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July 2006

NUCLEAR CLEANUP OF ROCKY FLATS

DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities

GAO-06-352

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Highlights

Highlights of GAO-06-352, a report to congressional requesters

Why GAO Did This Study

In 2001, when GAO reported on the cleanup of the Department of Energy's (DOE) Rocky Flats site, a former nuclear weapons production facility, the cleanup was behind schedule and over cost. In October 2005, the contractor declared that it had completed the cleanup much earlier and at less cost than DOE and the contractor had anticipated 5 years earlier. GAO was asked to determine the (1) factors that contributed to the cleanup's early completion, (2) remaining work and total costs, (3) measures to assess whether the cleanup achieved a level of protection of public health and environment consistent with the cleanup agreement, and (4) lessons the Rocky Flats cleanup may offer for other DOE cleanup projects.

What GAO Recommends

GAO recommendations include that the Secretary of Energy ensure appropriate oversight of contractors' controls over data quality and assess the costs and benefits of tracking lessons learned across the DOE complex. DOE, Interior, Colorado, and Kaiser-Hill provided written comments, and generally agreed with the contents of the report. EPA did not provide official written comments but did provide editorial and technical suggestions, as did the other agencies, that we incorporated, as appropriate. DOE concurred with our recommendation about tracking lessons learned but did not state whether it concurred with the other two.

www.gao.gov/cgi-bin/getrpt?GAO-06-352.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Gene Aloise at (202) 512-3841 or aloisee@gao.gov.

What GAO Found

Four factors contributed to the early completion of Rocky Flats' cleanup: (1) DOE's and the contractor's ability to overcome numerous challenges, (2) the use of an accelerated cleanup process, (3) site-specific characteristics that limited the scope of the contamination, and (4) the contractor's financial incentive to finish the work quickly and safely.

Although the cleanup is complete, its sufficiency has not yet been ascertained; key steps remain before the planned Rocky Flats National Wildlife Refuge that will occupy the site can open to the public. For example, in about November 2006, the regulatory agencies—the Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment—plan to issue their joint final decision on the sufficiency of the cleanup and any risk posed by residual contaminants.

The total cost of the cleanup, since 1995, is about $10 billion in constant 2005 dollars. This cost includes contract costs of about $7.7 billion (including contractor fees of about $630 million), long-term stewardship and pension liabilities estimated at about $1.3 billion, and other costs of nearly $1 billion.

Although numerous measures in place to assess the cleanup appear adequate to judge the sufficiency of the cleanup, DOE did not effectively carry out some aspects of its oversight responsibilities. Among the assessment measures are completion of the regulatory process, activities undertaken to verify remedial actions, and reviews by independent and federal entities. The regulatory agencies have approved the cleanup of 360 areas of known or suspected contamination at the site. Data supporting the cleanup of these areas form the basis of regulatory decisions regarding the cleanup's sufficiency. Accordingly, we reviewed the contractor's controls intended to ensure the quality of these data and found them to be robust. However, DOE lacked assurance that the controls were working as intended because it did not independently assess the quality of these key data. One official told us that DOE was involved daily in reviewing documents and discussed with the contractor any data quality issues that arose.

DOE has identified and implemented at other sites some lessons from Rocky Flats, but DOE has not systematically tracked lessons learned at all of its cleanup sites, thus potentially losing the benefits of such lessons.

Rocky Flats in 1995

Rocky Flats in 2005

Source: DOE.

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Abbreviations

Advisory Board	Rocky Flats Citizens Advisory Board
ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Coalition	Rocky Flats Coalition of Local Governments
Colorado	Colorado Department of Public Health and Environment
DOE	Department of Energy
EPA	Environmental Protection Agency
FWS	Fish and Wildlife Service
HPGe	high-purity germanium
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
ORISE	Oak Ridge Institute for Science and Education
PARCC	precision, accuracy, representativeness, completeness, and comparability
pCi/g	picocuries per gram
RCRA	Resource Conservation and Recovery Act
Refuge Act	Rocky Flats National Wildlife Refuge Act
RI/FS	remedial investigation/feasibility study
TRC	total recordable cases
VOC	volatile organic compound
WIPP	Waste Isolation Pilot Plant

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United States Government Accountability Office
Washington, D.C. 20548

July 10, 2006

The Honorable Jeff Sessions
Chairman
Subcommittee on Strategic Forces
Committee on Armed Services
United States Senate

The Honorable Wayne Allard
United States Senate

Once a bustling nuclear weapons production complex employing thousands of workers, the Department of Energy's (DOE) Rocky Flats site, near Denver, Colorado, is being transformed into a wildlife refuge that will be managed by the Department of the Interior's Fish and Wildlife Service (FWS). For about 40 years, the Rocky Flats plant produced plutonium triggers, or "pits," for nuclear weapons. That activity resulted in radiological and chemical contamination of some of the site's buildings, soil, and water. Cleanup of the site began in 1995 under a contract between DOE and Kaiser-Hill Company L.L.C.,[1] and included decontaminating and demolishing several plutonium-processing buildings, one of which had been labeled "the most dangerous building in America," along with hundreds of other contaminated buildings and structures. The cleanup required the contractor to remove large volumes of nuclear material and radioactive debris, and investigate and remediate as necessary contamination at 360 individual hazardous substance sites that were identified through historical records and extensive sampling and analysis at the site in the early 1990s. In total, according to GAO's calculations, the amount of cleanup waste that had to be removed from the site was equivalent to a 65-story building the length and width of a football field.

Cleanup of the site was conducted under the Rocky Flats Cleanup Agreement, the legally binding agreement that provided the framework for the cleanup effort. The cleanup agreement implements the provisions of the applicable statutes, including the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended

[1]Kaiser-Hill Company L.L.C. is a joint venture between Kaiser Group Holdings Inc. and CH2M Hill.

(CERCLA);[2] the Resource Conservation and Recovery Act of 1976, as amended (RCRA); and the Colorado Hazardous Waste Act. The cleanup agreement specified the roles of DOE and the two regulatory agencies for the site: the Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (Colorado). Pursuant to the cleanup agreement, EPA had lead regulatory authority over the cleanup of the site's buffer zone, which includes about 5,900 acres of undeveloped land around the center of the site, while Colorado had lead regulatory authority over the cleanup of the core industrial area—which includes about 385 acres in the center of the site, where the plutonium-processing activities occurred.

