca Mountain. I work from 7 a.m. to 5:30 p.m. four days a week.

"The job involves [tending to] security, administration, logistics and operations. I guess you could say I'm the landlord here. I have to maintain the facilities and infrastructure. I have to tend to all the logistical requirements [of the people who do YMP's work in Area 25]. I have to make sure that vehicles, radios, first-aid kits and other vital equipment are issued and used properly and kept up to date. I have to ensure that medical resources are kept operational, that security has been performed, and that badging and site access and communications are properly maintained. And, of course, I have to respond to complaints.

"I guess you could say I'm the landlord here..."

"You have to be a politician in this job. I wear three hats — that of the detail engineer, of the manager and of the official greeter. We get many dignitaries here — often two a day. You have to be flexible, to go with the flow, to be able to do three things — wear three hats — at the same time. It comes with the job. I'm not boasting, but it takes a unique person to do the juggling. You have to be able to put aside your problems and put on your diplomat's face, to use tact, and to deal with people internally and externally. I have to communicate daily with the NVO (Nevada Operations Office) community, and sometimes Nye County and Clark County (representatives and citizens). You have to keep a rapport with everyone.

"I always liked working with the public. But I wouldn't ever want to go into politics. It's not my bag. I have no desire or thought of even venturing into the political arena. Basically though, this job taught me how to deal with people and with different attitudes, and how to carry out your mission. The idea is to negotiate your way to a win-win situation."

"You have to be able to put aside your problems and put on your diplomat's face."

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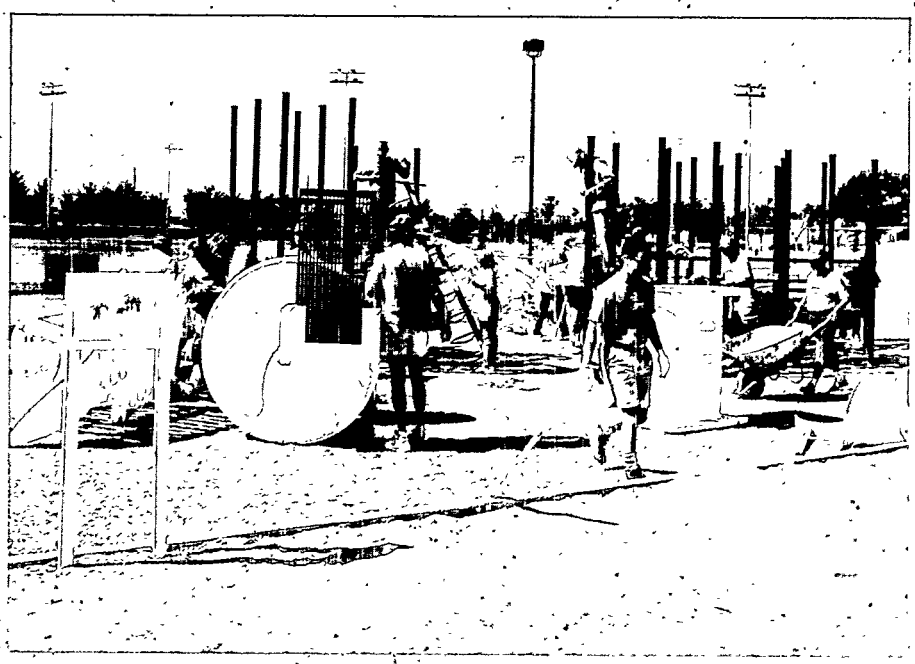
New playground

Knudsen Corp., Intera, Inc., and Woodward-Clyde Federal Services. Also involved were the North Las Vegas Department of Recreation and Parks, Nevada Business Services, local troops from the Boy Scouts of America, and the Nevada Power Company.

The playground infrastructure, including walks and curbs, had been installed earlier through a job-training program for area youth sponsored by the Nevada Business Services. As a community service, Nevada Power donated and installed about $13,000 in lights in the park for after-dark activities. After the YMP volunteers finished their work on the playground, the Boy Scouts planted new trees in the park.

It became evident in talking to them that the volunteers were every bit as excited as the kids about the playground opening. Magdalena Hannigan was there to help with her husband Eddie, who recently retired from TRW but was on hand to help anyway.

"It feels good to come out and do something for the community," Hannigan said, as she watched the children straining at the gate, waiting to come in and play.



