

GAO

Report to the Chairman, Environment,  
Energy and Natural Resources  
Subcommittee, Committee on  
Government Operations, House of  
Representatives

January 1991

# NUCLEAR SAFETY AND HEALTH

## Problems With Cleaning Up the Solar Ponds at Rocky Flats



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**Resources, Community, and  
Economic Development Division**

B-241574

January 3, 1991

The Honorable Mike Synar  
Chairman, Environment, Energy and  
Natural Resources Subcommittee  
Committee on Government Operations  
House of Representatives

Dear Mr. Chairman:

On November 29, 1989, you requested that we evaluate the Department of Energy's (DOE) efforts to clean up the solar evaporation ponds at DOE's Rocky Flats Plant in Colorado. The Rocky Flats Plant, a key facility for plutonium production within DOE's nuclear weapons complex, has numerous environmental problems. One of these problems, the solar evaporation ponds, has been a high-priority cleanup project at the plant for many years. As agreed with your office, this report provides information on problems that delayed the cleanup project, DOE's effort to correct those problems, and the current status of the project.

Solar evaporation ponds are surface excavations used at the plant for storing and evaporating low-level radioactive and hazardous liquid waste. The ponds are suspected of causing groundwater contamination. In the early 1980s DOE began phasing out the use of these ponds and in 1985 began cleanup activities. The cleanup included removing the sediment (sludge waste) from the ponds and mixing it with cement to form large blocks. The resulting solidified waste form, known as pondcrete, was to be packaged and shipped off site for disposal.

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**Results in Brief**

Significant problems have slowed the process of removing the waste from the ponds and completing the project. Soon after the project began, DOE had to reclassify the waste from low-level radioactive waste to mixed waste after it was detected that the waste contained low concentrations of hazardous waste. As a result, DOE was required to seek the necessary permits to store and dispose of the mixed waste. Further, the DOE contractor improperly mixed the cement and sludge waste in making the pondcrete, causing thousands of pondcrete blocks to subsequently crumble and crack. Finally, the packaging material deteriorated when subjected to the weather.

The Rocky Flats contractor has taken various actions to correct the pondcrete problems, including the development of procedures for

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processing and reinspecting all pondcrete boxes before they are shipped off site. In addition, procedures were developed for frequent surveillance of the storage pads and for repackaging failed pondcrete boxes. Although DOE's initial lack of plans for the project contributed to the solar pond cleanup problems, DOE now has initiated actions to improve program control, including the development of a detailed program plan.

Substantial work remains to be done on the solar pond project. More than 8,000 pondcrete blocks produced in the cleanup need to be remixed and repackaged. In addition, DOE has to finish removing sludge waste from the largest solar pond and clean out the remaining four solar ponds. DOE officials at Rocky Flats estimate that as many as 20,000 additional blocks will be produced in the cleanup. They believe the total solar cleanup project will cost more than \$100 million.

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## Background

The Rocky Flats Plant is located on a 6,550-acre site about 16 miles from Denver, Colorado. It is currently operated by EG&G under a contract with DOE.<sup>1</sup> Since the early 1950s, when operations began at the plant, its primary mission has been to produce plutonium component parts for nuclear weapons.<sup>2</sup> Such operations involve the routine handling and disposal of radioactive, hazardous, and/or toxic materials. In the past, these materials have not always been handled and disposed of in a manner that would prevent the environment from becoming contaminated. As a result, DOE faces a massive environmental cleanup effort at the plant.

As of June 1990 over 175 waste sites had been identified at the plant, some of which have caused groundwater contamination at levels thousands of times greater than the levels set by the federal drinking water standards. To address these problems, DOE has, under various environmental laws, initiated projects to begin the long and difficult task of cleaning up the plant site. DOE officials at the plant have estimated that it may cost over \$750 million to clean up the Rocky Flats Plant.

One of the highest priority environmental remediation efforts at the plant has been cleaning up the solar evaporation ponds. These ponds are

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<sup>1</sup>EG&G took over the operation on January 1, 1990, from the Rockwell International Corporation, North American Space Operations Group.

<sup>2</sup>The Rocky Flats Plant is part of DOE's nuclear weapons complex. This complex consists of numerous sites located throughout the country to make nuclear weapons and naval fuel.