When GAO reported on the cleanup effort in February 2001, the project was behind schedule and over cost.[3] However, in October 2005, the contractor declared that it had finished the physical cleanup of the site, as defined in the contract (e.g., demolishing buildings and shipping contaminated waste and soil off site), much earlier and at less cost than DOE and the contractor had anticipated 5 years earlier. Although the cleanup is complete, its sufficiency has not yet been ascertained. EPA's and Colorado's joint final decision on the sufficiency of the cleanup and the final remedy for the site is expected to be published around November 2006.[4] With the exception of one pedestrian trail, most of the planned wildlife refuge will not open until at least 5 years after the refuge is established (depending on the availability of funding).

In this context, we determined the (1) factors that contributed to the physical cleanup's early completion; (2) work remaining to be done as well as total project costs, including long-term costs; (3) measures in place to assess whether the cleanup achieved a level of protection of public health and environment consistent with the Rocky Flats Cleanup Agreement; and

[2]Rocky Flats was added to CERCLA's National Priorities List in October 1989. The National Priorities List is EPA's list of national priorities among the known or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. As of April 2006, the final list comprised 1,244 sites, with another 59 sites proposed for listing. Another 309 sites that were formerly on the final list have been deleted.

[3]GAO, *Nuclear Cleanup: Progress Made at Rocky Flats, but Closure by 2006 Is Unlikely, and Costs May Increase*, GAO-01-284 (Washington, D.C.: Feb. 28, 2001).

[4]The final decision document will be a joint corrective action decision under RCRA and record of decision under CERCLA.

(4) lessons the Rocky Flats project may hold for other DOE cleanup projects.

In conducting our work, we visited the Rocky Flats site several times and reviewed documents and data prepared by DOE, EPA, Colorado, FWS, the contractor, and various scientific organizations. We reviewed and analyzed agency and contractor documents on decontamination and demolition accomplishments and techniques. We also analyzed documents related to the cost-plus-incentive-fee contract, including contract negotiation documents, the contract cost and fee structure, and contract modifications, although we did not evaluate the cost-effectiveness of the contract. We reviewed and analyzed cleanup verification strategies and results, and reviewed the content of scientific analyses, including a study of how actinides[5] migrate through soil and water and an assessment of the public health risk posed by contaminants remaining at the site, but did not evaluate the science underlying them. In addition, because decisions about the sufficiency of the cleanup have been and will be based on remediation data, we assessed the soundness of the agencies' and contractor's processes and procedures for ensuring the quality of these data. We also reviewed the results of audits of the key laboratories used by the contractor to analyze samples of radioactively contaminated soil.

For further review, we selected a nonprobability sample of four of Rocky Flats' 360 cleanup areas (including areas referred to as individual hazardous substance sites, potential areas of concern, and under-building contamination sites), using criteria such as the location of the cleanup area and the severity of its contamination.[6] For these four individual cleanup areas—building 771, the 903 pad, the 903 lip area, and trench T-7—we assessed the closeout reports and the data supporting them to determine the extent to which the data collection and laboratory analyses adhered to data quality standards and procedures. For example, we reviewed records of laboratory analyses of contaminated soil samples from the areas, and documents showing the extent to which the projects adhered to stated data quality objectives. We did not evaluate the remedial data or laboratory analyses themselves.

[5]Actinides are a series of 15 radioactive chemical elements with atomic numbers 89 (actinium) and greater.

[6]Results from nonprobability samples cannot be used to make inferences about a population, because in a nonprobability sample some elements of the population being studied have no chance or an unknown chance of being selected as part of the sample.

Further, to obtain citizen and local government views about community input to the cleanup and the effect of various cleanup verification activities, we surveyed 58 current and past members of the two local community groups that served in an advisory capacity to DOE: the Rocky Flats Citizens Advisory Board and the Rocky Flats Coalition of Local Governments. We also attended monthly meetings of these two groups. We interviewed officials of DOE, EPA, Colorado, FWS, the contractor, and various scientific organizations. We conducted our work in accordance with generally accepted government auditing standards from March 2005 through May 2006. In September 2005, we briefed you and your staff and reported on the preliminary results of our review.[7] Details on our objectives, scope, and methodology are in appendix I; summary survey results are in appendix II.

Results in Brief

Officials of DOE, EPA, Colorado, and the contractor identified four key factors that contributed to Rocky Flats' early cleanup:

- DOE and the contractor overcame significant challenges that we identified in our 2001 report, such as decontaminating and demolishing hundreds of structures and packaging and shipping vast quantities of radioactive and hazardous wastes. For example, innovative techniques, such as the use of cerium nitrate to decontaminate gloveboxes so they could be shipped whole rather than cut into pieces, enabled the contractor to proceed with cleanup much faster and at less expense than anticipated.

- An accelerated cleanup process allowed cleanup actions to proceed much more quickly and collaboratively than a traditional cleanup process would have allowed. As the cleanup progressed, DOE, the contractor, EPA, and Colorado staff often worked side by side in the field, participating in or observing soil removal actions and sampling procedures.

[7]GAO, *Nuclear Cleanup: Preliminary Results of the Review of the Department of Energy's Rocky Flats Closure Project*, GAO-05-1044R (Washington, D.C.: Sept. 22, 2005).

- Site-specific characteristics (e.g., climate, geography, the robust construction of the buildings, and the chemical nature of the key contaminants) physically limited the extent of the contamination. For example, the dry Colorado climate and the alluvial fan[8] on which the site is situated helped minimize erosion, thereby inhibiting off-site migration of contaminants. Also, the thick shale and claystone that underlie the site prevented contaminants from seeping into the deep drinking-water aquifer.

- The contractor had a large financial incentive, shared throughout the contractor workforce, to complete the work economically, quickly, and safely. The earlier the contractor finished its work, and the lower its cost in doing so, the more the contractor stood to earn—as much as $560 million in incentive fees. This financial incentive drove site workers to seek creative cleanup solutions.

Although DOE's contractor completed the physical cleanup of the site in October 2005, several additional actions need to be completed before the site can open to the public as a wildlife refuge. In July 2006, DOE expects to issue for public comment its proposed plan, which will include a summary of the three proposed future monitoring and remediation alternatives for the site and will identify the preferred alternative. After public comments on the proposed plan have been received and considered, EPA and Colorado will jointly determine whether any further cleanup is needed at the site or whether the cleanup actions already taken are sufficient to render the site safe for its intended purpose. A final decision by EPA and Colorado is expected in late 2006. If the joint decision is that no further action is required, and EPA certifies that the cleanup and closure of Rocky Flats is complete, DOE will transfer primary administrative jurisdiction over the majority of the site to the Department of the Interior for use as a wildlife refuge. If funds are available, FWS plans to open one pedestrian trail in the first year after the transfer and to open the remainder of the public trails and facilities between the fifth and 15th years following transfer. DOE expects to retain possession of the former industrial area, which will contain shallow groundwater treatment systems and monitoring wells, and will be responsible for the long-term stewardship of these systems. To protect these systems, DOE will restrict public access to this portion of the site.

