



OCRWM BULLETIN

WINTER 1995

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

OCRWM DIRECTOR BRIEFS U.S. NUCLEAR REGULATORY COMMISSION

On December 19, 1994, the Office of Civilian Radioactive Waste Management's (OCRWM) Director, Dr. Daniel Dreyfus, made a presentation to the U.S. Nuclear Regulatory Commission (NRC) on the status of the Civilian Radioactive Waste

Management Program. Dr. Dreyfus briefed the NRC on OCRWM's 1994 achievements, including evaluating the suitability of the Yucca Mountain site and addressing waste acceptance, storage, and transportation issues. Dr. Dreyfus also discussed

OCRWM's plans for 1995. Highlights of these achievements and plans, as described by Dr. Dreyfus, follow:

PROGRESS IN 1994

Dr. Dreyfus told the Commission that one of the most important accomplishments in 1994, and the key to OCRWM's progress in the future, was the determination of the level of financial support that would be endorsed by the Administration and Congress. Congress approved a 37-percent increase in OCRWM funding for FY 95 despite severe government-wide budgetary restrictions. Most of the additional funding has been allo-

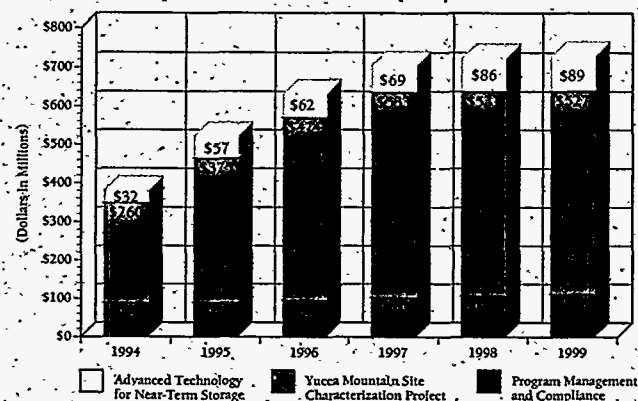
cated to Yucca Mountain site characterization activities. Dr. Dreyfus commented that he was "hopeful that the future funding profile proposed with our FY 95 budget [outlined in the bar chart, above] can be attained despite the much more restrictive deficit controls across the government that can be expected in the years ahead."

Yucca Mountain Site Suitability Investigations

Dr. Dreyfus noted that during the past year, OCRWM had developed a new approach to the site suitability determination and, if the site is found suit-

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OCRWM PROGRAM BUDGET CHANGES FY 1994-1999



FY 1994-1999 Figures Exclude Appropriations for Civilian Waste R&D Activities

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able, the licensing of a proposed repository at Yucca Mountain, Nevada.

Dr. Dreyfus stated that "the new program approach is an attempt to bring the program back to the original intent of the legislation and regulatory framework. The approach provides a management tool to focus site characterization and engineering activities initially on that information deemed necessary and sufficient to support a technical site suitability determination."

OCRWM has sought public comments on the process for evaluating site suitability that it published in the *Federal Register* (Vol. 59, No. 149) on August 4, 1994.

Related major accomplishments in 1994 were the completion of the pre-decisional draft of the *Yucca Mountain Site Characterization Project Five-Year Plan, Fiscal Year 1996-2000* and OCRWM's recent submittal of *The Yucca Mountain Technical Implementation Plan for Fiscal Year 1995* (both documents are available through the OCRWM National Information Center). These plans flesh out the restructured program that OCRWM is now implementing.

During 1994, the Yucca Mountain project made progress in constructing the Exploratory Studies Facility (ESF), in surface-based testing, waste package and repository advanced conceptual design, performance assessment, planning, licensing, and in support system development activities.

Waste Acceptance, Storage, and Transportation

Dr. Dreyfus told the Commission that the "resolution of waste acceptance, storage, and transportation issues is of critical importance." He went on to say that "to address these issues, which are becoming very visible in the political arena, we have several objectives. We are preparing to be able to

participate knowledgeably in the forthcoming debate on interim storage options, we are developing a capability to meet the challenges of transporting spent fuel in a timely fashion, and we are striving to make advanced storage and transportation technologies available to the marketplace."

Last May, the Department issued a Notice of Inquiry to solicit the views of affected parties on (1) 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 a suitable storage facility constructed under the Nuclear Waste Policy Act of 1982, as amended; (2) the need for an interim, away-from-reactor storage facility prior to repository operations; and (3) 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 reactor sites beyond 1998. OCRWM has received more than 1,000 comments. Dr. Dreyfus remarked that OCRWM is evaluating the comments in the context of litigation that has been initiated by some stakeholders and as a basis for forming Administration positions on anticipated legislation dealing with the waste acceptance and interim storage issues.

In June, OCRWM issued a request for proposals (RFP) for the design of a multi-purpose canister (MPC) subsystem. Dr. Dreyfus noted that "this subsystem would help standardize spent nuclear fuel storage at reactor sites, or at interim storage sites if they are developed. It would facilitate transportation and, if we are successful, it would simplify disposal. We received and responded to vendor questions, amended the RFP, received proposals, and expect to award one or more contracts in April 1995."

In support of this overall effort, the Department, on October 24, 1994, issued a notice of its intent to prepare

an Environmental Impact Statement to support a decision on the fabrication and deployment of a multi-purpose canister-based system for the management of civilian spent fuel. OCRWM conducted three scoping meetings in November and December (see related article, *Environmental Impact Statement Scoping for the Multi-Purpose Canister-Based System*, in this issue) and expects to complete the statement and the Record of Decision in 1996.

In support of OCRWM's transportation initiatives, in July and August OCRWM submitted safety analysis reports for packaging to the NRC for the GA-4 and GA-9 legal weight truck casks. OCRWM is working with the NRC to certify these cask designs to ensure their timely availability.

PLANS FOR 1995

"Our plans for 1995 are ambitious," said Dr. Dreyfus. "We intend to make further progress in evaluating the suitability of the Yucca Mountain site, in complying with the requirements of the National Environmental Policy Act [NEPA], in resolving licensing issues, and in acquiring the information we need to support these activities. We also intend to make progress in our waste acceptance, storage, and transportation activities."

Yucca Mountain Site Suitability Investigations

OCRWM has finalized its site suitability evaluation process by taking into account the input it has received from stakeholders and from reviewers such as the NRC. OCRWM has issued a white paper that addresses the questions that have been raised about the intent and definition of the "Technical Site Suitability" determination, and will also prepare technical and compliance documentation to support decisions on five higher-level findings for guideline conditions related to surface processes.

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DISCLAIMER

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NOTICE OF INQUIRY: TECHNICAL ASSISTANCE AND TRAINING FOR SAFE TRANSPORTATION OF RADIOACTIVE WASTE

The Office of Civilian Radioactive Waste Management (OCRWM) published a Notice of Inquiry (Notice) in the Federal Register (Vol. 60, No.1) on January 3, 1995, initiating a public process that will lead to the development of a policy and procedures for implementation of Section 180(c) of the Nuclear Waste Policy Act of 1982, as amended. The Notice requests comments from the public on Section 180(c) of the Act, which requires that the Secretary of Energy provide technical assistance and funding to train State, local, and Indian tribal public safety officials of appropriate jurisdictions with regard to the transport of spent nuclear fuel or high-level radioactive waste. Such training would cover safe, routine transport procedures, as well as emergency-response procedures.

The Notice provides several options available to OCRWM for implementing the funding and technical assistance requirements of the Act. To ensure that OCRWM addresses the full range of issues and alternatives related to the policy and procedures, comments are solicited on the scope and implementation mechanisms of Section 180(c). Specifically, the Notice requests comments on which option(s) is (are) the least administratively burdensome and/or offer(s) the greatest flexibility, eligibility criteria, formulas for division of funds, restrictions on use of funds, use of funds in similar programs, scope of the term "technical assistance," and training activities appropriate for implementation under Section 180(c).

An information packet, which includes a copy of the Notice, is available by calling the OCRWM National Information Center at 1-800-225-NWPA (6972) or 488-5513 in Washington, D.C. The 90-day comment period ends April 3, 1995. Written comments should be directed to: U.S. Department of Energy, c/o Lois Smith, TRW Environmental Safety Systems, 2650 Park Tower Drive, Suite 800, Vienna, VA 22180, ATTN: Section 180(c) Comments.

When sending in written comments, please include your name, address, and 3 copies of the comments.

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Dr. Dreyfus stated that OCRWM "will begin the formal NEPA process for the repository and will initiate scoping activities for the required statutory Environmental Impact Statement. We will complete the next revision of our annotated outline for a repository license application and issue it as a Department document for the first time. [In January 1995] we will submit our responses to the [NRC] staff's questions and comments from their review of our topical report on Extreme Erosion. Later this year, we will submit for [NRC] review the second in our series of three topical reports on Seismic Hazards Assessment methodology."

OCRWM will also continue to obtain and analyze data from surface-based

tests and from the tests it is conducting in the ESF during construction.

"We are now," said Dr. Dreyfus, "involved in the shakedown phase of tunnel boring machine operations and will continue tunneling in accordance with our plans."