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surface excavations for storing and evaporating various liquid wastes. Of the more than 175 waste sites, five are solar ponds of various sizes that have been constructed and used at Rocky Flats. Some of these ponds, over the years, leaked waste into the ground. On-site groundwater monitoring has shown that groundwater is contaminated with radioactive material (above the drinking water standard), nitrates (greater than 500 times the drinking water standard), volatile organics, and heavy metals.

In the early 1980s DOE, because of the existing contamination and possible further contamination, began phasing out use of the solar ponds. DOE's remediation plan for the ponds was to drain and treat the liquid waste and process the pond sediment. The sediment, which DOE classified as low-level radioactive waste,<sup>3</sup> was to be mixed with cement and poured into large (about 2 by 3-1/2 by 3-1/2 feet) tri-wall fiberwall boxes having plastic liners. The resulting solidified form, referred to as pondcrete, was to be disposed of at DOE's Nevada Test Site (NTS). After the sediment was removed and solidified, DOE would close the sites in conformance with appropriate environmental laws. Cleanup work on the solar ponds began in 1985. By September 1986 approximately 2,000 blocks of pondcrete had been produced, shipped to NTS, and buried as low-level radioactive waste.

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## Problems That Delayed Cleanup of the Solar Ponds

In September 1986 significant problems began to develop that delayed the solar pond cleanup. At that time, shipments to NTS were stopped after DOE detected relatively low concentrations of hazardous constituents in the waste—solvents such as methylene chloride, acetone, and tetrachloroethane. Accordingly, the waste was reclassified as mixed waste—a combination of hazardous and radioactive waste. This meant that methods for handling and disposing of the waste would have to meet the requirements of the Resource Conservation and Recovery Act (RCRA) as well as meet DOE's requirements for disposing of low-level radioactive waste. Further, under RCRA, DOE would have to obtain a permit from the Environmental Protection Agency (EPA) or the state for the pondcrete's treatment, storage, and disposal.

Although no facilities at that time were permitted to dispose of mixed waste, the DOE contractor continued to process pondcrete and store it on site. According to DOE officials, the contractor continued to produce the

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<sup>3</sup>Low-level radioactive waste is waste that is not classified as uranium mill tailings, transuranic waste, high-level radioactive waste, or spent nuclear fuel.

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pondcrete because it wanted to stabilize the pond sediment as quickly as possible to better protect the environment. The officials also told us that they had informal agreements with the state of Colorado to remove the sediment as soon as possible. However, the pondcrete blocks could not leave the plant site until the state of Nevada permitted NTS to dispose of and/or store the mixed waste. From September 1986 to May 1988, the Rocky Flats contractor produced more than 16,500 pondcrete blocks of mixed waste which it stored on site on outdoor asphalt pads.

On May 23, 1988, a foreman at the plant noticed that some of the fiber-board boxes stored in the open on asphalt pads were deformed. Upon further investigation, the foreman noted that the boxes had deteriorated and some of the pondcrete blocks had crumbled and cracked. At least one box had spilled open. At the time, DOE estimated that about 2,000 of the pondcrete blocks stored had deteriorated, but later it determined that over 8,000 blocks, or almost half of the blocks stored outdoors, had deteriorated.

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## DOE's Efforts to Resolve the Pondcrete Problems

On May 24, 1988, a day after the problem was discovered, the contractor notified DOE. After discussions with DOE, the contractor suspended the pondcrete processing operations and began cleanup operations at the outdoor asphalt storage pad. Since some of the pondcrete had crumbled and spilled onto the storage pad, the affected area was decontaminated and cleaned up. The contractor also inspected all pondcrete boxes for deterioration. Those that seemed likely to fail were moved indoors.

In addition to the immediate action described above, the contractor carried out an investigation between June 30, 1988, and February 23, 1989. The investigation identified three major factors as contributing to the deterioration of the pondcrete:

- Inadequate ratios of cement to sludge in the pondcrete process (the equipment used to introduce cement into the pondcrete mixture plugged up intermittently).
- Deterioration of the tri-wall boxes containing the pondcrete (the boxes were not designed for long-term storage where they were exposed to the weather).
- Inadequate quality control inspections that failed to identify any problems in almost 3 years of making the pondcrete.

