

May 1989

NUCLEAR WASTE

DOE Has Terminated Research Evaluating Crystalline Rock for a Repository





United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-202377

May 22, 1989

The Honorable William S. Cohen
United States Senate

The Honorable George J. Mitchell
United States Senate

On July 26, 1988, you requested that the General Accounting Office determine whether and to what extent the Department of Energy (DOE) has complied with section 161(c) of the Nuclear Waste Policy Amendments Act of 1987. Section 161(c) requires DOE to phase out funding for all existing research programs designed to evaluate the suitability of crystalline rock as a potential host medium for a nuclear waste repository. According to the act, DOE is to phase out these activities in an orderly manner within 6 months of the date on which the act became law. The 6-month period ended on June 22, 1988. On February 1, 1989, we briefed your offices on the results of our initial inquiries, and, as agreed at that meeting, this report discusses our findings.

Results in Brief

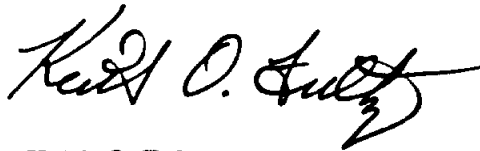
We found that DOE terminated funding of research projects specifically designed to evaluate the suitability of crystalline rock for a repository. DOE continued other research efforts involving crystalline rock because they will provide information that it considers useful for evaluating the suitability of Yucca Mountain, Nevada, for a potential repository. Such research activities are not prohibited by the amendments.

In January 1988, DOE began evaluating both its domestic and international research programs to ensure their compliance with the 1987 amendments. Several DOE offices and contractors were involved in the evaluation. DOE officials believe that the evaluation effectively brought the Office of Civilian Radioactive Waste Management's activities into compliance with the amendments while maintaining useful international relations of continuing benefit to the nuclear waste program in general and to DOE's investigation of the Yucca Mountain site in particular. (The 1987 amendments designated Yucca Mountain as the only site that DOE is to investigate for a potential repository.) The approach and results of DOE's evaluation are discussed in appendix I.

Our review of DOE documents indicates that, by June 22, 1988, DOE

We are sending copies of this report to appropriate congressional committees, the Secretary of Energy, and other interested parties.

Major contributors to this report are listed in appendix II.

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

Keith O. Fultz
Director, Energy Issues

**Appendix I
DOE's Evaluation of Domestic and
International Research Activities to Ensure
Compliance With Amendments**

- classifying and addressing comments on the Draft Area Recommendation Report for potential crystalline rock sites for a second repository;
- compiling technical and scientific information on geologic parameters for crystalline rock;
- evaluating alternate concepts for waste disposal in various geologic media, including crystalline rock;
- establishing methodologies and strategies for assessing the performance of crystalline rock sites;
- applying siting criteria guidelines to potentially acceptable crystalline sites; and
- conducting a survey of remote sensing techniques for crystalline site screening.

These activities were budgeted at \$1.5 million for fiscal year 1988. DOE documents indicate that all of these activities were terminated.

DOE documents also indicate that, in addition to terminating those activities directly related to evaluating crystalline rock for a repository, DOE redirected other crystalline research activities to obtain information that could benefit investigation of the Yucca Mountain site. These activities include

- efforts to develop information on water flow through fractured rock formations;
- studies of "coupled processes" that together affect the overall performance of a repository; and
- demonstrations of total system performance assessments.

DOE continued these activities because of their usefulness for investigating and developing a repository at Yucca Mountain.

International Research

DOE has been participating in bilateral and multinational agreements in the area of geologic disposal of nuclear waste for many years. DOE entered these agreements to (1) enhance its ability to obtain, evaluate, and analyze information for investigating potential repository sites and assessing repository performance and (2) obtain experience in developing the instruments, test plans, and models required to determine the suitability of sites for geologic disposal.

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- The Organization for Economic Cooperation and Development/Nuclear Energy Agency Stripa Project (Phase III), a multinational project being conducted in an abandoned iron ore mine in central Sweden. Its principal objectives are to develop (1) technology that can be applied to repository investigations in fractured rock formations and (2) techniques and materials to seal penetrations into such rock formations. DOE expects the project to provide technological and scientific advances applicable to a wide variety of potential repository host rock formations, including tuff—the volcanic rock formation at Yucca Mountain.