[8]An alluvial fan is a fan-shaped wedge of sediment that typically accumulates in arid or semiarid climates on land where a stream emerges from a steep canyon onto a flat area.

The total cost of the cleanup since 1995 is about $10 billion.[9] This cost includes DOE's 1995 and 2000 contracts with Kaiser-Hill, which total nearly $8 billion; the cost of DOE's Rocky Flats Field Office, which totals about $760 million; and the cost of other DOE sites' support of the Rocky Flats project, which totals about $138 million; estimated future costs such as pension and benefits liabilities, estimated at approximately $1 billion over 60 years; long-term stewardship of the site, projected to cost $303 million through 2080; and the potential acquisition of some private mineral rights at Rocky Flats, for which the Congress authorized $10 million in January 2006.[10]

Numerous measures have been and are being taken to assess the cleanup. Although these measures appear adequate to judge the sufficiency of the cleanup, DOE did not effectively carry out some aspects of its oversight responsibilities. The three key cleanup assessment measures are (1) completion of the regulatory process—EPA's and Colorado's review and approval of the cleanup actions already taken and the results of other ongoing assessments under CERCLA and RCRA; (2) a DOE-initiated verification of the contractor's cleanup actions; and (3) reviews conducted by other federal agencies and by consultants hired by local community groups:

- Completion of the CERCLA and RCRA process will culminate in EPA's and Colorado's final decision on the cleanup's sufficiency and the selection of a final remedy. The contractor's procedures to ensure the quality of the data supporting the accelerated cleanup actions appeared sound and comprehensive. However, DOE did not assess the contractor's data quality assurance process, as required by the protocols agreed to with the regulatory agencies.[11] A DOE official explained that DOE officials' day-to-day review of data enabled them to detect data issues as they arose.

[9]Unless otherwise noted, all costs cited in this report have been adjusted for inflation and are expressed in constant 2005 dollars.

[10]National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 3112, 119 Stat. 3136, 3540 (2006).

[11]The review requirement was specified in the industrial area and buffer zone sampling and analysis plan, which contained the sampling, analysis, and documentation protocols agreed to between DOE and the regulatory agencies.

- A DOE-initiated verification of the contractor's cleanup was inconsistent with the verification plan. DOE did not complete an independent review of the accuracy of contractor-conducted scans for remaining radiological contamination. DOE officials said they had decided that these activities would not provide sufficient additional information to justify their completion, but had no documentation to support this decision. Further, existing DOE policy and guidance lack clarity about how they apply to the Rocky Flats cleanup and what the verification goals are.

- Federal agency reviews and community-driven independent reviews assessed aspects of the cleanup. For example, a CERCLA-required public health assessment concluded that no public health hazard exists for the communities surrounding Rocky Flats.

Although DOE has identified and implemented at other cleanup sites some lessons learned at Rocky Flats, DOE does not require that lessons learned at one cleanup site be implemented at other sites, even though they may be applicable. In 2002, DOE identified a number of lessons from the Rocky Flats cleanup, including implementing a performance-based contracting strategy and encouraging the innovative application of technology. DOE then assessed the applicability of these lessons at some DOE sites and directed these sites to implement applicable lessons. Although DOE conducted follow-up reviews at the sites through 2005, these reviews were focused on other aspects of the cleanup program and did not assess whether the sites had implemented the lessons learned from Rocky Flats. During our review, we noted additional lessons that could also be useful for other DOE sites planning or undergoing cleanup, such as involving the future site manager in remedial decisions and taking a consultative approach with the regulatory agencies on cleanup decisions. However, DOE has no process for ensuring that all lessons are captured and implemented as appropriate at other DOE sites. As a result, DOE may be losing the chance to save both time and money in its planned or ongoing site cleanup efforts.

We are making a number of recommendations aimed at strengthening DOE's oversight of data quality, its cleanup assessments, and its process for ensuring that lessons learned at cleanup sites are analyzed and implemented as appropriate at other DOE sites.

We provided a draft of this report to DOE, Interior, EPA, Colorado, and Kaiser-Hill for their review and comment. DOE, Interior, Colorado, and

Kaiser-Hill provided written comments (see apps. V, VI, VII, and VIII, respectively), and generally agreed with the contents of the report. EPA did not provide official written comments but did provide editorial and technical suggestions, as did the other agencies, that we incorporated, as appropriate. DOE concurred with one of our recommendations but did not state whether it concurred with the other two.

Background

For nearly 40 years, the Rocky Flats plant, located about 16 miles northwest of downtown Denver, served as a nuclear weapons production facility. Afterward, the site bore the scars of that role: soil, groundwater, surface water, and many of the buildings at the site were contaminated with radioactive materials, such as plutonium and uranium; toxic metals, such as beryllium; and hazardous chemicals, such as cleaning solvents and degreasers. Accordingly, the site became one of DOE's priorities for environmental cleanup. While most of the approximately 6,300 acres that make up the Rocky Flats site served through the years as an undeveloped buffer zone, about one-half of a square mile (385 acres) in the center of the site constituted the industrial area, where for decades, plutonium was shaped into plutonium triggers or "pits" for use in nuclear weapons. About one-fourth of the site's more than 800 original structures (e.g., buildings and storage tanks) were radiologically or chemically contaminated—some severely so—by site operations over the years.

The site was cleaned up under the terms of a contract between DOE and Kaiser-Hill. The first contract took effect July 1, 1995. In late 1999, DOE and Kaiser-Hill negotiated a new contract, which took effect on February 1, 2000. The cleanup work was done predominantly by subcontractors, under the contractor's management.

The 2000 contract specified both the contractor's and DOE's responsibilities. The contractor was responsible for processing, packaging, and shipping off site all of Rocky Flats' nuclear materials and radioactive and hazardous wastes;[12] cleaning up and demolishing more than 700 structures that remained on site in February 2000; and cleaning up the site's contaminated soil and groundwater. DOE was required to provide a variety of services and items to support the project. Essentially, the contract required DOE to arrange receiver sites for all the materials and wastes and obtain the necessary certifications for the containers in which the materials and wastes had to be packed and shipped. Many DOE sites played a significant role in Rocky Flats' cleanup and closure, especially those sites that received materials or wastes from Rocky Flats, such as the Savannah River Site in South Carolina, the Waste Isolation Pilot Plant (WIPP) in New Mexico,[13] the Nevada Test Site, and the Hanford Site in Washington.