Magdalena Hannigan: *"It feels good to come out and do something for the community."*

"I really enjoyed seeing those kids storm the equipment after waiting around there all day," added Osterhoudt. "But the best part of my day occurred after I had just introduced Dale Foust (TRW's assistant general manager for Nevada Site Operation) during the opening ceremony. I felt this tugging, and I leaned down, and this little boy put his arms around my neck, gave me a kiss, and said, 'Thank you for building this playground.' It was absolutely incredible, the epitome of what this is all about."

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TBM begins lengthy shakedown

down period into three distinct phases:

- *Phase A Assembly* — Completed in July, this entailed assembling the TBM and starting minimal testing of the machine. Engineers and workers checked wiring and switches. Safety and maintenance training continued.
- *Phase B Testing* — By late fall, workers will have moved the TBM over tracks into the starter tunnel and positioned it against the tunnel's rock face. Operators and support personnel will then check TBM component systems and initiate full-scale system and stress tests. Engineers will examine motor alignment and hydraulic pressure for possible leaks. The machine will start up and excavate approximately 12 meters (40 feet) to allow engineers to evaluate the machine's performance under load for the first time. Underground training of TBM operators and support personnel will also begin.
- *Phase C Shakedown* — Once TBM testing is completed, a shakedown phase involving limited operation will begin. During this period, muck will be removed with rail-mounted muck cars.

By February 1995 or later, depending upon delivery, a conveyor system will arrive to replace the muck cars. Workers also will shut down the TBM for the month needed to complete installation. Workers will use the time to attach geological mapping cars to the TBM. At the completion of these tasks, the machine will be ready for full operation.

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Tunnel boring machines

these produced, terrible working conditions.

Obviously, today's tunnel boring machines hold a few advantages over most previous forms of excavation. TBMs are built to cope with changing underground conditions. The same TBM generally can adapt to both hard rock and loose ground, as well as to wet—even very wet—soil. Sometimes, TBMs can encounter all three types of conditions in a single day. Often, the machine's operators cannot know what conditions they face only a few meters ahead. The only thing they can count on is that conditions will change. Yet TBMs not only dig tunnels, but also line or bolt them to prevent water leakage or collapse of the tunnel. Also, they remove muck, clear staging areas, and act as locomotives for cars carrying special equipment or facilities.

With TBMs, steady as she goes saves time and money

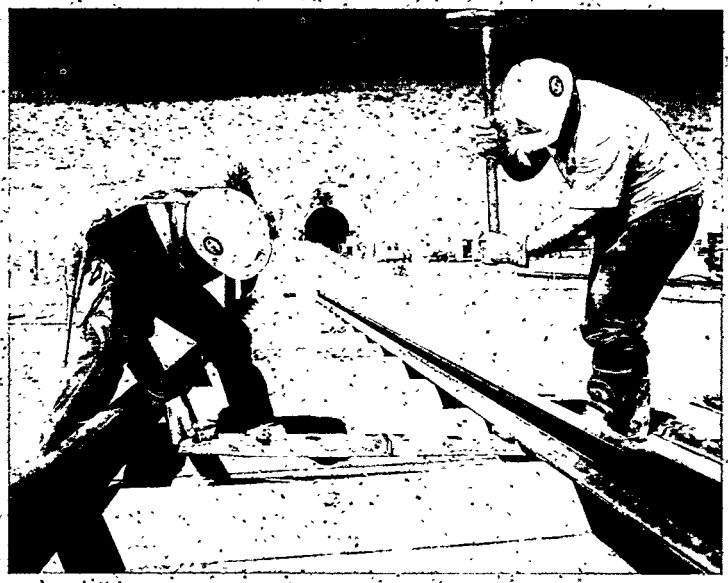
Another advantage in using TBMs is that they cut through rock, remove muck, and line tunnels at a steady rate. Without TBMs, the excavation of a "Chunnel" linking England and France probably would certainly have presented too expensive, dangerous and lengthy a prospect to have ever warranted serious consideration.

Tunneling through the ages

What few people recall is that the newly completed 50-kilometer (31-mile) Chunnel project is really the third attempt to bore through the chalk under the English Channel. There have been 26 proposed endeavors in all.

The first attempt involved an early TBM. In 1882, Colonel Frederick Beaumont invented a primitive prototype to do the job. The Chunnel effort was abandoned a year later because of British fears of invasion from mainland Europe. A second Euro-linking venture aborted in 1974, when the French decided, instead, to become involved in the supersonic Concorde jet airplane project.

Tunnel-digging technology improved substantively during the 15th century with the arrival of gunpowder. Black-powder blasting was last used in this country in the mid-1800s to build the Transcontinental Railroad. The drilling and blasting methods developed during the 15th century stayed in use for 300 years, although Alfred Nobel's discovery of dynamite made blasting somewhat safer. Black powder was eventually replaced by nitroglycerine (which was more effective, though more dangerous), and later by more stable ammonium nitrate-based materials.