OCRWM expects to continue surface-based testing at about the same level as in FY 94. OCRWM will emphasize testing and monitoring in existing drillholes and focus on long-lead critical-path activities. As part of its approach, OCRWM will be re-examining every investigation in its technical program to ensure that it is contributing to the needs of its suitability and licensing activities.

"One of our major priorities," said Dr. Dreyfus, "will be to assemble and analyze existing data so that we can use the data to support our efforts to demon-

strate measurable progress toward a decision about site suitability."

Waste Acceptance, Storage, and Transportation

Regarding OCRWM's 1995 plans for waste acceptance and storage, Dr. Dreyfus stated: "Our waste acceptance and near-term storage activities will concentrate on the multi-purpose canister and on compliance with the requirements of NEPA. We have completed scoping meetings and are now preparing an Environmental Impact Statement to support a decision on the fabrication and deployment of the multi-purpose canister subsystem. Expectations are to complete evaluations of vendor proposals, award one or more contracts for the design of

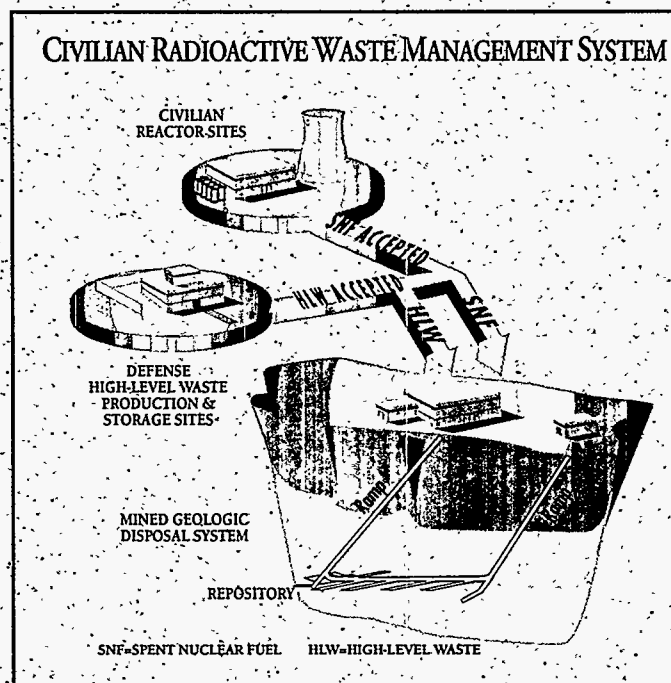
"NRC" continued on page 4

OCRWM PROGRAM PLAN

In the Summer/Fall 1994 issue of the *OCRWM Bulletin* it was reported that OCRWM was proposing a restructured program, a proposal known then as the "Proposed Program Approach." The approach, approved by OCRWM's Director on October 1, 1994, and now incorporated into the three-volume *OCRWM Program Plan*, is an initiative to restructure the major elements of the OCRWM program following an extensive program assessment. The assessment concluded that the existing program no longer represented a viable option for meeting the original intent of the Nuclear Waste Policy Act. A new, more flexible approach responding to changing conditions was needed. The new program approach defines two "business centers"—the Yucca Mountain Site Characterization Project and the Waste Acceptance, Storage, and Transportation Project—and program integration, human resources, administration, and quality assurance groups supporting the program and projects.

The first volume of the *Program Plan* presents the OCRWM overall program situation and describes the key features of the approach that are to be implemented, covering the goals, activities, and schedule milestones for Fiscal Years 1995-2000. The second volume deals with the Yucca Mountain Site Characterization Project, focusing on site suitability, the National Environmental Policy

Act process, repository licensing, and management and compliance. The third volume describes the Waste Acceptance, Storage, and Transportation Project, emphasizing waste acceptance and the near-term management of spent fuel, the multi-purpose canister system, the transportation system, and management and compliance. As with the first volume, the latter volumes cover Fiscal Years 1995-2000.



The *Program Plan* is intended to be a living document. It will be revised periodically to accommodate change, to reflect progress, to respond to external advice and comments, and to convey to stakeholders, other interested parties, and program personnel the resulting changes to the program's approach, strategies, and plans.

All three volumes of the plan are available to the public through the OCRWM National Information Center, 1-800-225-NWPA (6972) or 488-5513 in Washington, D.C.

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the multi-purpose canister subsystem in April, and initiate the design.

"Activities are underway to complete and submit to the NRC in May a topical report to provide the basis for the NRC's acceptance of OCRWM's use of 'partial' burnup credit and special cask loading procedures for storage and transportation."

After discussing OCRWM's 1994 achievements and plans for 1995, Dr. Dreyfus also addressed specific issues of concern to the NRC. These issues included OCRWM's site suit-

ability approach, defense-in-depth, on-going interactions with the NRC staff, quality assurance, and criticality control. Individuals who want more information on Dr. Dreyfus' statement concerning these issues may request—through the OCRWM National Information Center—a copy of Dr. Dreyfus' Statement for the Record presented to the U.S. Nuclear Regulatory Commission on December 19, 1994. The Information Center's toll-free number is 1-800-225-NWPA (6972), or, in Washington, D.C., 488-5513. There is no charge for a copy of the Statement. To purchase a transcript of the December 19, 1994, NRC

meeting, contact the NRC's Public Document Room at (202) 634-3273.

INFOLINK UPDATE

In the last issue of the *OCRWM Bulletin* it was reported that INFOLINK, OCRWM's electronic public information database, would be upgraded in July 1995. Due to budget constraints, plans for updates are still under development.

ENVIRONMENTAL IMPACT STATEMENT SCOPING FOR THE MULTI-PURPOSE CANISTER-BASED SYSTEM

With the publication of a Notice of Intent in the October 24, 1994, *Federal Register*, the Office of Civilian Radioactive Waste Management (OCRWM) formally announced its intent to prepare an Environmental Impact Statement (EIS) for the fabrication and deployment of a multi-purpose canister (MPC)-based system for the management of civilian-spent nuclear fuel. OCRWM has initiated action to prepare an EIS because selecting, fabricating, and deploying one or more systems to manage spent nuclear fuel was determined to be a major Federal action with national importance.



Dan Kane, nuclear engineer, discusses MPC design and fabrication at the Washington, D.C., MPC EIS scoping meeting.

Preparing an EIS is a well-defined process that must be performed in accordance with both the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (NEPA) and the Department of Energy's (DOE) Regulations and Implementing Procedures adopted pursuant to the Council's regulations. After informing the public that an EIS will be written, a process known as "scoping" begins. The scoping process allows the general public, as well as Federal and State agencies and Indian tribes, to provide comments on environmental issues and possible alternatives that should be covered in the EIS.

The scoping period for the MPC EIS ended on January 6, 1995. In the summer of 1995, an Implementation Plan will be issued that summarizes scoping comments and identifies issues and alternatives to be included in the EIS. A draft EIS will then be issued in the fall of 1995. After a period for public comment, a final EIS will be issued (fall of 1996) that reflects the

oral and written comments received during the public review of the draft EIS. OCRWM will then issue the formal Record of Decision.

Under the Nuclear Waste Policy Act of 1982, as amended, OCRWM is responsible for managing the disposal of spent nuclear fuel from civilian nuclear powerplants, and for possible monitored retrievable storage of spent nuclear fuel prior to disposal. OCRWM is also responsible for the transportation of spent nuclear fuel in connection with OCRWM's disposal and storage facilities. A number of alternative technologies are already available that may accomplish these objectives and protect the environment. The environmental impacts of OCRWM's proposed action to fabricate and deploy a standardized MPC-based system will be compared with the environmental impacts of other alternatives.

OCRWM has sought actively "to gather the most diverse collection of opinions, perspectives, and values from

the broadest spectrum of the public, enabling OCRWM to make better, more informed decisions," consistent with the new Secretarial Policy on the National Environmental Policy Act of 1969 (June 1994). This aggressive approach to provide stakeholders with extensive and meaningful opportunities to participate in the civilian radioactive waste management program's decision-making process was reiterated in the draft Recommendations for Effective Public Participation under NEPA issued by DOE's Environment, Safety and Health's Office of NEPA Oversight.

Potentially interested parties were informed of the issuance of the Notice of Intent for the MPC EIS and the opportunities for participation through:

- Notification letters to more than 600 "core" program and environmental justice stakeholders
- An *OCRWM Bulletin Extra* mailed to approximately 10,000 subscribers

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NUCLEAR WASTE TECHNICAL REVIEW BOARD UPDATE

To broaden the dialogue on the Office of Civilian Radioactive Waste Management (OCRWM) program's approach, and to inform the Nuclear Waste Technical Review Board (NWTRB) of OCRWM's current plans and outlook for the coming year, Dr. Dreyfus, OCRWM's Director, spoke at an October 1994 NWTRB Full Board meeting. During his remarks, he made the following key points:

Repository Site Characterization

"The program can pursue a technical site suitability determination, and the subsequent licensing of a repository, within the general statutory and regulatory parameters as they presently exist. This effort can be performed in a scientifically and socially defensible manner while meeting rational requirements for cost control. Limited resources require us to concentrate the scientific work initially on the factors essential to making a technical site suitability determination."