Much of the cleanup work at Rocky Flats was labor intensive and tedious. Plutonium is dangerous to human health, even in minute quantities, especially if inhaled or ingested. Accordingly, workers handling plutonium-contaminated materials and equipment had to wear cumbersome protective suits with enclosed respiratory systems, and sometimes had to wield heavy and ungainly tools. Also, the equipment being worked on had to be enclosed within plastic or glass to prevent airborne contaminants from reaching unprotected workers or surfaces. Figure 1 shows workers in protective clothing cutting contaminated materials to fit shipping containers.

[12]These wastes—items such as clothing, gloves, equipment, rags, paper, filters, and plastic—included low-level radioactive waste, transuranic waste, and mixed waste. Low-level radioactive waste contains radioactive constituents measuring 100 or fewer nanocuries of transuranic isotopes (described below) per gram of waste (a nanocurie is 1 billionth of a curie; a curie is the amount of radioactivity in 1 gram of radium). Transuranic waste is radioactive waste contaminated with transuranic isotopes (i.e., isotopes of elements heavier than uranium, such as plutonium), with half-lives greater than 20 years, in concentrations above 100 nanocuries per gram of waste. Mixed waste is radioactive waste—either low level or transuranic—that also contains hazardous wastes such as toxic metals, cleaning solvents, degreasers, and paint thinners.

[13]WIPP is DOE's deep geologic repository for transuranic and transuranic mixed wastes, located in an underground salt formation near Carlsbad, New Mexico.

Figure 1: Workers in Protective Suits Cut Plutonium-Contaminated Equipment

Source: DOE.

Four Key Factors Contributed to Early Cleanup

Four key factors contributed to the early completion of the physical cleanup of Rocky Flats: (1) DOE and the contractor overcame several major challenges identified in GAO's 2001 report on the Rocky Flats cleanup, (2) DOE and the site's regulatory agencies agreed to use an accelerated process to clean up the site, (3) a number of site-specific characteristics combined to limit the scope and complexity of the cleanup effort, and (4) DOE offered the contractor $560 million in total incentive fees to finish the cleanup ahead of schedule and under cost.

DOE and Contractor Overcame Previously Identified Cleanup Challenges

The first key factor that contributed to the early completion of the physical cleanup of Rocky Flats was that DOE and the contractor resolved four of the five major challenges we identified in our 2001 report. These challenges included (1) completing the decontamination and demolition of the site's structures; (2) overcoming limitations on the available number of transportation casks and on the loading capability for transuranic waste; (3) identifying the overall scope of the cleanup project—specifically, the extent of contamination, the eventual use of the site, and the level of cleanup that eventual use would require; (4) getting the automated plutonium-packaging system to reliably perform at the rate needed for timely completion; and (5) preventing safety problems, which can result in work shutdowns and delay cleanup work.

Completing Decontamination and Demolition of Structures

One major challenge DOE and the contractor overcame was completing the decontamination and demolition of hundreds of structures at the site. At the end of fiscal year 2000, the contractor had completed only about 10 percent of the predemolition work, which included activities such as removing plutonium and other nuclear materials from furnaces, pipes, and other locations within buildings; draining and removing plutonium- or uranium-laden liquids or residues from process pipes and tanks; dismantling plutonium-processing furnaces; stripping out contaminated process pipelines; and cutting up and removing hundreds of contaminated gloveboxes.[14] Further, at the time of our 2001 report, the contractor had demolished only 81 of the 802 structures that existed at the site when cleanup began. That accomplishment equated to about 10 percent of the total number of structures and only about 5 percent of the total square footage. Remaining to be demolished at the end of fiscal year 2000 were 721 structures, encompassing about 3.4 million square feet.

DOE and the contractor overcame challenges to decontamination and demolition primarily through innovation, as workers continuously sought innovative cleanup technologies that would accomplish tasks more safely, quickly, and cheaply. For example, the contractor found that it could chemically decontaminate large pieces of equipment, such as tanks and

[14]A glovebox is a closed glass, plastic, or metal chamber for handling hazardous or radioactive material. The operator handles the material through gloves sealed to the chamber's wall. Gloveboxes range in size from a few square feet to thousands of square feet.

gloveboxes, by wiping their surfaces with a liquid cerium nitrate solution.[15] By doing so, the contractor could reduce the contamination enough that the contaminated object could be shipped as low-level radioactive waste rather than transuranic waste, which requires a more costly shipping and disposal process. The Rocky Flats buildings contained approximately 1,475 gloveboxes, ranging from shoe box size to the size of an entire room. By reducing the level of contamination, the contractor could ship even large gloveboxes whole, rather than having to cut them into pieces small enough to fit into standard waste boxes used for shipping transuranic waste. Figure 2 shows workers using cerium nitrate to decontaminate a glovebox and loading a dismantled, decontaminated glovebox into a container for shipping.

Figure 2: Workers Use Cerium Nitrate to Decontaminate a Glovebox; Workers Load a Dismantled Glovebox into a Shipping Container

Source: DOE.

[15]After being used to decontaminate tanks and gloveboxes, the cerium nitrate solution was processed and disposed of as low-level liquid waste. According to Kaiser-Hill, cerium nitrate was one of several decontamination solutions used at the site.

The use of explosives in building demolition was another important time-saving demolition technique. Contractor officials said they had learned lessons from another DOE site at which DOE had doubted the demolitions experts and reduced the amount of explosives used, resulting in an explosion that failed to bring the structure down. At Rocky Flats, accordingly, the contractor and DOE brought in demolitions experts and, while closely reviewing the demolition plans and overseeing the work, let the experts' opinions prevail. As a result, the use of explosives saved time and money for the contractor and DOE. For example, in bringing down building 881, one of the four original manufacturing facilities at Rocky Flats, a contractor official estimated that the use of explosives saved about 4 months, and reduced risks to workers by removing hazards associated with heavy equipment and the falling debris that typically results from their use in lieu of explosives. After being completely decontaminated, building 881 was wired with explosives and, as shown in figure 3, collapsed into its basement.

Figure 3: Use of Explosives in the Demolition of Rocky Flats' Building 881

Source: DOE.