Layin' 'em in and tyin' 'em down... Workers run a track for muck cars into the TBM starter tunnel. Current TBM technology is a combination of the latest developments and standards such as railroad tracks, which are used when appropriate.

Drilling techniques leapfrog through the Hoosac Tunnel

While blasting materials improved, engineers also worked on better drilling methods. Early drilling techniques involved a process called "double-jacking," in which one man would swing a two-handed sledge while a second man held and rotated the drill steel. Between 1854 and 1875, however, during the excavation of the Hoosac Tunnel in northwest Massachusetts, this medieval technology suddenly evolved into an approximation of the modern tunnel boring methods used today. Indeed, if necessity is the mother of invention, the Hoosac will probably be recalled by engineers as the mother of all TBMs. A project that began with steam and compressed air drilling ended with an early approximation of the modern TBM.

First on the drawing board for the Hoosac project were steam drills. They didn't work well, though, because the steam had to be piped to the drill. Along the way, this steam condensed and lost much of its "kick." Next up was compressed air. That worked well enough, but without a durable drill bit, no amount of air could hammer out a tunnel. The first practical drill came along in 1865. It was designed by Charles Burleigh, of the Putnam Machine Works in Massachusetts. An improved version of the Burleigh drill halved drilling costs on the

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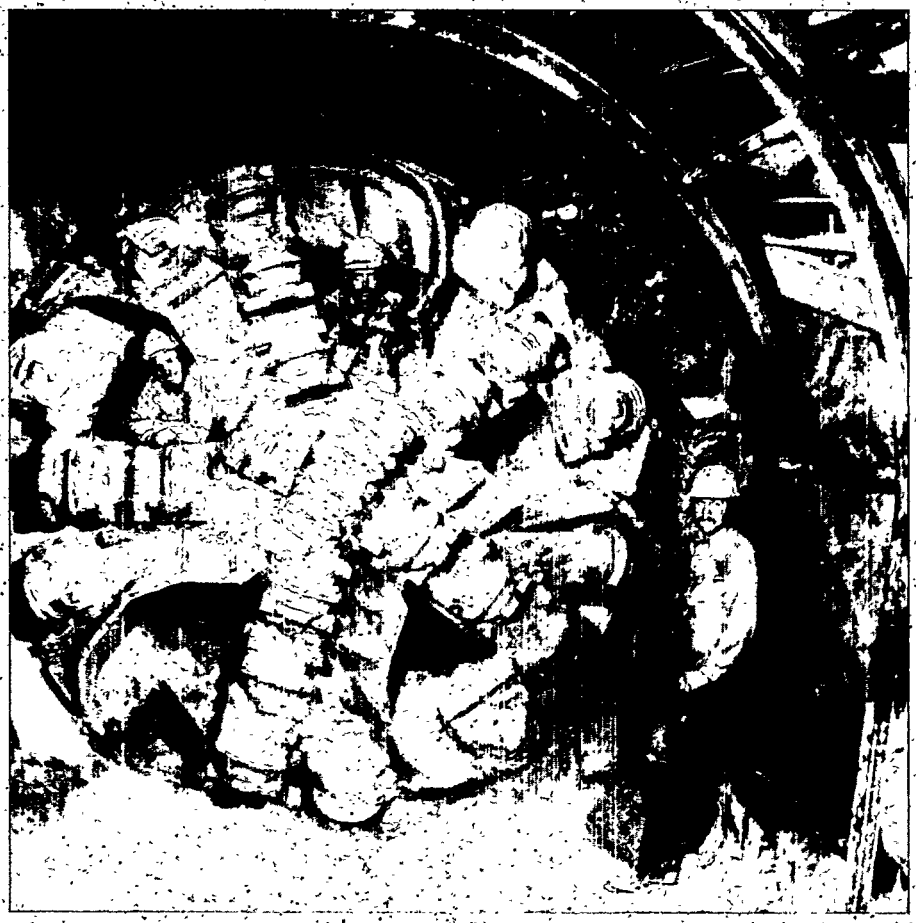
TBM

Hoosac and doubled the rate of progress.