About the same time that the contractor was carrying out its investigation at Rocky Flats, NTS assessed 28 blocks of pondcrete from Rocky Flats that had not yet been buried. The NTS assessment found that the blocks were soft enough to be grooved or dug into by a stick and that only 3 of the 28 blocks could be considered hard. Although most of the 28 pondcrete blocks were not hard, NTS accepted the blocks because no liquids were found during the assessment.<sup>4</sup>

In regard to the approximately 2,000 blocks that had already been buried, NTS determined that the probability of contaminants migrating into and from the burial ground was very small. This determination was based on (1) the NTS assessment of the 28 pondcrete blocks, (2) the distribution of the containers throughout the burial ground, and (3) the dryness of the surrounding soils. NTS plans no further remedial actions unless significant depressions become evident in the burial grounds or the NTS monitoring system installed in and below the burial grounds indicates that a release of hazardous material is occurring. EPA, under the RCRA permit process, is charged with approving disposal practices, including monitoring, and can delegate these responsibilities to the states. The state of Nevada is currently reviewing the adequacy of the monitoring system.

While the Rocky Flats and NTS investigations were being carried out, the Rocky Flats contractor took a series of actions to correct the pondcrete situation. Procedures were developed for processing pondcrete and for reinspecting all pondcrete boxes before any decision was made to ship the blocks to NTS or reprocess them. As part of these procedures, criteria were developed specifying the proper hardness for the pondcrete blocks. The criteria, among other things, specified that the pondcrete blocks had to withstand pressures of 1,000 pounds per square foot. The contractor also initiated procedures for frequent surveillance of the storage pads. Finally, procedures were developed for repackaging failed pondcrete boxes.<sup>5</sup>

The pondcrete problem also served as a contributing factor in NTS' decision to revise its acceptance criteria for packaging the blocks in October 1988. The new criteria require that the pondcrete blocks be packaged, shipped, and buried in plywood boxes and that these boxes have a compressive strength of 4,000 pounds per square foot. This standard was

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<sup>4</sup>This determination by NTS was consistent with its acceptance criteria in effect at the time.

<sup>5</sup>When EG&G began operating the plant in January 1990, it began to re-evaluate all of the procedures developed by the previous contractor.

set to enable the boxes to support similar waste packages and earth cover without being crushed during stacking or when disposed of. These new criteria will also allow the blocks to be stacked higher in storage and thus save space.

Physical work to resolve the pondcrete problem began in November 1989. At that time the contractor, using the recently developed reinspection procedures, began dividing the pondcrete blocks into those blocks needing reprocessing—remixing and repackaging—and those just needing repackaging. Those blocks needing repackaging were repackaged to meet the NTS criteria and shipped to NTS for storage pending NTS' final permit to dispose of mixed waste.

### Current Status of Solar Pond Cleanup Project

Substantial work remains to be done on the solar pond project. DOE officials believe the total project cost will be over \$100 million before completion. Although DOE expects to resume pondcrete production activities by December 1990, we believe other factors, including meeting aggressive schedules for removing the pond sediment, could cause further problems. Finally, while the lack of detailed plans in the past contributed to the cleanup problems, DOE has initiated actions to improve its program control over the project.

### Current Status of Cleanup Operations

After about 5 years work on the solar ponds, only one—the largest—is partially cleaned out. The cleanup produced over 18,500 pondcrete blocks. Table 1 shows the disposition of these blocks as of July 1, 1990.

Table 1: Status of Pondcrete Blocks

| Status  | Number        |
|---|---------------|
| Shipped to NTS prior to September 1986 as low-level radioactive waste | 2,000         |
| Repackaged and shipped to NTS as mixed waste <sup>a</sup>             | 8,666         |
| Stored at Rocky Flats awaiting remixing and repackaging               | 8,031         |
| <b>Total</b>  | <b>18,697</b> |

<sup>a</sup>This waste has been buried in retrievable fashion pending NTS' final RCRA permit.