Program Management

"In Fiscal Year 1995, we are placing a high priority on several aspects of program management. These include clarifying organizational roles, making changes to enable Federal leadership in exercising appropriate control, and making participants more responsible and accountable for their work."

Consideration of Legislation

"In addition to the immediate program activities, we expect to be involved in a significant public debate on the national radioactive waste management policy during the [1995] Congressional session."

The NWTRB provided specific comments and recommendations on the new OCRWM program approach in a December 6, 1994, letter to Dr. Dreyfus. The Board's letter included conclusions from recent meetings, its views on the key technical uncertainties facing the program, and a number of general recommendations as to the exploration, testing, and analytical activities needed to produce a technically defensible evaluation of the suitability of the Yucca Mountain site, as well as some areas where current efforts could be reduced.

On November 17-18, 1994, the NWTRB's Panels on Structural Geology and Geoen지니어ing, and Hydrogeology and Geochemistry met in Washington, D.C., to discuss approaches to managing and possibly utilizing the heat generated by the waste in the design and operation of the radioactive waste management system. This approach is referred to as OCRWM's thermal loading strategy. The NWTRB has long advocated the systems approach

that the OCRWM program has taken to evaluate the impacts of thermal loading on the design and operation of the waste management system. Participating in the discussions with the NWTRB panel members were OCRWM managers and program participants in the areas of waste acceptance, storage, transportation, and disposal. The topics discussed included the selection and implementation of coherent thermal management and a repository thermal-loading strategy for commercial spent fuel.

On January 10 and 11, 1995, OCRWM Deputy Director Lake Barrett and staff participated in another NWTRB Full Board meeting. This meeting, held in Beatty, Nevada, focused on compliance with the National Environmental Policy Act, socioeconomic studies by OCRWM and other interested parties, and the program's current strategy and test program to demonstrate waste isolation in the unsaturated geologic environment at Yucca Mountain.

Future interactions on a variety of topics are scheduled for the coming year. Information regarding these meetings is provided in the OCRWM Calendar, or may be obtained directly from the NWTRB's Public Affairs Office; (703) 235-4473.

NEW OCRWM VIDEOTAPE AVAILABLE

The *OCRWM 1994 Program in Review* videotape is now available through the OCRWM National Information Center. This 17-minute video presents an overview of the high-level radioactive waste management system being developed in the United States. Featured in the video are the latest advancements in the OCRWM Program, including the multi-purpose canister concept for storing, transporting, and disposing of high-level waste and spent fuel; the starter tunnel of the Exploratory Studies Facility (ESF) at Yucca Mountain; and the Tunnel Boring Machine, which is now excavating the ESF.

The videotape can be ordered free of charge by calling the Information Center at 1-800-225-NWPA (6972) (in Washington, D.C., 488-5513) or by writing to the Center at P.O. Box 44375, Washington, D.C., 20026.

NUCLEAR WASTE NEGOTIATOR UPDATE

The Office of the Nuclear Waste Negotiator began working with the Skull Valley Band of Goshutes in November to develop a framework for negotiations over the terms for siting a Monitored Retrievable Storage (MRS) facility. The work began after Negotiator Richard Stallings and the Utah tribe signed a cooperative agreement on November 10, 1994. This agreement, the first of three signed by the Negotiator in November, provides for \$46,800 to support the tribe's participation in developing the framework for negotiations.



OCRWM site assessment team and Goshute tribal members survey a potential MRS site at Hickman Knolls in Skull Valley.

Also on November 10, 1994, Negotiator Stallings signed a cooperative agreement with the University of Utah that gives the school's engineering department \$25,000 to study the

economic and transportation impacts an MRS would have on the State. The Negotiator signed a third agreement on November 23, 1994, with Tooele County, Utah, the county in which the tribe's reservation is located. That

agreement gives the county \$18,500 to determine the potential impacts of an MRS on population and demographics, employment, income, housing, education, public services, cultural and recreational activities, tourism, and economic development. The county will pay the university \$10,000 to analyze such impacts. The remainder of the funding will support the county's participation in the studies.

Stallings called the agreement "a model for future cooperation between the Federal Government and Native Americans that

includes participation at the State and local level." According to the Office of the Nuclear Waste Negotiator, negotiations specific to terms of a siting agreement would take place under a subsequent cooperative agreement.

OCRWM TO PARTICIPATE IN WASTE MANAGEMENT '95 CONFERENCE

Dr. Daniel Dreyfus, OCRWM Director, or Lake Barrett, OCRWM Deputy Director; Dean Stucker, Team Leader for the Repository/Waste Package Team at Yucca Mountain; Stephan Brocoum, Assistant Manager for Suitability and Licensing at Yucca Mountain; and Gregory Cook, Director of Public Affairs at the Yucca Mountain Site Characterization Office, are scheduled to speak at the upcoming Waste Management '95 Conference in Tucson, Arizona. The conference is being hosted by the University of Arizona and sponsored by the University, the American Nuclear Society, the U.S. Department of Energy, New Mexico State University and the Waste-Management Education and Research Consortium, and the American Society of Mechanical Engineers. The conference, which is being organized in cooperation with the International Atomic Energy Agency, will be held at the Tucson Convention Center February 26 through March 2, 1995.

The participating OCRWM speakers and the dates and times of their presentations are listed below:

OCRWM Progress, Programs, and Policies—Daniel Dreyfus, Monday, February 27, 8:30 a.m.

Underground Conceptual Repository Design at Yucca Mountain, Nevada—Dean Stucker, Monday, February 27, 10:30 a.m.

New Public Health and Safety Standards for Yucca Mountain and Their Impact on the Carbon-14 Issue—Stephan Brocoum, Monday, February 27, 10:30 a.m.

International Perspective on U.S. High-Level Waste Licensing Requirements—Stephan Brocoum, Monday, February 27, 2:00 p.m.

Responding to Communicator Needs: In-House Communication Training on the Yucca Mountain Project—Gregory Cook, Tuesday, February 28, 8:30 a.m.

OCRWM EXHIBIT FEATURED AT NATIONAL ATOMIC MUSEUM

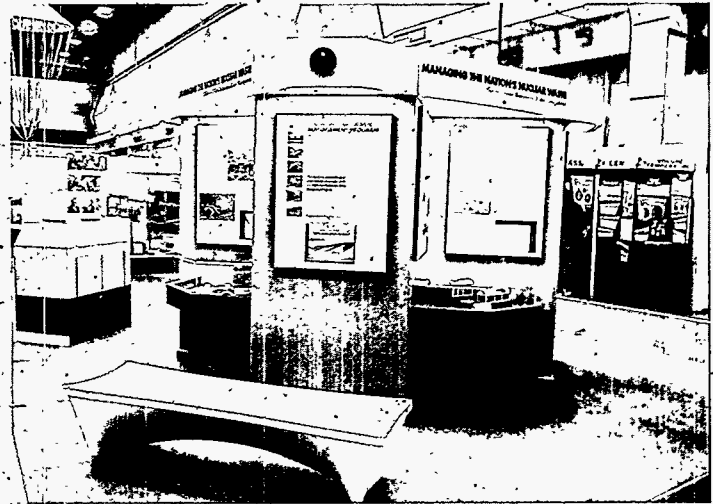
When the National Atomic Museum in Albuquerque, New Mexico, reopened its halls and celebrated its 25th anniversary last October 22nd, OCRWM's refurbished "Managing the Nation's Nuclear Waste" exhibit was on display. The exhibit, developed by OCRWM, was redesigned last summer to include interactive elements and updated information related to spent fuel and high-level radioactive waste management and advancements in the OCRWM program.

Many of the 4,000 people who attended the museum's Grand Reopening had the opportunity to interact with the multi-sided exhibit, which includes a touch-screen computer activity on the Nation's high-level radioactive waste program, and a fiber-optic map display that—with the press of a button—lights up to show U.S. locations of spent nuclear fuel and high-level radioactive waste ultimately destined for geologic disposal. Attendees at the ceremony also were able to watch on separate monitors the

exhibit's two videotapes—one on the multi-purpose canister concept, the other on site-characterization activities being conducted at Yucca Mountain, Nevada.

By reading panels of information on the sides of the exhibit, attendees were informed on various elements of the OCRWM program, including environmental studies being done at Yucca Mountain, issues surrounding the transportation of spent nuclear fuel and high-level radioactive waste, advanced technologies in the OCRWM program, and OCRWM's educational initiatives.

The National Atomic Museum, which hosts approximately 200,000 visitors each year, is displaying the "Managing



OCRWM exhibit on display at National Atomic Museum

the Nation's Nuclear Waste" exhibit on a semi-permanent basis. The exhibit can be viewed from 9 to 5 daily in the newly renovated exhibit hall of the museum, located on the Kirtland Air Force Base in Albuquerque. For more information on this exhibit or OCRWM's other exhibits, call the OCRWM National Information Center at 1-800-225-NWPA (6972) or, in Washington, D.C., 488-5513.

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- An information mailing to 3,000 interested DOE and environmental justice stakeholders
- 42 information packages mailed to National Congress of American Indians members and other interested tribal representatives
- Paid advertisements placed in a national newspaper and the respective newspapers of the cities where scoping meetings were scheduled
- A flyer sent over EnvironNet (electronic mail) with 400,000 individual subscribers in 93 countries
- DOE press releases sent to 2,382 daily editors, 25 wire services, 1,556 magazines, 281 American

Indian and Hispanic media, and 1,147 electronic media.