In addition to building 881, the contractor used explosives to bring down smaller facilities, such as the guard and water towers, and to separate the concrete from the rebar (the steel reinforcing bar) on the walls of building 886.

Additional information on decontamination and demolition activities at Rocky Flats is contained in appendix III.

Overcoming Limitations on Shipping and Transportation Capabilities

A second challenge DOE and the contractor overcame was limitations on the available number of transportation casks and on the loading capability for transuranic waste. At the time of our 2001 report, the contractor's ability to ship the total volume of waste off site to DOE's WIPP facility by the target closure date was in doubt because of uncertainties about whether DOE could obtain and provide the number of transportation casks necessary to meet the contractor's projected shipping schedule, especially for fiscal years 2002 and 2003, and because of uncertainties about whether the three loading facilities (two of which were still under construction at the time of our 2000 review) would be able to meet the shipping schedule for the site's peak shipping years. That shipping schedule had been compressed by various events, including delays in the opening of WIPP.

DOE and the contractor overcame this challenge primarily through cooperation and perseverance. Whenever a DOE site could not use a shipping container as scheduled, WIPP would send the container to Rocky Flats instead. Also, DOE headquarters maintained a high priority on Rocky Flats throughout the cleanup and made sure that it received the government-furnished services and items it needed. Figure 4 shows special transportation casks used to transport transuranic waste.

Figure 4: Transuranic Waste Packaged for Shipment to the Waste Isolation Pilot Plant

Source: DOE.

Also, while buildings at Rocky Flats were being demolished, the contractor built the two additional loading facilities, as previously mentioned, to ensure that loading and shipping schedules could be supported. The new facilities resolved the challenge of inadequate loading capability and allowed the contractor to increase its transuranic waste-shipping capability to 15 shipments a week.

Identifying the Overall Scope of the Cleanup

A third major challenge DOE and the contractor overcame was identifying the overall scope of the cleanup—specifically, the extent of contamination, the eventual use of the site, and the level of cleanup that eventual use would require. At the time of our 2001 report, the postcleanup use of the site—and, therefore, the level of cleanup required—was uncertain. Moreover, the extent of soil contamination on the site and the depth and degree of contamination under many of the former production buildings was not fully understood, particularly in the former industrial area, because parts of the site had not been fully sampled. Finally, at the time of our 2001

report, DOE, the regulatory agencies, and the community stakeholders had not yet reached agreement on an appropriate level of soil cleanup, although various studies were under way. These challenges were resolved through congressional intervention and community collaboration.

Congressional action ended the uncertainty about the end use of the site with passage of the Rocky Flats National Wildlife Refuge Act of 2001 (Refuge Act).[16] Knowing the site's end use enabled DOE and the regulatory agencies to then make assumptions about site users and their risk of exposure to residual contamination. The risk posed to a person by exposure to a contaminant is measured by a combination of the contaminant's toxicity, together with the frequency, pathway, and duration of exposure. Thus, a more stringent cleanup level is required for a site that will be used constantly, such as for residential purposes, than for a site that will be used sporadically, such as for recreational purposes. Once the Refuge Act was passed, DOE and the regulatory agencies assumed that the principal site users would be wildlife refuge workers, who would spend about 8 hours a day at the site (4 hours indoors and 4 hours outdoors), 250 days a year, for 18.7 years; and refuge visitors, who would spend about 2.5 hours a day at the site, 100 days a year, for 30 years (6 years as a child and 24 years as an adult). Soil cleanup levels could then be set at a level that would protect both types of users.

DOE collaborated with the community in determining the level of remediation the cleanup would achieve. Before passage of the Refuge Act, the Rocky Flats Cleanup Agreement had specified an interim soil cleanup level (action level) of 651 picocuries of plutonium per gram (pCi/g) of soil,[17] meaning that a soil cleanup action[18] would be triggered by a soil sample

[16]Pub. L. No. 107-107 §§ 3171-3182, 115 Stat. 1012, 1379-1388. Prior to enactment of the Refuge Act, DOE and the regulatory agencies proceeded under the assumption that the land would be used in the future for open space.

[17]A picocurie is a trillionth of a curie, which is the amount of radioactivity in a gram of radium. The higher the soil action level, the more plutonium can be left in the soil. A lower action level means that less plutonium can be left, so more soil must be removed.

[18]Remediation of radioactively contaminated soil at Rocky Flats generally meant removal. In general, it is more cost effective to remove plutonium-contaminated soil than to treat and return it.

indicating the existence of plutonium in excess of 651 pCi/g.[19] This action level was considered unacceptable by the two stakeholder community groups: the Rocky Flats Citizens Advisory Board and the Rocky Flats Coalition of Local Governments; these groups argued for a much more stringent action level. DOE funded a community-directed, independent scientific assessment of soil action levels. This independent assessment was overseen by a panel of community representatives. DOE also funded a workshop, organized by the Rocky Flats Citizens Advisory Board, featuring experts who provided presentations on radiological assessments, risk analyses, and various computer-modeling scenarios and assumptions. Working with local governments and members of the public, DOE and the regulatory agencies ultimately agreed on a soil action level of 50 picocuries of plutonium per gram (pCi/g) of surface soil (i.e., the top 3 feet of soil), meaning that a remedial action would be triggered by a soil sample indicating the existence of plutonium in excess of 50 pCi/g. A plutonium level of 50 pCi/g translates to a risk level of 1 in 500,000 (that is, this level of contamination could result in one more case of cancer than otherwise would have been expected in every 500,000 persons).[20] DOE and the regulatory agencies decided that, with a surface soil action level of 50 pCi/g, higher concentrations of plutonium in soil could remain at greater depth. Accordingly, DOE and the regulatory agencies agreed to set an action level of 3,000 pCi/g for depths of 3 to 6 feet below the surface, depending on the extent of the contamination. Once a remedial action was triggered, cleanup would continue until contamination greater than 1,000 pCi/g had been removed.

In addition to collaborating on decisions about soil cleanup levels, community groups provided comments and advice on many other aspects of the cleanup that influenced DOE's decisions in some cases. Our survey of the Rocky Flats Citizens Advisory Board and the Rocky Flats Coalition of Local Governments found that 21 of the 25 respondents were very or somewhat satisfied with how DOE engaged the group in the cleanup process. Also, 19 of the 25 respondents said they were very or somewhat

[19]According to Colorado officials, the action level (651 picocuries per gram) that was specified in the 1996 cleanup agreement was based on EPA's draft proposed rule, which at the time was a dose-based, rather than the current risk-based, calculation.