In addition to remixing and repackaging more than 8,000 blocks at Rocky Flats, DOE has to finish removing sediment from the largest solar pond and clean out the other four solar ponds. DOE officials at Rocky



Flats estimate that as many as 20,000 additional blocks will be produced.<sup>6</sup> Once the sediment has been mixed into pondcrete and shipped off site, final remediation or closure of the ponds themselves can begin.<sup>7</sup> DOE's original solar pond closure plan, dated July 1, 1988, called for in-place disposal of the liners and subsoils that have become contaminated.<sup>8</sup> The proposal was modified in February 1989 to remove contaminated liners and subsoils. Although DOE's closure plan for the solar ponds has been submitted to Colorado, the state has not yet approved it.

### Estimated Cost of the Solar Pond Project

The cost of carrying out the solar pond project has been increasing. Until recently DOE has not made cost estimates for completing the solar pond cleanup project. During the past year, however, DOE's 6-year cost estimate for the project has increased dramatically. A DOE July 1989 estimate showed that the solar pond cleanup would cost about \$27 million in fiscal years 1990 through 1995. DOE's most recent estimate of April 4, 1990, specifies a total cost of about \$50 million in fiscal years 1990 through 1995—an increase of over 87 percent.<sup>9</sup>

DOE officials at the Rocky Flats Plant told us that they are working on a more complete estimate for the entire solar pond project that includes not only the cleanup of waste in the ponds but also the closure of the ponds. This estimate indicates that the project will cost about \$73 million to complete in 2009.<sup>10</sup> This amount is in addition to the \$39 million that DOE estimates had already been spent as of April 1990. Further, a DOE official told us that he is currently revising this estimate and indicated that the cost could rise substantially.

### Factors That Could Cause Further Problems

Although DOE has taken numerous actions to correct the pondcrete problems, we believe a variety of factors could cause further problems in processing the pondcrete:

<sup>6</sup>The number of blocks produced may vary depending on the ratio of cement to sludge used in making the pondcrete.

<sup>7</sup>A closure is the deactivation, stabilization, and surveillance of a waste site or facility under RCRA.

<sup>8</sup>The closure plan does not include detailed procedures on making pondcrete.

<sup>9</sup>These estimates were obtained from activity data sheets supporting DOE's 5-year environmental restoration and waste management plans. The cost data are in constant 1989 dollars.

<sup>10</sup>DOE expects most of the pond cleanup work to be completed by fiscal year 2001. Most of the estimated cost after 2001 will be site monitoring. Cost data are in 1989 dollars.

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- On June 28, 1989, DOE and the Governor of Colorado signed an agreement that, among other things, specified that all solar pond sediment must be removed and shipped off site by October 1991. This date establishes a very aggressive schedule for removing the pond sediment, which will be difficult for DOE to meet.
  - On January 1, 1990, the contractor at Rocky Flats was replaced by EG&G. Subsequently, the new contractor made an extensive review of all plant operations. This review, which is still underway, may result in changes to the plant's processing of pondcrete that could affect the cleanup schedule.
  - NTS is preparing an environmental assessment covering its waste disposal operations to determine if such operations will have a significant environmental impact. If the assessment shows "no significant environmental impact," mixed-waste operations will then resume. According to DOE officials this assessment should be completed and approved by January 1991.

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### Current Status of Planning Efforts to Improve Program Control

In late 1989 DOE began the process of improving program controls over the solar pond cleanup project. Program controls are institutional mechanisms whereby an organization can provide direction and oversight to its workers or contractors. One principal means to maintain such control is through a detailed program plan. Such a plan spells out how a project is to be carried out, establishes milestones, and estimates the cost. It can also be used to monitor the contractor's progress.

Lack of program control mechanisms, such as a detailed program plan, has contributed to the problems associated with the solar pond cleanup. When the project began, neither DOE headquarters nor field office officials required detailed plans to be prepared on how the project was to be carried out. Contractor personnel involved in the pondcrete processing told us that there were no detailed plans or procedures, such as physical standards for hardness, used in making the pondcrete blocks. To varying extents the standards used were left to the discretion of the employees making the pondcrete. For example, the operators mixing the pondcrete determined the ratio of cement to sludge on the basis of their observation of the mixture's color and thickness. In our view, had a detailed plan with adequate quality control features been developed when the pondcrete project was first started, some of the major problems associated with the cleanup could have been avoided.