The State of Nevada also notified the public of its opportunity to comment on the proposed program by mailing a flyer to interested parties.

OCRWM has provided an extensive array of opportunities for the public to participate and to comment. Three national-level scoping meetings were held in Las Vegas (November 21), Chicago (November 30), and Washington, D.C. (December 7). Attendance was 90, 65, and 80, respectively, for morning informational workshops and 66, 55, and 70, respectively, for afternoon formal scoping hearings.

On-the-record oral comments were presented at each meeting by 23, 7, and 17 individuals and organizations, respectively. At the conclusion of the scoping period (January 6, 1995), 57 letters were received and 289 structured comment forms developed by OCRWM or affected units of government were received. The public also used an MPC EIS toll-free fax line, telephone line, and an electronic bulletin-board to submit 10 comments. Requests for information from the public resulted in 322 information packets, consisting of fact sheets, comment forms, and reports, being mailed to interested parties. OCRWM will prepare an MPC EIS Implementation Plan in accordance with DOE's regulations (10 CFR Part

NEW PUBLICATIONS

To order any of the new publications listed below, contact the OCRWM National Information Center (toll-free) at 1-800-225-NWPA (6972) (488-5513 in Washington, D.C.) or in writing: P.O. Box 44375, Washington, D.C., 20026.

FY 1993 Annual Report to Congress: Office of Civilian Radioactive Waste Management, U.S. Department of Energy, DOE/RW-0449, September 1994

This tenth annual report, submitted to the Congress by the Office of Civilian Radioactive Waste Management, contains details of the program's accomplishments and activities during Fiscal Year 1993 (October 1, 1992, through September 30, 1993) and the audited financial statements for the Nuclear Waste Fund.

Civilian Radioactive Waste Management Program Plan (three volumes), U.S. Department of Energy, DOE/RW-0458/Vol I; DOE/RW-0458/Vol. II; DOE/RW-0458/Vol. III; January 1995

The *Program Plan* provides OCRWM-program constituents with an overview of the revised approach that is being implemented. The first volume provides an overview of the entire Program Plan, provides background on the situation that led to the decision to implement a new approach, and describes the key features of the approach that is being implemented. Volumes II and III describe in detail the goals, activities, schedule milestones, and funding requirements for the program's two business centers for the current fiscal year (1995) and for the subsequent 5-year planning period (1996-2000). (See related article, *OCRWM Program Plan*, in this issue.)

*New/Revised Fact Sheets**

Multi-Purpose Canister System, U.S. Department of Energy, DOE/RW-0426/Rev. 1, October 1994

What is an EIS?, U.S. Department of Energy, DOE/RW-0454; October 1994

National Environmental Policy Act, Department of Energy, DOE/RW-0453, October 1994

How To Be Involved, U.S. Department of Energy, DOE/RW-0455, October 1994

The Civilian Radioactive Waste Management System, U.S. Department of Energy, DOE/RW-0358/Rev.1, October 1994

Spent Nuclear Fuel, U.S. Department of Energy, DOE/RW-0378/Rev.1, October 1994

Storage of Spent Nuclear Fuel, U.S. Department of Energy, DOE/RW-0355/Rev.1, October 1994

Transportation of Spent Nuclear Fuel, U.S. Department of Energy, DOE/RW-0356/Rev.1, October 1994

Nuclear Waste Policy Act and Amendments, U.S. Department of Energy, DOE/RW-0357/Rev.1; October 1994

Radiation, U.S. Department of Energy, DOE/RW-0368/Rev. 1, October 1994

Safety: The Key to Success, DOE/RW-0376/Rev.1, October 1994

*All 11 fact sheets can be ordered by asking for the *Multi-Purpose Canister System Environmental Impact Statement Information set*.

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1021) implementing NEPA. This plan briefly records the results of the scoping process, defines the relevant issues and alternatives, establishes the content of the EIS, and provides a schedule for developing the EIS. The OCRWM MPC EIS Implementation Plan will reflect the diverse opinions, perspectives, and values obtained through the public participation mechanisms described above. This will include comments provided orally at the three national scoping

meetings, in writing, and/or through electronic means. OCRWM will define the issues and alternatives that will be examined in detail in the EIS before proceeding. The MPC EIS Implementation Plan will provide the public with a preview and blueprint of the expected scope and content of the MPC EIS that is to be developed.

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

U.S. Department of Energy
c/o Argonne National Laboratory
9700 Cass Avenue, Building 900
Argonne, IL 60439
Attention: MPC Comments
800-MPC-3304 (toll-free)
800-MPC-4531 (fax)
MPCEIS @ smtlink.ead.anl.gov
(e-mail)
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FEBRUARY

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1995

WEEKEND	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
		Nuclear Waste Transportation Meeting Las Vegas, NV			
4	FY 1996 Budget to Congress Press Office		DOENRC BI-Monthly Management Meeting Videoconference Las Vegas, NV	OCRWM Directors' Program Review Dunn Loring, VA (O)	
5					
6					
7					
8			NEI Congressional Information Program Leadership Workshop Las Vegas, NV		
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20	President's Day				
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24					
25	NARUC Winter Comm. Mtg. Washington, DC				
26	Waste Management '95 Tucson, AZ				
27					
28					
29					
30					
31					

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

1995

MARCH

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WEEKEND	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
25 NARUC Winter Committee Meeting, Washington, DC					
26 Waste Management '95 Tucson, AZ	27	28	1 NRC Repository Criticality Control Technical Exchange Rockville, MD	2	3
4			3 Nuclear Energy Agency Meeting Paris, France		
5	6	7	8	9	10
11			DOENRC ACNW Meeting Rockville, MD		
12	13	14	15	16	17
18		DOENRC Bi-Monthly ESF Meeting Las Vegas, NV NRC Site Visit/TBM TE Las Vegas, NV			
19	20	21	22	23	24
25					
26	27	28	29	30	31

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

WINTER/SPRING OCRWM EXHIBIT SCHEDULE

Hoosier Science Teachers Association
February 9-11, Indianapolis, IN
Exhibit: National Program Exhibit

Waste Management '95
February 26-March 2, Tucson, AZ
Exhibits: National Program Exhibit;
Transportation and/or Multi-Purpose
Canister Exhibit(s)

Technology Literacy Conference
March 2-5, Arlington, VA
Exhibit: National Program Exhibit

Association of American Railroads (AAR)
March 21-23, Dallas, TX
Exhibits: Transportation and/or
Multi-Purpose Canister Exhibit(s)

National Science Teachers Association
42nd National Convention
March 23-26, Philadelphia, PA
Exhibits: National Program Exhibit;
Transportation and/or
Multi-Purpose Canister Exhibit(s)

Association for the Supervision and
Curriculum Development Annual
Conference
March 25-28, San Francisco, CA
Exhibit: National Program Exhibit

International Technological Education
Association Conference
March 26-29, Nashville, TN
Exhibit: National Program Exhibit

Seventh Annual International High-
Level Radioactive Waste Management
Conference
April 30-May 4, Las Vegas, NV
Exhibits: National Program Exhibit;
Transportation and/or Multi-Purpose
Canister Exhibit(s)

ANS Nuclear Technology Expo
(Annual Meeting)
June 25-28, Philadelphia, PA
Exhibit: National Program Exhibit

Due to the recent realignment of OCRWM, some education and information points of contact for the Headquarters program have changed. The new Team Leader for the OCRWM information and education program, including the National Information Center, is Elissa Turner (202-586-1710). Ms. Turner reports directly to Harold H. Brandt, Director of the Administration Division (202-586-1652), who, in turn, reports to James C. Bresee, Acting Director of the Office of Human Resources and Administration (202-586-9173). Comments on the *OCRWM Bulletin* can be directed to Mr. Bresee (refer to the Reader Response card, below).

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

Winter 1995

Project scientists use sound waves for geophysical map of ground deep below Yucca Mountain

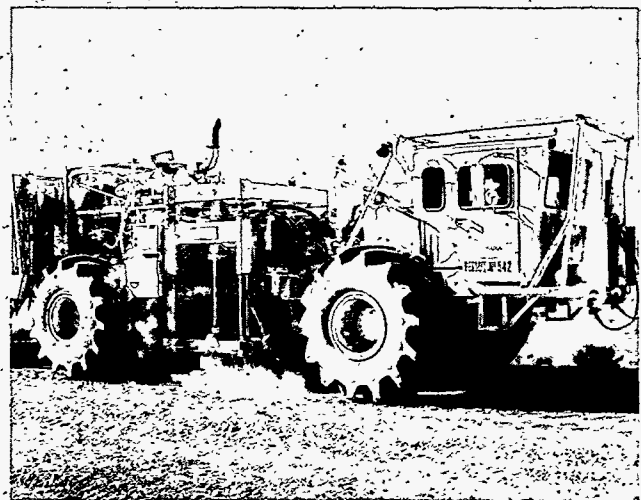
Project scientists are calling it "one of the largest and most complex geophysical studies we've ever done for the Yucca Mountain Project."