The Hoosac's chief engineer, Thomas Doane, later mounted several drills onto a track-mounted rig, which he used to dig directly into rock. This was not an early TBM, but a precursor of a machine called the "drill jumbo." But the first TBM — a self-contained machine that fastens itself to the rock wall and grinds and chips at its surface with a rotary drill (rather like a large mechanical earthworm)—also appeared for the first time inside the Hoosac. It only excavated three meters (10 feet) of tunnel, and was put out of service, mostly because it could not stand up to the punishment. But when the time came in the late 1870s to consider cutting through the soft chalk under the English Channel, a full-faced rotary machine suddenly started looking good again. Unfortunately, the project itself languished for political reasons.

Cutting through hard rock was not something the early TBMs did well, mainly because no one could make tool bits that lasted. But in 1956, engineers rolled out the first TBM built expressly for hard rock boring. It debuted in the Humber River sewer project in Toronto. This machine used disc cutters, and eventually bored 35 meters (115 feet).

Though they are close relatives, today's TBM is bigger, stronger, more durable, and able to handle vastly different ground conditions. The Yucca Mountain Project commissioned a TBM because it takes less money and time than conventional drill-and-blast techniques. Also important, it does so with a minimum of environmental disruption.



A modern tunnel boring machine, or "mole," breaks through the opening of the Vatt Tunnel in Utah in 1981. (Photo: U.S. Department of the Interior, courtesy of Franklin Watts Photo Archives).

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Nevada Science Fair

the sense of accomplishment you get from starting, and successfully completing, a project," Gibson teacher Nelda Schaffer said.

Rachel Sommer, a junior at Meadows School in Las Vegas, knows first-hand about such feelings. Her project, "Matrix Analysis of Rumor Network," won first place in the mathematics division, and was first runner-up in the general Sweepstakes category. Her efforts earned her a trip to Birmingham, Alabama. There, she participated in the 45th International Science and Energy Fair, receiving an Honorable Mention from the National Aeronautics and Space Administration.

Rachel enjoyed being a part of what she describes as "a learning environment that is so rich — not just the science, but the diversity of everyone involved. I was meeting these people and I just knew that they were going to be something special someday."

Bill Distel, a Yucca Mountain Project geologist who participated as a Science Fair judge, commented on his own experience:

"I finished my judging with a better and deeper appreciation of those who will be the scientists and leaders of our future."

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Project hydrologists suspect water table higher

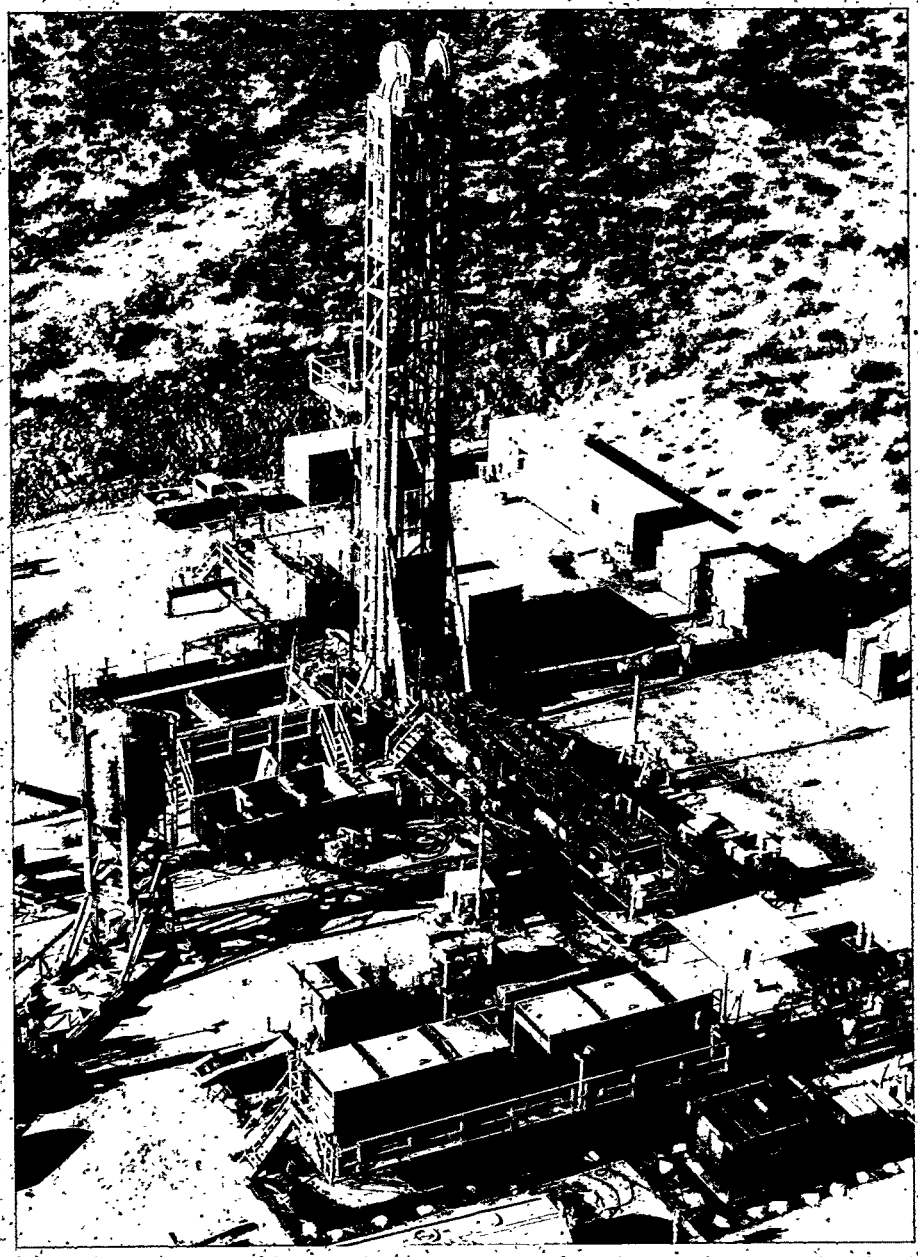
the water table. The water table at the northern part of Yucca Mountain, under a borehole called USW UZ-14 (UZ stands for Unsaturated Zone), lies about 575 meters (1,890 feet) below the surface. This is about 40 meters (130 feet) higher than where they first thought they'd find it. The water table is higher at UZ-14 than other places under and to the south of the mountain. But it is not as high as water levels to the north.