[20]Initially, according to Colorado officials, cleanup action levels for all contaminants at the site, including uranium and americium, were set at a level equivalent to a risk level of 10^{-5} (i.e., an excess cancer risk of 1 in 100,000). For plutonium, that level would be about 116 pCi/g. However, through collaboration with the community stakeholders, a more stringent level was set for plutonium: 50 pCi/g.

satisfied with how DOE used the group's input. Nearly all (23 of 25) said they believed the groups' input had a very or somewhat positive effect on the cleanup process.

Problems with Automated Plutonium-Packaging System

The unreliable functioning of the automated plutonium-packaging system is the only one of the five challenges we identified in 2001 that DOE and the contractor never fully resolved. It was only through persistence and "brute force" that the packaging was finally completed in July 2003, more than a year late and at least $50 million over budget. The system never worked reliably, and many of the processes that were designed to be automated had to be done manually. It required continuous maintenance and modification, and broke down as many as two or three times a day, requiring a "triage" repair team on call 24 hours a day. Nevertheless, according to DOE officials, the pursuit of any alternative to the system would probably have resulted in even greater cost and schedule delays. Figure 5 shows GAO officials and staff being briefed on the glovebox line behind the automated plutonium-packaging system; this glovebox line handled the prepackaging of wet combustibles.

Figure 5: GAO Staff Being Briefed on the Prepackaging of Wet Combustibles, July 2002 and October 2000

Source: DOE.

Preventing Safety Problems

The final challenge that DOE and the contractor overcame was safety problems, which can result in shutdowns and delay cleanup work. At the time of our 2001 report, DOE was concerned about the number and severity of safety violations that had occurred since the inception of the

2000 contract. In response to those concerns, the contractor developed a comprehensive plan to improve its safety and compliance performance.

Although some safety incidents occurred after our 2001 report, the contractor's overall safety performance improved. In two key measures of safety, for example, Rocky Flats' performance was considerably better than the average performance in the construction industry. One of these measures is total recordable cases (TRC). Recordable cases, in general, are any that require "more than a Band-Aid,™" according to a contractor safety official—for example, an injury that requires stitches, prescription medication, or 1 or more days away from work. At Rocky Flats, the 12-month TRC rolling average at the end of 2004 was 0.9 per 100 full-time workers. This was a significant improvement over the 7.6 rate that existed at the site in July 1995, when Kaiser-Hill took over from the previous contractor. By comparison, the TRC average in the construction industry for calendar year 2004 was 6.4 per 100 full-time workers. The contractually established limit for TRCs at Rocky Flats was a 12-month rolling average of 3.5 per 100 full-time workers. Using the other key measure of safety, lost workdays, Rocky Flats also performed well. At the end of 2004, the site's 12-month rolling average rate for lost workday cases was 0.2, much lower than the site's July 1995 rate of 4.6 and well below the construction industry rate of 2.4 for calendar year 2004. The contractually established limit for lost workdays at Rocky Flats was a 12-month rolling average rate of 2.0.

The contractor's safety director reported that these safety improvements were achieved through a combination of actions, including getting the Chief Executive Officer, Chief Operating Officer, and other top management officials involved; improving the work-planning process to incorporate job-hazards analyses; involving the workers early in safety-planning and job-hazards analyses; holding first-line supervisors (i.e., foremen) responsible for informing workers of top management's emphasis on safety; and improving the training provided to workers. The site developed a course, commonly known as Rocky Flats 101, that contained a hands-on, simulated work environment in which workers learned how to use ladders and various other tools in contaminated spaces. The course was very effective, according to the safety director.

Accelerated Cleanup Process Allowed Faster, More Collaborative Work

The second key factor that contributed to the early completion of the physical cleanup of Rocky Flats was the use of an accelerated cleanup process. The Rocky Flats cleanup began in the late 1980s and early 1990s with extensive characterization (sampling of soil, groundwater, surface water, and air). But after several years of characterization, public frustration was building at the lack of visible progress in cleaning up the contamination at the site. According to DOE officials, the extensive sampling that was done at the site in the late 1980s and early 1990s, together with historical documents about the use and disposal of materials and wastes, facilitated use of the accelerated process.[21] Instead of proceeding under the full CERCLA/RCRA process, the Rocky Flats Cleanup Agreement authorized DOE to perform most of the cleanup through removal actions. In a 1996 report, we recommended that DOE make greater use of removal actions to increase the efficiency and cost-effectiveness of cleanups.[22] Under the accelerated process, cleanup actions, including soil removal, occur early and throughout the process rather than at the end, with confirmation sampling at each cleanup area to ensure that the remediation was sufficient.[23] DOE officials report that the accelerated process allowed more timely removal of contaminants from the site.

The pace of work in reviewing and approving cleanup documents was "frantic," according to Colorado officials. Colorado, DOE, and the contractor agreed on a "review template" of documents Colorado needed to see for each building and area; the template allowed Colorado officials to provide immediate review by working closely with the contractor.

[21]The Rocky Flats cleanup implements both CERCLA and RCRA. Although the terminology used by each program differs, the CERCLA and RCRA processes are similar. The typical full remedial processes under CERCLA and RCRA include (1) determining the nature and extent of contamination; (2) assessing potential threats to human health and the environment; (3) establishing risk-based action levels; (4) identifying potential cleanup technologies and processes, and evaluating cleanup alternatives and corrective measures; (5) identifying the preferred remedy and obtaining public comment on it; (6) selecting and implementing the final remedy; and (7) monitoring and maintaining the remedy.

[22]GAO, *Nuclear Waste: Greater Use of Removal Actions Could Cut Time and Cost for Cleanups*, GAO/RCED-96-124 (Washington, D.C.: May 23, 1996).

[23]The cleanup actions, called "accelerated actions," were planned and executed to satisfy, among other things, the requirements of the Environmental Restoration Rocky Flats Cleanup Agreement Standard Operating Protocol for Routine Soil Remediation. Notification of the planned activities was approved by EPA or Colorado, depending on where the accelerated action was located. (EPA was the lead regulatory agency for the buffer zone; Colorado, for the industrial area.)