It began last November, when workers rolled four 18-wheeler-sized Vibroseis™ vehicles, or "thumper" trucks, out to the foot of Yucca Mountain. Each vehicle comes equipped with a large, hydraulically controlled device designed to create an energy wave upon impact with the ground. Massive pads at the front of the trucks slam into the soil, creating vibrations, or sound waves that move out into the surrounding rock. These vibrations are tracked by complex acoustic sounding equipment.

Shallow and deep regional tests

Scientists used a single thumper truck for a "Site Area Shallow Test" that focused on underground geologic features near the repository area. In this test, they broadcast low-level energy waves through the shallow rocks near Yucca Mountain to depths of 1,000 meters (3,280 feet). As these sound waves bounced back through the rock — some slowly and some more quickly, depending upon the kind of rock they moved through — they carried with them a comprehensive view of the geologic features within the ground below.

Another test looked at underground geologic features in a line extending



A Vibroseis™ "thumper" truck rolls out for some deep soundings of Yucca Mountain.

from the Amargosa Valley past Yucca Mountain to Jackass Flats. From these two experiments, scientists should gain a comprehensive sonic map of the rock under and near Yucca Mountain. This

Continued on page 78

At a Glance

- Yucca Mountain Project Field Geologist Chris Menges wanted to be a historian. But then he took a raft ride down the Colorado. See profile on page 81.
- What happens when Project personnel set their minds to helping some local Boy Scouts erect a teepee? See page 83.
- Remember when learning math involved moments of skin-crawling terror or abject confusion? Meet a class where they won't even give you a pen and paper to work out the problems. A class, moreover, where no one's complaining! See page 85.
- Some towns just seem to have a story to tell. See how one town's past relates to its future. Turn to page 86.

YMP research drives technological innovation

The U.S. Department of Energy is conducting one of the most significant geological research programs ever done in the United States by trying to find out if Yucca Mountain can isolate high-level nuclear waste.

To do this, scientists must complete extensive drilling and excavation programs designed to give them a thorough understanding of the mountain's

makeup, including its geology and hydrology. Since it is important to understand the mountain in its natural state, scientists must conduct their work in a way that causes the least change to the mountain's natural condition. This has resulted in advances in current drilling and excavation technologies and techniques that some believe could benefit

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Printed with soy-based ink on recycled paper containing 100% postconsumer recovered fiber.

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Yucca Mountain sound waves



Thumper trucks deploy to begin tests for regional soundings of area near Yucca Mountain.

will help take some of the uncertainty out of deciding whether Yucca Mountain may be a suitable location for a high-level nuclear waste repository.

Geologists quickly stored and began to interpret their preliminary data. They believe the data will help them see how volcanic material that erupted from volcanoes many millions of years ago eventually settled into distinct geologic bodies now located deep within the earth. These soundings also may offer important information about the presence and orientation of faults and volcanic features situated within the shallow layers of the earth.

A geologic "sonogram"

"I've always compared this test to performing a sonogram in the early months of pregnancy," says Mark Tynan, a Department of Energy (DOE) geologist on the Project who, with his associates, has been preparing for these tests for about two years.

With their first probes, scientists looked for general features of the section of ground under study. A more detailed

picture of the subsurface geology eventually will emerge from these seismic and subsequent magnetic, gravity, and electrical tests. The information from these tests should help scientists determine if water can travel to or from the potential repository zone, and if so, through what pathways, and how quickly.

Finding faults and, possibly, pockets of magma deep underground

Using up to four thumper trucks for the deep sounding test, scientists will try to direct sound all the way down to where the Earth's crust meets its middle shell, as deep as 35 kilometers (22 miles) below the Earth's surface. Their goal will be to create a more comprehensive portrait of the faults and other tectonic structures found in the area. Their seismic reflection picture also will extend 35 kilometers (22 miles) in an east-west line transecting Yucca Mountain.

Vibrations produced by trucks, however powerful, are not sufficient to create

images of the scope and complexity sought by researchers interested in a comprehensive underground map of the region. Scientists will augment the energy generated by the thumper trucks with detonations from up to 24 strategically placed 200-foot-(60-meter-) deep boreholes packed with conventional explosives. The energies released from these carefully controlled detonations are expected to reveal much-needed new information about the shape and location of deep-seated fault systems and other crustal structures. They may even show the presence of deep volcanic pockets of magma.

Scientists believe the knowledge produced by the seismic tests will greatly assist them in better understanding the mountain's environment.

Previous soundings attempted

According to Tynan, this is not the first time that scientists have used these types of tests to determine the geology of underground areas. Thumper trucks were developed for this purpose more than 30 years ago by companies looking for oil. Scientists tried smaller-scale soundings at Yucca Mountain during the 1970s and 1980s, but these early attempts were unsuccessful. Tynan says the kind of volcanic rock found in the area tends to absorb or scatter the energies transmitted to them. The rock reflects too little energy back for scientists to discern underground features with great clarity. Previous technologies used to study the mountain simply weren't good enough to overcome this difficulty.

But Tynan says that he hopes advances in data acquisition and processing technologies in the last decade have largely compensated for the poor reflective qualities of the rock in the area. Relying on technological improvements, Lawrence Berkeley Laboratories and the United States Geological Survey (USGS) successfully concluded a series of high-resolution shallow-soundings at Yucca Mountain

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Sound waves

between 1990 and 1994 that serve as prototypes for the current tests.

Coordination of tests a complicated business

The tests were conducted in lands administered by DOE, the U.S. Air Force, the Bureau of Land Management, and other agencies, as well as on land that is privately owned.

Securing permission to conduct testing required considerable coordination and planning by DOE and the USGS. Other project scientists had to complete extensive environmental, biological, and archaeological surveys of the areas

to be affected before the USGS could do its work.

Wildlife that might be affected by the tests, such as the desert tortoise, had to be carefully inventoried, tracked and kept from harm. Archaeological sites were located. Scientists submitted all pre-activity surveys to the various organizations administering the land involved for their consideration.

In instances where archaeological sites could not be surveyed, or where wildlife habitats might be negatively affected, trucks were rerouted. The controlling agencies reviewed all plans, sometimes conducting independent

inquiries, and gave the scientists the go-ahead to conduct their tests.

Ultimately, these tests should offer scientists a new way to test their previous hypotheses about the mountain and the Great Basin region in which it is situated. Also, these tests should provide some key information regarding the geology of Yucca Mountain. For instance, they could help shed light upon natural features within the area that might trigger seismic activity. These tests will contribute to a determination of the suitability of Yucca Mountain as a place to permanently dispose the nation's high-level nuclear waste. ■

Continued from page 77

Innovation

other drilling and excavating efforts in the future.

As part of this program of site characterization, drillers are removing rock core samples from dozens of boreholes at depths of 790 meters (2,600 feet) or greater. These samples are analyzed and catalogued at an on-site sample management facility.

Also involved in site characterization is a tunnel boring machine (TBM) slated to excavate a 14-kilometer (8.7-mile)-long, 7.6-meter (25-foot)-diameter underground laboratory inside the mountain.

Once, comparable drilling efforts meant injecting water, fluids and even mud into boreholes, straining, and sometimes contaminating, the natural geologic systems underground.

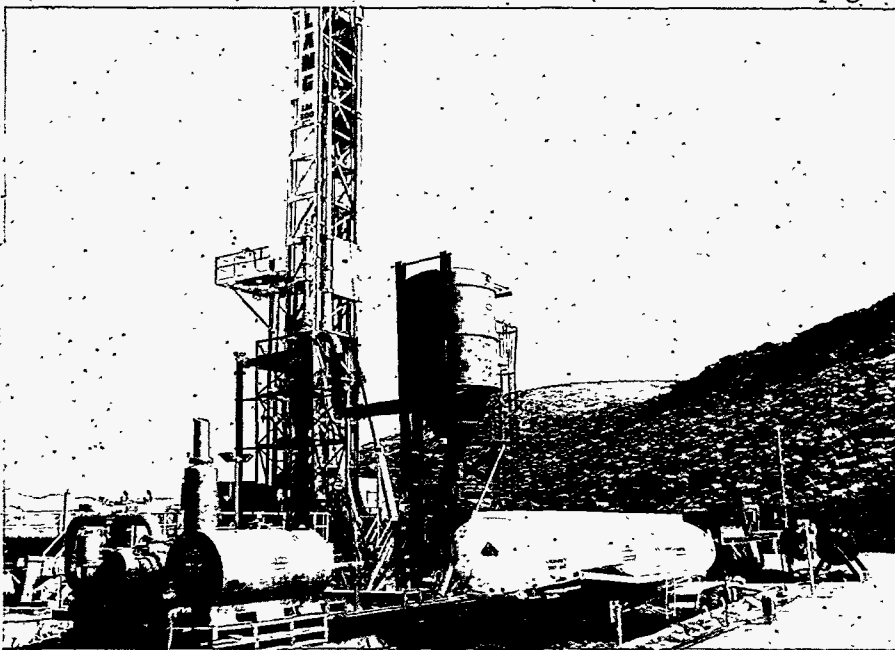
Similarly, tunnel boring once involved intensive use of explosives. Neither of these methods suited the work at Yucca Mountain. New methods for drilling and tunnel boring were needed. The technologies chosen

— vacuum drilling using dual-wall coring rods, the use of safety-enhanced TBMs, and refinements of existing drilling and excavating techniques — are cleaner and safer than those used in previous efforts. Because they have demonstrated their worth on the Yucca Mountain Project, they will ultimately benefit future excavation projects, whether in the public or private sectors.