Neither the presence of perched water nor a higher water table, in themselves, set off alarm bells among scientists studying the mountain, as making the site unsuitable for a potential repository. Hydrologists anticipated finding the water table an altitude of 730 to 825 meters (2,400 to 2,700 feet) above sea level underneath Yucca Mountain. But why the water table should change much in such a small area still causes some head-scratching.

"We don't really know what accounts for the changes in elevation of the water levels," observes Richard Luckey, a United States Geological Survey hydrologist based in Denver, Colorado.

"This change in the water table is interesting, particularly because there is no single geologic feature to which we can attribute these variations. But there's nothing about it that's either unexpected or alarming. This does not say that Yucca Mountain is, in any way, a fatally flawed site. This is simply one of the things site characterization will look at in the next few years."

The scientists who must solve this apparent anomaly are not without hunches as to its cause. Many think that the rock underneath Yucca Mountain is not fractured in some layers. This would mean that some infiltrating water cannot easily seep down to what may be the table's natural depth.



Drilling at UZ-14 — *"We don't really know what accounts for the changes in elevation of the water table... but there's nothing about it that is either unexpected or alarming," says hydrologist Richard Luckey.*

Alternately, some suspect that a natural dike might be acting as a barrier to water flow, causing a higher water table. Others suspect that under Yucca Mountain there may be two distinct aquifers, or permeable rock layers containing water, one higher than the other.

Whatever the reason for this elevation, Luckey believes that, "In the next few years, as we drill more boreholes nearby, we should come up with an answer."

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Tours of Yucca Mountain

Saturday, Oct. 22, 1994
and Saturday Nov. 12, 1994
7:15 a.m. - 5 p.m.

The U. S. Department of Energy's Yucca Mountain Project invites you to tour the Yucca Mountain area and talk to scientists and staff members about ongoing studies.

Reservations should be made at least 14 days in advance by calling (702) 794-7104 during business hours. Tours will be filled on a first-come, first-served basis.

Yucca Mountain is about 100 miles northwest of Las Vegas. To visit the site, information such as full names, addresses, social security numbers, dates and places of birth and telephone numbers must be provided when making a reservation. The tour is open to any U.S. citizen over the age of 14. Non-U.S. citizens must allow for about a month between applying to attend a tour and receiving authorization to take the tour.

1994 Public Exhibits Schedule

Oct. 13-17 — American Nuclear Society, Washington, DC.
Exhibit hours: Sun., 1 p.m.-5 p.m., Mon., 11:30 a.m.-6 p.m.,
Tues. 10 a.m.-6 p.m., Wed. 9 a.m.-12 p.m.

"Great things are done when men and mountains meet."

– William Blake

All photos used in "Of Mountains & Science" are provided courtesy of the U.S. DNA-DOE/Johnson Controls World Services Photos.

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September 1994