Although the cleanup agreement specified that Colorado had 14 days (30 days in some cases) to review and provide comments on cleanup-related documents, use of the review template shortened the review time considerably. For example, the contractor would send draft documents to Colorado officials, who would provide comments directly to the contractor; the contractor then would respond by making corrections, providing additional data or documents, or doing more work if necessary. By working closely with the contractor along the way to resolve questions or concerns, Colorado was able to respond quickly—sometimes on the same day—to DOE's faxed requests for official approval of cleanup-related documents. Colorado officials pointed out that had they not been willing to work in this way with the contractor, but had instead taken the 14 or 30 days provided for review and approval under the cleanup agreement, the contractor would not have been able to complete the cleanup as early as it did. (DOE noted that Colorado's work with the contractor was not done without DOE's involvement; as mentioned throughout the report, the entire process was collaborative.)

DOE, EPA, and Colorado agreed that the accelerated process and the collaboration it fostered were essential to the cleanup's early completion. According to EPA and Colorado officials, their agencies had staff on site "continuously," working in the field with DOE and contractor staff to discuss and observe cleanup operations, and requiring "real time" changes as necessary. Throughout the process, the regulatory agencies were intimately involved in reviewing data and otherwise contributing to the development of studies, plans, and decision documents. As a result, the "back end" of the review process was very streamlined, according to contractor officials.

While the accelerated cleanup actions were under way, and as data from the completed cleanup actions became available, DOE concurrently conducted the remedial investigation and feasibility study (RI/FS),[24] which summarizes site conditions at closure and evaluates necessary long-term remedies, such as site monitoring. Based on all of the data collected at the site, including the results of the individual accelerated cleanup actions and

[24]Throughout this report, our use of either a general descriptive term or a CERCLA term for a specific regulatory document is intended to include the RCRA equivalent as well. For example, if we refer to the final decision document, we mean both the CERCLA record of decision and the RCRA corrective action decision. Similarly, if we refer to the feasibility study (a CERCLA term), we mean that to include the corrective measures study (a RCRA term).

the RI/FS, DOE will identify its preferred final remedy in the proposed plan, which will be released for formal public comment once the final RI/FS has been approved by EPA and Colorado. DOE shared the draft RI/FS with the public and obtained EPA's and Colorado's comments on it; these comments were considered during preparation of the final RI/FS. After considering comments received on the proposed plan during a 60-day public comment period, DOE will select and document its preferred remedy in the final decision document. Once EPA and Colorado approve the final decision document, it will serve as both the corrective action decision (under RCRA) and the record of decision (under CERCLA).

Site-Specific Characteristics Aided Cleanup Effort

The third key factor that contributed to the early completion of the physical cleanup of Rocky Flats was a confluence of circumstances—climatic, geologic, chemical, structural and economic—that confined the scope and complexity of the cleanup effort. Climatically and geologically, the semiarid climate and the alluvial fan upon which the site is located contributed to slow erosion of soils over time, thus inhibiting the off-site migration of contaminants. The site also benefited from layers of shale and claystone—hundreds of feet thick in places—that prevented contamination from seeping into the deep drinking-water aquifer that underlies part of the site.

Chemically, the cleanup was aided by the nature of the two key contaminants—plutonium and americium, which are essentially insoluble in water and, instead, tend to bind to soil and sediment particles, according to a study undertaken in the late 1990s.[25] At Rocky Flats, there is little groundwater movement, and no groundwater was contaminated with plutonium and americium.[26] Instead, soil was the predominant environmental medium requiring cleanup. Remediation of contaminated soil generally consists of digging it up and shipping it to a disposal site, a simpler task than remediating groundwater. The contaminants move around the site, and potentially off site, by surface-soil erosion, wind, or surface water. For example, westerly winds spread contaminated soil to off-site lands east of Rocky Flats. In a 1997 combined corrective action decision/record of decision about these lands,[27] EPA and Colorado determined that the lands did not pose an unacceptable or significant risk to human health or the environment, notwithstanding the low levels of plutonium and americium that existed in the soil—in portions of the lands—from Rocky Flats activities.[28]

Structurally, the robust construction of the plutonium-processing buildings, with their thick concrete floors and walls, contained many leaks and spills of radioactive and hazardous materials, thereby limiting the extent and severity of contamination under the buildings. Building 371, for example, was a complex, extremely strong, and rigid structure that was built to withstand accidents such as earthquakes, tornadoes, winds, and fires. The building was a partially buried structure of reinforced concrete with an extensive foundation of concrete caissons up to 6 feet in diameter, drilled

[25]Kaiser-Hill, *Actinide Migration Evaluation Pathway Analysis Summary Report*, ER-108 (2002).

[26]Some contaminated groundwater seeps to the surface, particularly during periods of rain or snow, and then trickles into ditches and streams. The primary groundwater contaminants are volatile organic compounds (e.g., degreasers and solvents such as trichloroethene, carbon tetrachloride, and chloroform). These contaminants are largely controlled by the groundwater treatment systems on site, which were installed to protect surface water.

[27]EPA, *Superfund Record of Decision: Rocky Flats Plant* (USDOE), EPA ID: CO7890010526, OU 3, Golden, CO, EPA/ROD/R08-97/196, 1997 (Golden, Colo., June 3, 1997).

[28]In 1990 a class action suit was filed in federal court against two corporations that formerly operated the Rocky Flats Plant under contract to DOE. Among other things, the plaintiffs claimed that their land was damaged by the release of hazardous substances from Rocky Flats. In February 2006, a jury found for the plaintiffs and awarded compensatory and punitive damages. However, the court has not yet entered a judgment, and the litigation is ongoing. *Cook v. Rockwell International*, No. Civ.A. 90-CV-181-JLK (D. Colo.).

into bedrock, and concrete wall and slab thicknesses beyond typical industrial use and code requirements. Similarly, building 771 featured concrete thicknesses ranging from 6.5 inches to more than 2 feet.

Finally, the local economy was a factor in the success of the cleanup, according to Colorado officials. The local economy was not heavily dependent on the cleanup project to provide jobs, so closing the site did not meet large-scale community opposition.

DOE Provided the Contractor with a Financial Incentive to Finish Early and Under Cost

The fourth key factor that contributed to the early completion of the physical cleanup of Rocky Flats involved certain features of the cleanup contract, including a substantial financial incentive for the contractor to finish the cleanup work ahead of schedule and below budget. The contract provided for an incentive fee tied partly to schedule but predominantly to cost. The contractor would earn the target fee of $340 million if it completed its work between December 16, 2006, and March 31, 2007, at a cost between $4 billion and $4.2 billion.[29] If the contractor completed the cleanup outside of these schedule and cost ranges, the fee would rise or fall accordingly—to as much as $460 million for less costly, earlier completion, or as little as $130 million for more costly, later completion. In 2003, when officials saw that the contractor was confident of earning the maximum fee and was no longer working aggressively to further shorten the completion timeline or reduce costs, DOE approved a $100 million increase in the maximum incentive fee. In the end, DOE awarded the contractor $49 million of the additional available fee, based on a reduction in the total project cost of an additional $129 million.