Clean borehole drilling

Drillers at Yucca Mountain do not use water or other fluids to remove cuttings and debris from boreholes drilled in the unsaturated zone above the water table. These fluids, and even warm air, could contaminate or otherwise change the natural conditions within the rock and soil.

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The Yucca Mountain Project's clean-drilling LM-300 rig.

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Innovation. . .

To prevent contamination of the core sample, Project engineers have developed, and are constantly refining, new and better ways to remove core samples. Because of new equipment and procedures, some of the boreholes found at Yucca Mountain are among the cleanest ever drilled.

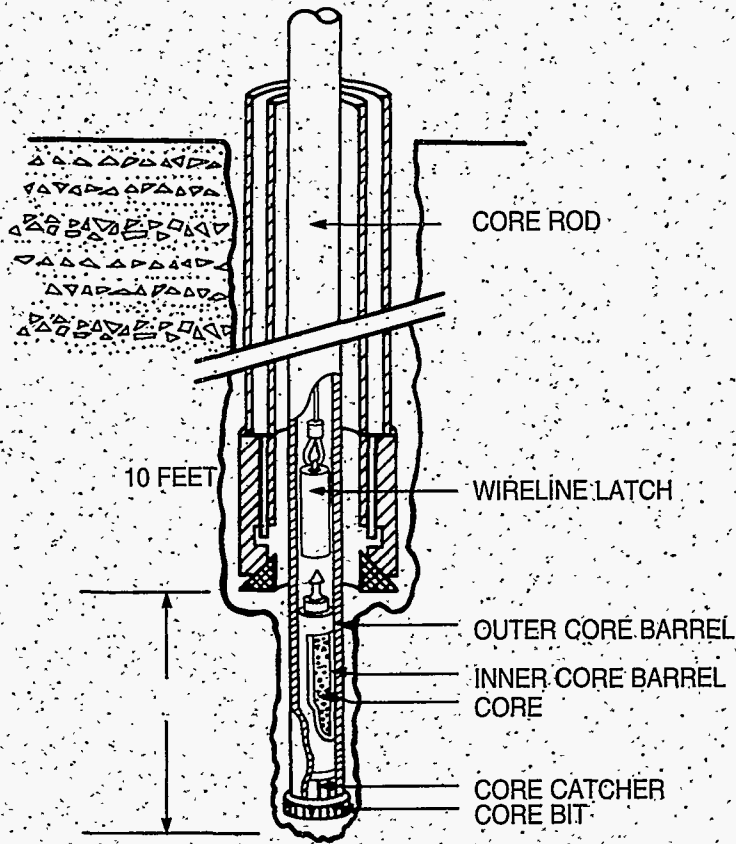
Most of this has been achieved by use of a dual-wall coring system. With a rig called the LM-300, drillers remove 60-millimeter diameter core with a coring assembly placed inside a 245-millimeter by 152-millimeter dual-wall drill pipe. That is a 2.4 inch core inside a 9 5/8-inch by 6-inch dual-wall pipe. Air moves down the inside of the core rod and back to the surface through a gap between the core rod and inner tube of the dual-wall pipe. A vacuum system ensures that cuttings and air near the remaining bit are sucked into this pipe before they can contaminate the borehole.

Typically, blowing high-pressure air into a borehole risks displacing the air pockets in the mountain with new air from the surface, which could contaminate the rock. Project scientists don't want new air in this rock, so drillers extract cuttings with a vacuum-like process. It involves running air through the pipes, all the while pumping more air out than goes in. This near-vacuum prevents contamination. Drillers call this "balanced-air drilling."

Improved drilling efficiency

The hard, fractured volcanic rock under Yucca Mountain makes for slow coring. Rigs working in such an environment can devote only a portion of their operation time to removing core samples because the rest is devoted to maintenance. Additionally, drill rigs in this environment require extra equipment preparation to withstand the rigors of drilling.

Scientists involved in site characterization need to drill boreholes from which they can remove rock core samples. Samples removed from a wide



This dual-wall core-rod was designed to meet the Yucca Mountain Project's requirement to prevent contamination while drilling and removing core samples.

array of boreholes will give scientists a comprehensive picture of the nature of the rock, and other underground geological features.

But borehole drilling is a tedious, time-consuming process that takes its toll upon equipment, requiring regular equipment repair or replacement. For Project engineers, time is a precious resource and they are constantly seeking new ways to improve speed and decrease downtime.

Toward these ends, some Project drillers are now using redesigned cutters to ream and core hard rock. Additionally, Project engineers are exploring other new ways to enhance their drilling abilities. To do this, they are working with the schools of petroleum engineering at California State University, Fullerton and at the Colorado School of Mines, and with Quest International Inc. of Seattle.

Improvements for future increases in durability

In extremely hard rock conditions, drill rigs face greater risk of failure from metal fatigue. The LM-300 has performed well to date, but engineers are still evaluating improvements for future rigs. Electric motors, for instance, may one day replace hydraulic motors. This might improve a rig's performance and protect the environment by decreasing combustible air emissions.

Aiming for increased rig durability, YMP engineers have suggested improvements for core rod assemblies that descend into the boreholes and ream through the rock. The harsh conditions at Yucca Mountain create significant stresses and vibrations. YMP engineers are exploring the use of a new, more durable rod that may prove more resistant to fatigue and shaking. Because this rod

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In their own words...

Chris Menges

There was a time early in geologist Chris Menges' education when he thought he might pursue a degree in history. Menges, 44, recalls an interest in sleuthing and an eye for detail that might have served him well as a peruser of the written historical record. But he also favored outdoor activities, notably rock and mountain climbing, hiking and rafting. It became increasingly clear to him that he might not be entirely happy locked up in a library. A rafting trip down the Colorado River during his undergraduate studies at the University of Washington in Seattle clinched a career track switch for him. His companions in the raft were geologists, and Menges recalls the sublime pleasure he felt watching them making sense of their environment as they made their way down the river. Bolstering his math skills, he made his move.

Today, Menges still loves a mystery. Since joining the Yucca Mountain Project two and a half years ago, where he has been charged with studying recent faults near the mountain, he has found many such mysteries. There is much that geologists wish to know about Yucca Mountain, possibly more than has ever been required of a similar geological feature. The answers to all the unknowns Menges and other Project geologists face, though, are not always apparent, or even necessarily in reach. But Menges believes that by subjecting the five or six active faults within a five-kilometer radius of Yucca Mountain to intense and unprecedented scrutiny, geologists like him will find the answers they need.

"Early on, while still an undergraduate, I discovered I had a strength in science that I wasn't real cognizant of. At first, I thought I couldn't handle the math, but eventually I learned how to

do it. I'm just not a natural. Time was you could be a geologist without knowing math — you just needed a basic knowledge of rocks. That's not so true now. The science is a little more rigorous. If you go on for advanced degrees or become a professional, you encounter more and more mathematics.

"I haven't found it a handicap. But my skills are in other areas of geology. I'm a field geologist basically. I also have a good mind for detail, and work well with empirical data. If I'm studying an active fault, I can come up in a detailed manner with some valid, fairly carefully thought-out interpretations of the history of the fault.

Dealing with ongoing processes

"Initially, I was interested in igneous rocks. But after I got my bachelors de-

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Innovation.

could drill a straighter hole, it could reduce the number of core and/or ream cycles by allowing longer core runs. This may decrease the total time required for sampling.

Greater control inside boreholes

The balanced-air system used by the YMP to prevent contamination of the mountain can work well to a maximum depth of 790 meters (2,600 feet). But engineers need to control drilling conditions at greater depths to not contaminate the rock there. Toward this end, they have installed a new system that provides a digital record and readout of air movement in and out of a borehole. Also, they've installed a system for removing cuttings and debris that allows for more rapid sampling without requiring a shutdown in the ongoing injection and removal of air. This helps them remove samples more quickly, minimizing total sampling cost.

The ultimate improvement under consideration would be in the cutting tools at the face of the rock. Engineers would like to design a reaming bit that opens the borehole to the desired diameter and removes core samples at the same time. This capability is expected to be slow in development because it, too, must satisfy all the stringent scientific test controls required on the YMP.

Cleaner and safer excavating

As with drilling, excavation technologies such as tunnel boring have advanced because of the YMP. Project engineers have influenced, and in many cases determined, the specifications for the tunnel boring machine (TBM) in use at Yucca Mountain. Some of their innovations could become standard features in future machines.

For instance, engineers asked for a probe drill that could drill ahead of the TBM independently of the machine. Such a drill was needed to sample and analyze the different ground and water

features ahead of the TBM. The Yucca Mountain TBM also includes a number of features designed to improve operator safety while preventing unnecessary contamination of the mountain. This TBM not only uses less hydraulic fluid than most other machines, but also includes mechanisms for trapping the fluid if there is a leak. Additionally, the TBM comes with an advanced diagnostic system that can identify any subsystem or unit that fails.