DOE also determined that certain activities under the agreements with Canada, Switzerland, and Sweden were affected by the amendments.

Canada

DOE entered into an agreement with Atomic Energy of Canada, Ltd., in 1986 to carry out a joint research project on the investigation of crystalline geologic formations. This project involves extending the shaft of the Underground Research Laboratory in Manitoba, Canada. Under the agreement DOE budgeted \$10.6 million for fiscal year 1988, of which it had spent about \$5.2 million in direct contributions through June 22, 1988.

DOE's evaluation indicated that the amendments did not permit DOE to continue to fund work under the agreement after June 22, 1988. Accordingly, the agreement was "set aside" on June 22, 1988, when DOE's authority to participate in the ongoing work expired. Under the terms of the "set aside," (1) DOE was responsible for its share of costs through June 22, 1988, (2) DOE was to pay what was essentially an early termination penalty of \$3.2 million to Atomic Energy of Canada for setting aside the agreement, and (3) DOE and Atomic Energy of Canada were to promptly initiate negotiations on a replacement agreement acceptable under current U.S. law. The replacement agreement focuses on studies to support DOE's current work in tuff at the Yucca Mountain site.

According to DOE, this settlement allows DOE to take advantage of a research laboratory constructed in Canada at significant U.S. expense and provides DOE's program a unique opportunity to test and qualify techniques and equipment in a repository environment years earlier than at a U.S. site.

Switzerland

In 1986, DOE and the Swiss National Cooperative for the Disposal of Radioactive Waste signed an agreement to investigate fluid and gas flow

Major Contributors to This Report

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and transport in fractured rock formations. These studies were to be conducted in crystalline rock formations in Switzerland. DOE budgeted \$680,000 for indirect support of this agreement for fiscal year 1988.

In its assessment, DOE determined that the 1987 amendments did not preclude the activities under this agreement. Under the agreement, DOE is evaluating investigation and modeling techniques for fluid and gas flow and transport. According to DOE, the activities are important in developing instruments and analytical techniques to model fractured rock networks. DOE also believes that these activities will benefit the site investigation program at Yucca Mountain by improving DOE's ability to analyze low fluid flow rates and apply the results during performance assessments of hydrologic conditions.

Sweden

DOE entered into a bilateral agreement with the Swedish Nuclear Fuel and Waste Management Company in 1977. DOE budgeted about \$300,000 for activities under this agreement for fiscal year 1988. Section 161(c) prevents DOE from continuing to fund two activities under this agreement that had been initiated just before passage of the amendments: a study of long-term crystalline bedrock stability and a study of the effects on crystalline rock of periods of extreme cold and thawing in the environment. The bilateral agreement has been revised to officially terminate these tasks. DOE estimated that it would save \$150,000 in fiscal year 1988 by terminating these projects.

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In early January 1988, DOE established a group—consisting of staff from OCRWM and the Chicago and Nevada Operations offices, and contractor personnel—to perform a technical evaluation of the international program in light of the amendments and to recommend appropriate modifications. The group represented a broad range of technical disciplines and had considerable knowledge of DOE's international activities and plans to investigate the Yucca Mountain site.

With regard to the amendment's direction to discontinue work evaluating crystalline rock for a repository, the group's focus was to determine, on a technical basis, the degree to which each program activity was generic or was so specific as to be useful only in evaluating crystalline rock. The group used a literal interpretation of section 161 in its evaluation. For example, the group considered certain studies in crystalline rock to be relevant to DOE's nuclear waste program because they are designed to increase the understanding of the underlying physical principles of the movement of radioactive particles. These studies are not designed to evaluate crystalline rock suitability as a repository host medium.

The evaluation group stated that several factors influenced their recommendations. Significant among these factors was that although several international activities involve research in crystalline rock or were initiated specifically to evaluate crystalline rock, the implications of many of these studies extend to other media and help to resolve generic questions about safety analyses for geologic disposal.