Without a detailed plan it is difficult for DOE or any oversight organization to know if the contractor is developing reasonable cost estimates

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and time frames for completion. Although cost estimates have been developed for the solar pond project, we cannot verify these estimates because detailed plans have not been developed. Similarly, although DOE has agreed with the state of Colorado to have all pondcrete removed off site by October 1991, we cannot determine if this deadline is reasonable without detailed plans showing how this will be accomplished.

DOE officials have recognized the need to improve program control over environmental restoration projects and have taken several actions. At the headquarters level, DOE, in November 1989, created a new office of Environmental Restoration and Waste Management to consolidate cleanup projects within the Department. The new office is developing an integrated planning, budget, and control system to track and monitor its various environmental projects. This planning effort includes an Office of Environmental Restoration Management Plan that will spell out how the headquarters office is going to manage and monitor remediation efforts undertaken by its various division offices. DOE officials expect to begin implementing this plan in March 1991.

DOE headquarters is also preparing an Environmental Restoration On-site Remediation Program Management Plan that is to be used by field offices to implement the overall plan. The draft on-site plan spells out in detail the data DOE is requiring on all restoration projects so that DOE can better manage its restoration programs. The requirements include such information as the scope of work, provisions for quality assurance, cost data, and systems for controlling program management and planning. DOE officials also expect to begin implementing this plan in March 1991.

At the field level, DOE officials told us that they are requiring the contractor to develop a detailed program plan called the Solar Ponds Cleanup Project Management Plan. The field plan will cover such things as the scope of work to be performed, time frames, cost estimates, resources needed, quality assurance, and reporting requirements. The plan should be consistent with DOE headquarters management plans mentioned above. According to DOE field officials, this is the first time they have attempted to pull together a detailed plan for the overall project. These officials told us that they expected to have the plan approved by December 1990 and that work to complete the project will resume as soon as the plan has been completed and approved.

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We discussed the information in this report with DOE officials, who agreed that it was factually accurate. However, as agreed with your

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office, we did not obtain official agency comments on a draft of this report. Our work was performed between January and September 1990 in accordance with generally accepted government auditing standards. Appendix I provides a discussion of our objectives, scope, and methodology.

Unless you publicly announce its contents earlier, we plan no further distribution of this report for 30 days from the date of this letter. At that time we will send copies to the appropriate congressional committees; the Secretary of Energy; and the Director, Office of Management and Budget. We will also make copies available to others upon request. If you have any questions about this report, please contact me at (202) 275-1441. Major contributors to this report are listed in appendix II.

Sincerely yours,



Victor S. Rezendes  
Director, Energy Issues



# Objectives, Scope, and Methodology

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In an October 1989 hearing before the Environment, Energy and Natural Resources Subcommittee, House Committee on Government Operations, a problem was identified with the solar pondcrete processing operation at Rocky Flats. On November 29, 1989, the Chairman of the Subcommittee asked GAO to look into the pondcrete problem and report on the Department of Energy's (DOE) progress in correcting it.

During the review GAO focused on developing information on the cost of the pondcrete operation, what DOE is doing to correct the problems associated with the project, and the status of the pondcrete operation. This review was based on discussions and data obtained from DOE officials in the Office of Defense Programs, Environmental Restoration and Waste Management, at DOE headquarters; the Rocky Flats Plant; and the Nevada Test Site. The data obtained included DOE regulations, policies, procedures, criteria, or standards for making, storing, and shipping pondcrete; DOE agreements with the Environmental Protection Agency (EPA) and the state of Colorado concerning pondcrete; DOE site representative reports at Rocky Flats on the pondcrete situation; and the pondcrete unusual occurrence report and evaluation. We also visited the Rocky Flats Plant to observe the pondcrete operation and discussed the pondcrete process and problems with DOE, EPA, the contractor, and Colorado State officials. Using the information mentioned above, we assessed the adequacy of DOE's program control over the pondcrete processing operation. This work was performed between January and September of 1990 in accordance with generally accepted government auditing standards.

# Major Contributors to This Report

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