The drilling and excavation programs at Yucca Mountain are unique because they address a full-fledged scientific site investigation program entailing a construction project of major proportions. In such a venture, new technology must be found to meet new challenges. This has been especially true for the YMP, where innovation has joined science in an attempt to solve a key environmental problem. ■

Continued from page 81.

In their own words...

gree I got interested in neo-tectonics — the study of deformation and active modification of the earth. It has always appealed to me that you're dealing with active faults, with an ongoing process. So I drifted into Quaternary geology, which is the study of the recent past — of the last three or four million years.

"My work is a little more geologically oriented than being a seismologist, though. A seismologist deals with the process of earthquakes themselves. I'm more interested in studying past earthquakes based on the imprint they leave in the geologic record. The mystery comes from the fact that there is no direct historical or instrumental record of these earthquakes. These are earthquakes you have to deduce from records you find in the rocks — features you see in a given outcrop, or exposure.

"The issues for scientists such as myself are basically tectonic. What is the earthquake history of the area? And what implications does it have for establishing the suitability of the site or for designing a potential repository?

"I've been evaluating the faults with Quaternary activity at the site within a five-kilometer radius (of Yucca Mountain). The task involves trying to interpret past activity of faults based on exposures that you see. Some of those are artificially created. Basically, you go in and dig a trench with a bulldozer or a backhoe, exposing the fault in a three-meter section. Then you clean it up and map it in a greater amount of detail.

"Using some basic principles that have evolved over the past decade, you try to interpret from the relationship of rock units to faults: what surface-rupturing events occurred on the fault zone, and when and where? The assumption is that a rupture is usually associated with an earthquake of a given size. From that, you try to interpret how often and when and how large these were. In one case we're going back 700,000 years. In most cases, we're talking about events that happened tens or hundreds of thousands of years ago. In doing that,

we extend back the interpretable record on these faults over a time span that has geologic meaning.

No movement in historical times

"One of the problems is that there has been no movement on these faults in historical time. None whatsoever — not even micro-earthquakes. So there is no record other than the geologic record. Geologically, there were moderate events of 6.5 to 7 magnitude earthquakes. But they were very infrequent, occurring on a given fault every 10,000 to 50,000 years.

"Now it's true that you can find other sites without any significant faulting. The seismic issue is there, and you can't get away from it. There are six or seven faults at Yucca Mountain with known Quaternary activity. There are also faults within the proposed repository block where we don't see evidence for Quaternary activity. But there are other factors recommending the site that have to be weighed in, and they appear at this juncture to outweigh the risks. The fact is that the seismic issue can be solved by designing for an underground facility.

Contributing to science

"It is also a fact that in determining the suitability of the mountain as a repository site, we are also making a contribution to science. We're looking at a whole class of faults that has not really been studied in this much detail. We're looking at low-activity faults which would normally not be considered in a more general study. We have studied them in such detail for such a long time that the body of knowledge we have is bound to be significant.

"There are two issues in particular that I think fall into this category. One is the fact that we are collecting data on



Chris Menges: "The issues for scientists such as myself are basically tectonic."

whether volcanism and tectonics are linked. We know there is Quaternary volcanism in the area, and the volcanism we observe at the site is not always connected with active faults. I know a number of volcanic centers in the Yucca Mountain area that are nowhere near active faults. But some *are* near active faults and there may be some sort of association between them.

"We're in an area of actively extending rocks, which means things are pulling apart. The volcanism and earthquakes may interact, perhaps by providing pathways for the magma. It's not clear, though, which would be the controlling mechanism. It's possible that the volcanism could take up some of this extension as it moves up through a fault plane. And if a fault happens to be near failing, it might fail at that time. These are all speculations. But any data we collect on that will have a bearing of general interest for the science.

"Another contribution we're making is in the interaction of faults. We have five or six faults, and we're required to test whether an event (any significant movement) on one fault is associated

Continued on page 87

Chemehuevi District scouts hold Camporee in Pahrump

Last October, some 20 Yucca Mountain Project staff members organized and accompanied more than 200 scouts from the Chemehuevi District (Las Vegas and Pahrump) to a three-day Camporee in Pahrump, Nevada. The wind was up, the air filled with dust, and brisk temperatures marked the onset of fall. None of this dimmed the spirits of the participants, though, who erected tents, got their campfires running, and warmed themselves with a chili cook-off.

"The bad weather could have spoiled the day," said Gary Mansur, a Yucca Mountain Project volunteer for the event. "But everyone's good spirits and camaraderie made it fun."

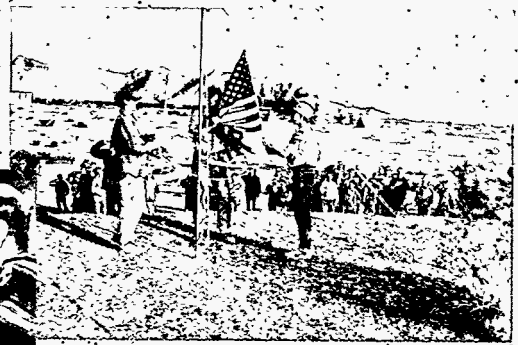
Fun? You bet! We're talking the thumping of hundreds of feet on the way to an evening campfire, where blue smoke carries the wafting aromas of cooking stew or ham and eggs. We're talking ghost stories told in hushed voices against the din of pattering rain on tents. Camporees are the ripple of windblown flags in the morning sun, and the first glimmerings of teamwork emerging in a patrol.

Among the skills learned or honed during the Camporee: First aid, map navigation, using rope to make table legs and other tent furnishing, tent peg-making, fire-making, ladder-making and tomahawk throwing.

There is something exhilarating for young boys in becoming completely self-reliant over a period of two or three days. It is this sense that lies at the core of the Camporee experience. Ken Beall, Chemehuevi District Chairman,



...or erecting a teepee...



Whether raising the flag...



starting a fire...



Or just trying something new ...

noted that the key to the Camporee is to have fun and learn — this goes for both the scouts and the volunteers.

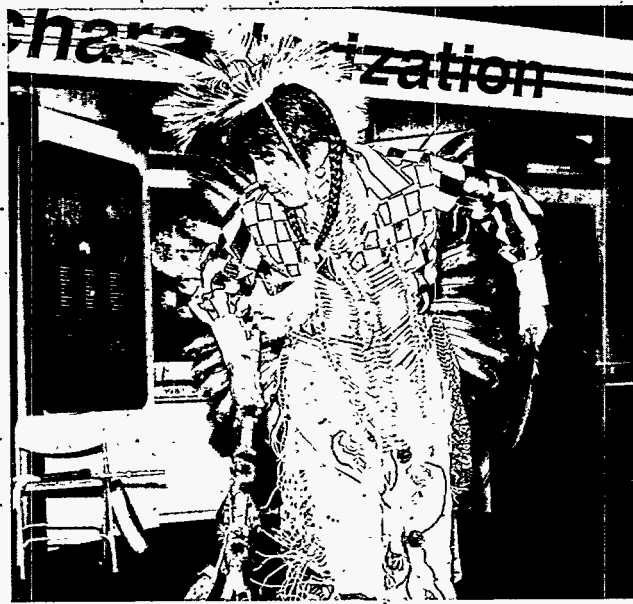
"I think the Project people had more fun than the scouts," Beall said. ■



YMP staff volunteers and their Camporee charges always pull together.

With reporting from Ken Beall

YMP Science Center Observes Native American Day



Tribal councils with a historical relationship to the Yucca Mountain site participated in a Native American Day at the Yucca Mountain Science Center in Las Vegas, Nev. Participants demonstrated traditional dress and dances of their tribes. Other demonstrations and activities involved beadwork, games, storytelling, and basketweaving.



Number-crunching whiz kids:

Las Vegas teacher turns timeless game into ultra-effective teaching tool

A Yucca Mountain Project-funded educational program kindling a passion for numbers among junior high school students takes the timeless game of musical chairs and turns it into something new: "Mathematical Chairs."

In teacher Ben Tocci's basic math class at K.O. Knudson Middle School, students regularly vie for the opportunity to occupy the "hot seat," where they field a constant flurry of mathematical problems.

Some students might regard the prospect of being placed in the algebra "hot seat" with the quiet resolve of people about to have their thumbnails snatched out. Remember when you sat in terror that your algebra teacher might call on you? Ironically, such fears have no place in this Las Vegas school. When asked what they like best about their class, Lilliana Davis, Dominic Castro and David Carey, all 8th graders, agree that the hot seat is... well... hot.

So how does the game work? Using a stockpile of worksheets featuring such problems such as converting decimals to percentages or fractions to decimals, Tocci throws out a problem. The first person in the class to come up with the right answer (don't bother with a pencil and paper — the answers start flying immediately) takes the coveted hot seat. Now things get fiery, as each new problem brings the chance to unseat your classmate. The winner is the one sitting in the hot seat when the class ends.

YMP funds math ability enhancement

Using this game as a cornerstone for a new approach to math instruction,

Tocci proposed that DOE fund the addition of an extra session of math class during the remainder of the 1993-94 school year, and then once again the following year. Tocci also proposed a summer math program and a twice-weekly afternoon tutorial. These measures eliminated some of the overcrowding in the existing basic math classes and in-



"Learning strategist" Ben Tocci carries his math skills improvement battle to the ultimate battleground — the minds and hearts of his students.

creased the amount of personal attention that can be given to the students.