The subcommittee prepared a draft evaluation report and provided it to OCRWM management and other DOE offices. In subsequent meetings and discussions, OCRWM, the Chicago and Nevada Operations offices and General Counsel agreed on the specific approach to be taken for each international program. DOE determined that some agreements were not affected by the act because the activities under these agreements were not designed to evaluate the suitability of crystalline rock. DOE therefore concluded that these activities should be continued because they can contribute to the Yucca Mountain site investigation. Such activities include the following:

- The Pocos de Caldas Natural Analog Study, a multinational effort being conducted in a combination of crystalline and volcanic rock in Brazil. According to DOE, this study contributes to an understanding of long-term behavior of radioactive particles in fractured rock formations.

DOE's Evaluation of Domestic and International Research Activities to Ensure Compliance With Amendments

The Department of Energy (DOE) was conducting or participating in a number of domestic and international crystalline rock research activities when the Nuclear Waste Policy Amendments Act was passed in December 1987. Several of these activities were specifically designed to evaluate the suitability of crystalline rock as a repository medium. At that time, DOE was attempting to identify potential crystalline rock sites for a second repository as required by the Nuclear Waste Policy Act (NWPA). The 1987 amendments halted the search for a second repository for at least 20 years.

In January 1988, in response to the 1987 amendments, DOE began evaluating both its domestic and international research programs to ensure their compliance with the act. In addition to the Office of Civilian Radioactive Waste Management (OCRWM), DOE's Offices of General Counsel, International Affairs and Energy Emergencies, and Congressional, Intergovernmental and Public Affairs, and the Nevada Nuclear Waste Storage Investigations and Chicago Repository Technology Program offices participated in the review. Contractor support was provided by Roy F. Weston, Inc., Pacific Northwest Laboratory, CER Corporation, and Science Application Inc.

DOE officials believe that the evaluation process effectively brought OCRWM activities into compliance with the 1987 amendments while maintaining international relations useful to the program and, in particular, to the Yucca Mountain site investigation.

By June 22, 1988, DOE had completed its evaluation of research projects and had (1) terminated domestic activities that could not be continued under section 161(c), (2) stopped funding crystalline rock studies being undertaken with Atomic Energy of Canada, Ltd., (3) begun work with Atomic Energy of Canada to develop an acceptable replacement agreement for studies that comply with section 161(c), and (4) redirected the remaining domestic and international research activities to support characterization of the Yucca Mountain site.

Domestic Research

DOE's evaluation of the domestic research program was conducted primarily by OCRWM technical staff in conjunction with personnel from the Chicago and Nevada Operations offices. In its evaluation, DOE identified six domestic activities specifically designed to evaluate the suitability of crystalline rock for a repository. These activities included

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Abbreviations

DOE	Department of Energy
GAO	General Accounting Office
NWPA	Nuclear Waste Policy Act
OCRWM	Office of Civilian Radioactive Waste Management

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- completed its evaluation of ongoing crystalline rock research projects to ensure compliance with the 1987 amendments,
 - terminated those research activities it identified as being specifically designed to evaluate the suitability of crystalline rock for a repository,
 - continued some research activities involving crystalline rock because these activities would benefit the investigation and development of the Yucca Mountain repository site, and
 - redirected some research activities so that they would contribute to investigating and developing the Yucca Mountain site.

Scope and Methodology

In responding to your request, we determined (1) what actions DOE has taken to comply with the amendments' requirements and (2) whether DOE terminated those crystalline rock research activities that were specifically designed to expand the base of knowledge on crystalline rock as a potential repository host medium. In this regard, we interviewed a number of officials in DOE's Office of Civilian Radioactive Waste Management who directed and coordinated DOE's phaseout of crystalline rock research activities. In addition, we reviewed key internal DOE documents and correspondence to determine (1) DOE's policy and approach toward implementing the act's requirements, (2) the implementation direction given to research project managers, and (3) DOE's justification for continuing some crystalline rock research activities and phasing out others. We also reviewed a draft study prepared by DOE and contractor technical staff that evaluated DOE's ongoing crystalline rock research activities on a project-by-project basis to determine whether each activity should be terminated, redirected, or continued. Our work was performed from December 1988 through March 1989 in accordance with generally accepted government auditing standards.

We discussed the facts presented in this report with cognizant DOE officials and incorporated their comments where appropriate.