The proposal was reviewed by DOE and found to support the educational initiatives stated in America 2000. This government-initiated program establishes an outline of national goals that the country is striving to meet by the year 2000. One of these goals is to increase the interest and proficiency of American students in science and math. The U.S. Department of Energy and the

Yucca Mountain Project have been staunch supporters of these efforts, hence their eagerness to fund Tocci's program. Indeed, it began to work so well, improving not just the students' mental math skills, but classroom attendance, that he decided to implement a supplemental math program with the "hot seat" game at its core. Tocci titled his program "Math: Just Fry It."

Tocci's pilot program ran for six weeks in the summer of 1994, with two sessions a day, two hours each. Attendance reached between 85 and 90 percent, which is unheard of in a voluntary summer program. Meanwhile, parents and students from other Las Vegas middle schools and high schools quickly heard of it and contacted the school to see if they could participate. Nobody was turned away, and "Math: Just Fry It" proved its success not just with its attendance record, but by the obvious changes in the students' attitudes that carried on into the school year.

Learning to work through roadblocks instead of shutting down

Much of the success of "Math: Just Fry It" can be attributed to Tocci's approach to teaching students math. He refers to himself not as a math teacher, but a "learning strategist." He instills in students the "proper attack skills" needed to work through a problem. Once they learn to work through the roadblocks instead of shutting down, he guides them through a sequence of steps that allows them to solve the problems in their heads.

Students are never left behind if they are having trouble grasping a concept. In addition, all math classes are videotaped so the students can go back

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YMP becomes repository for Goldfield history

Goldfield, Nevada, sprang to life in 1902 as one of the last great gold and silver mining camps in the American West. Although it has seen better days — and many worse ones from flash floods, fires, and several mining industry busts — the town endures.

In 1993, the Esmeralda County Commissioners decided the time had come to recognize this achievement by chronicling and preserving its history. This task fell to the Esmeralda County History Project. Last fall it donated a 14-volume oral history of the town to the Yucca Mountain Project Research and Study Center in Las Vegas. The volumes contain interviews with 16 people who recounted their view of Goldfield's history. These interviews recounted the history of Goldfield after its boomtown heyday faded following World War One.

DOE funds oral histories

These oral histories were prepared through a U.S. Department of Energy (DOE) grant to Esmeralda County as part of its funding for county oversight of the Yucca Mountain Project. The county's historical program fits in with the county's effort to determine possible socio-economic impacts of a repository at Yucca Mountain, in adjacent Nye County. By collecting these oral accounts, the county gained access to important information about the origins, histories, traditions and quality of life of those that might find themselves affected by a repository.

The history project also could become a springboard, organizationally, for new studies of social organization, social attitudes and behavioral effects that could be caused by the potential

construction of a repository at Yucca Mountain, or by the transport of nuclear waste through Esmeralda County.



The Esmeralda County courthouse sits on Main Street in Goldfield, one of Nevada's oldest enduring mining towns.

Esmeralda County focused its oral history on Goldfield because it's the town that would potentially be most affected by the transportation of nuclear waste, says the county's Repository Oversight Program director, Juanita Hoffman.

Goldfield's glory days ended in 1918, when mine production began to dwindle in the aftermath of the Great War. The town survived a flash flood in 1913 and a catastrophic fire in 1923 that, with a second fire the next year, nearly wiped it out. Yet between 1903 and 1942, the town produced approximately 7.7 million tons of ore containing more than 4.1 million ounces of gold and more than 1.4 million ounces of silver. With the price of gold during this time roughly \$20 an ounce, this accounted for some \$90 million in hard cash.

Situated about 70 kilometers (112 miles) west and north of Yucca Mountain off Highway 95, Goldfield today is a town of about 400 people, most of

them employed by the mining industry. It's also the county seat of Esmeralda County — the County courthouse is on Main Street. The town boasts a mini-mart and gas station,

two bars and two restaurants. Many of the folks who live there take pride and pleasure that they and their community have held on this long.

Canvassing the county

The Goldfield interviews were conducted by Robert McCracken, who has compiled oral histories for all the towns in Nye County. With help from Hoffman, McCracken was able to track down 16 people for his volumes.

"I canvassed the people in the county," said Hoffman, "to come up with people who had spent significant time in Goldfield. Probably half of them are still in Goldfield or Tonopah. The others are scattered throughout the West — in California, mainly, and Arizona."

The project took a year to complete. Writing in his introduction to the volumes, McCracken notes that "the interviews vary in length and detail, but together they form an unprecedented composite of life in Esmeralda County after 1920. These interviews can be compared to a bouquet: Each flower in the bouquet is unique — some are large, some are small — yet each adds to the total image. In sum, the interviews provide a view of Nevada's past that has heretofore been largely neglected by historians. Such histories are also a foundation for the present and future." ■

Jamie Elliott

Girl Scouts

Several times each year, Yucca Mountain Project personnel hold a Geology Merit Badge workshop to spark Earth Science interest in Las Vegas Girl Scouts. The latest workshop, where more than 40



At a recent Geology Merit Badge workshop at the Yucca Mountain Science Center, Girl Scouts travel through geologic time and learn how fossils can help unfold the secrets of Earth's history.

local Girl Scouts were able to work on their merit badges, was held on Nov. 12 at the Las Vegas Yucca Mountain Science Center.

Geology workshops were initiated four years ago, and have become a key component of the Project's educational outreach pro-



After learning about the inner workings of one of the Earth's most powerful geologic forces — the volcano — an eager scout constructs her own version of a lava-erupting mountain.

grams. At these workshops, Girl Scouts work with Project geologists to learn more about volcanoes, fossils, rocks and minerals, water movement and mapping. The knowledge they gain and the activities they participate in are applied to earning their Geology merit badges. ■



Yucca Mountain Project Geologist Linda Linden introduces her young audience to the fascinating world of rocks and minerals.

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In their own words...Chris Menges

with an event on another. You do this by trying to date the earthquakes as carefully as you can, isolating where they occurred in the past on individual faults, then comparing that record, trying to see if there's a coincidence, and if

it's plausible, trying to link them.

"The mysteries we face are interesting, and any answers we provide could be significant. But it's really a double-edged sword. There's an

indeterminacy to some of our work, a lack of resolution. You have to be dogged in your pursuit of the answers, but you also have to guard against frustration. Sometimes there are questions you just can't answer." ■

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Teaching tool

and view classes in which they may have had a problem.

Part of Tocci's strategy is teaching his students to L-O-V-E math. In fact, Tocci starts the first day of class by offering to pay them twenty dollars if, by the end of the class, they do not LOVE crunching numbers. By LOVE, they soon realize, Tocci means *Listen, Observe, Verbalize, and Execute*. It's a neat way to learn math, though not to make a quick \$20.

Listening, says Tocci, is imperative because one cannot solve a problem without understanding what the prob-

lem is asking. By observing, he means that the students must be sure they are addressing all elements of the problem. Verbalization comes next — the students must articulate how they are going to work through the problem. By execution, he means following the steps they need to take.

Motivational strategies become an integral part of this math program. Dozens of handwritten posters adorn the walls advising students that "A problem is a chance to do your best" and that "Those who make the worst use of their time are the first to complain of its shortness."

Parental involvement also plays a big role in the success of the math program.

Werner Kopp is one of the parents who have children in the program. He is impressed by the results in his child's grades. "My son doesn't come to me for help as much as he used to," says Kopp. "And he has much better problem-solving skills."

But what motivates Ben Tocci, who has been teaching at Knudson Middle School for 18 years, to spend two afternoons a week, six weeks out of his summer vacation, and an extra class period teaching students math? According to Tocci it comes down to another age-old adage: "I figure if I'm going to do something, I either do it right or not at all." ■

Jennifer Sizemore

Locations and dates for viewing exhibits about studies of Yucca Mountain

- April 6-9 Clark County Fair, Logandale, Nev., Logandale Fairgrounds. Exhibit hours: Thurs., 1 p.m.-10 p.m., • Fri., 10 a.m.-9 p.m., • Sat., 10 a.m.-9 p.m., Sun., 10 a.m.-8 p.m.
- April 20-23 Original Home Show, Las Vegas, Nev., Las Vegas Convention Center. Exhibit hours: Thurs., noon-9 p.m., • Fri., 4 p.m.-9 p.m., • Sat., noon-9 p.m., • Sun., noon-6 p.m.

Tours of Yucca Mountain

Saturday, January 21, 1995

Saturday, February 25, 1995

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-serve 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 and receiving authorization to take the tour.

Box lunches will be provided for \$4 per person.

Who do you call in Nevada?

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

— William Blake

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For Group Tours?

Carleen Hill 794-7375

For Exhibits?

Joanna Magruder 794-7056

For Speakers?

Jackie Brandt 794-7759

For Educational Programs?

Effie Harle 295-0886

For Publications

Jamie Elliott 794-7769



U.S. Department of Energy
Office of Civilian Radioactive Waste
Management

YUCCA MOUNTAIN
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