[29]In this paragraph, the cost and fee amounts are those cited in the contract and have not been adjusted to constant 2005 dollars; the contract contains no provision for inflation.

DOE also encouraged the contractor to continue its practice of sharing incentive fees among its workforce by offering employees financial incentives to continue to work safely and generate ideas for ways to save costs and time. In its initial contract bid for the 1995 contract for the Rocky Flats cleanup, Kaiser-Hill committed to share 20 percent of its profits with employees. The contractor's president explained that incentives were offered across the workforce, although the incentive type varied by work group. Salaried employees were individually evaluated based on their project and safety performance; the value of their incentive pay was based on the final total project cost. For hourly employees, incentive pay was determined though collective bargaining but was primarily based on schedule performance. Steelworkers received an annual incentive bonus, based on schedule performance; workers in the building trades received an annual hourly increase, also based on schedule performance. The contractor also had a safety incentive program that included spot cash awards. Over the life of the project, the contractor distributed approximately $100 million of company earnings (about 20 percent of its $510 million incentive fee) to its workers, and DOE contributed an additional $30 million that was used for incentive pay.[30]

According to the contractor, financial incentives for early or under-budget completion of a project are a powerful motivator; however, it is important to note that the financial incentive offered at Rocky Flats was only one of many factors contributing to the early completion of the cleanup. In GAO's experience, such incentives are not always this successful. As we reported in December 2005, the Department of Defense has not fared well at using incentive-fee contracts to improve cost-control behavior or meet program goals.[31] Specifically, about half of the 27 incentive-fee contracts included in GAO's review failed or were projected to fail to meet a key measure of program success—completing the objective (i.e., delivering the product or service specified by the contract) at or below the target price. Research on incentive fees by GAO, Harvard University, and the RAND Corporation going back decades has concluded that incentive fees do not consistently motivate contractors to control cost.

[30]DOE's contribution was specified in the contract, as 4 percent of salary cost.

[31]GAO, *Defense Acquisitions: DOD Has Paid Billions in Award and Incentive Fees Regardless of Acquisition Outcomes*, GAO-06-66 (Washington, D.C.: Dec. 19, 2005).

Additionally, according to the contractor, enhanced workforce transition benefits could be considered important to worker motivation and productivity. Enhanced benefits included pension and post-retirement medical benefits and outplacement services such as relocation and education benefits.

Another unusual and critically important feature of the Rocky Flats contract was consistent funding. An underlying premise of the contractor's ability to finish the job early and under budget was that a stable source of funding would be provided throughout the cleanup. As part of the contract negotiation process, DOE and the contractor assumed an annual funding level of $657 million per year. Both DOE headquarters and Congress helped each year to ensure that the site received a consistent funding level. The contract also stipulated the services and items that the government would provide, including making a number of shipping containers available and arranging treatment and disposal sites for radioactive waste at the site. If DOE did not meet its contractual obligation, it would be grounds for changing the contract. In that way, DOE bore the liability for any role it had in increasing contract costs.

Cleanup of Rocky Flats Is Complete at a Cost of about $10 Billion, but Key Steps Remain Before the Planned Wildlife Refuge Will Open

The physical cleanup at Rocky Flats is complete, at a total cost (including long-term costs) of about $10 billion;[32] however, several regulatory steps remain before land can be transferred to the Department of the Interior for establishment of the wildlife refuge planned for the site. After DOE issues and considers public comments on its proposed plan, identifying its preferred alternative for the site's future monitoring and remediation, EPA and Colorado will jointly determine whether any further cleanup is needed at the site or whether the cleanup actions already taken are sufficient to render the site safe for its intended purpose. A final decision by EPA and Colorado is expected in late 2006. If they decide that no further action is needed to remediate the site, EPA will delete portions of the site from the CERCLA National Priorities List[33] and certify that the cleanup and closure of Rocky Flats has been completed; the Secretary of the Interior can then accept administrative jurisdiction of designated lands and establish the

[32]Unless otherwise noted, all costs cited in this section have been adjusted for inflation and are expressed in constant 2005 dollars.

[33]Portions of the site being retained by DOE for long-term stewardship may not be removed from the list.

refuge, in accordance with the Rocky Flats National Wildlife Refuge Act of 2001.

Regulatory Steps Remain Before the Site Can Open as a Wildlife Refuge

Although the contractor has finished the cleanup at Rocky Flats, DOE, EPA, and Colorado must complete the remaining steps of the regulatory process before Rocky Flats can be removed from the National Priorities List. On October 13, 2005, the contractor declared that it had successfully completed the Rocky Flats cleanup—more than 1 year before the target cleanup completion date cited in the contract and more than 3 years before the completion date the contractor thought likely in our 2001 report.[34]

In declaring the cleanup complete in October 2005, the contractor stated that it had met all of the cleanup requirements in the contract, which included: (1) demolishing all buildings; (2) investigating and remediating as necessary 360 individual cleanup areas; (3) removing wastes as specified in the cleanup agreement; (4) installing closure caps for two landfills; (5) covering appropriate areas such as building foundations, utilities, paved roads, and parking lots with a minimum of 3 feet of fill (e.g., Rocky Flats alluvium) after final grade; (6) ensuring that on-site surface water meets health-based standards for open-space use; and (7) ensuring that water leaving the site via two creeks will meet Colorado water quality standards. The contractor reported its major cleanup accomplishments in an October 2005 report.[35] Among these accomplishments were that the contractor

- deactivated, decontaminated, removed, and cut up 1,475 gloveboxes, and disposed of them off site;
- cleaned up and removed more than 800 structures, including more than 1 million square feet associated with five major plutonium facilities and two major uranium facilities;
- shipped to other DOE facilities 21 tons of special nuclear materials (plutonium and highly enriched uranium), including metals, oxides, and over 100 tons of plutonium residues;

[34]GAO-01-284.

[35]Kaiser-Hill Company L.L.C., *Executive Summary, Draft RCRA Facility Investigation—Remedial Investigation/Corrective Measures Study—Feasibility Study Report for the Rocky Flats Environmental Technology Site*, prepared for the Department of Energy, October 2005.

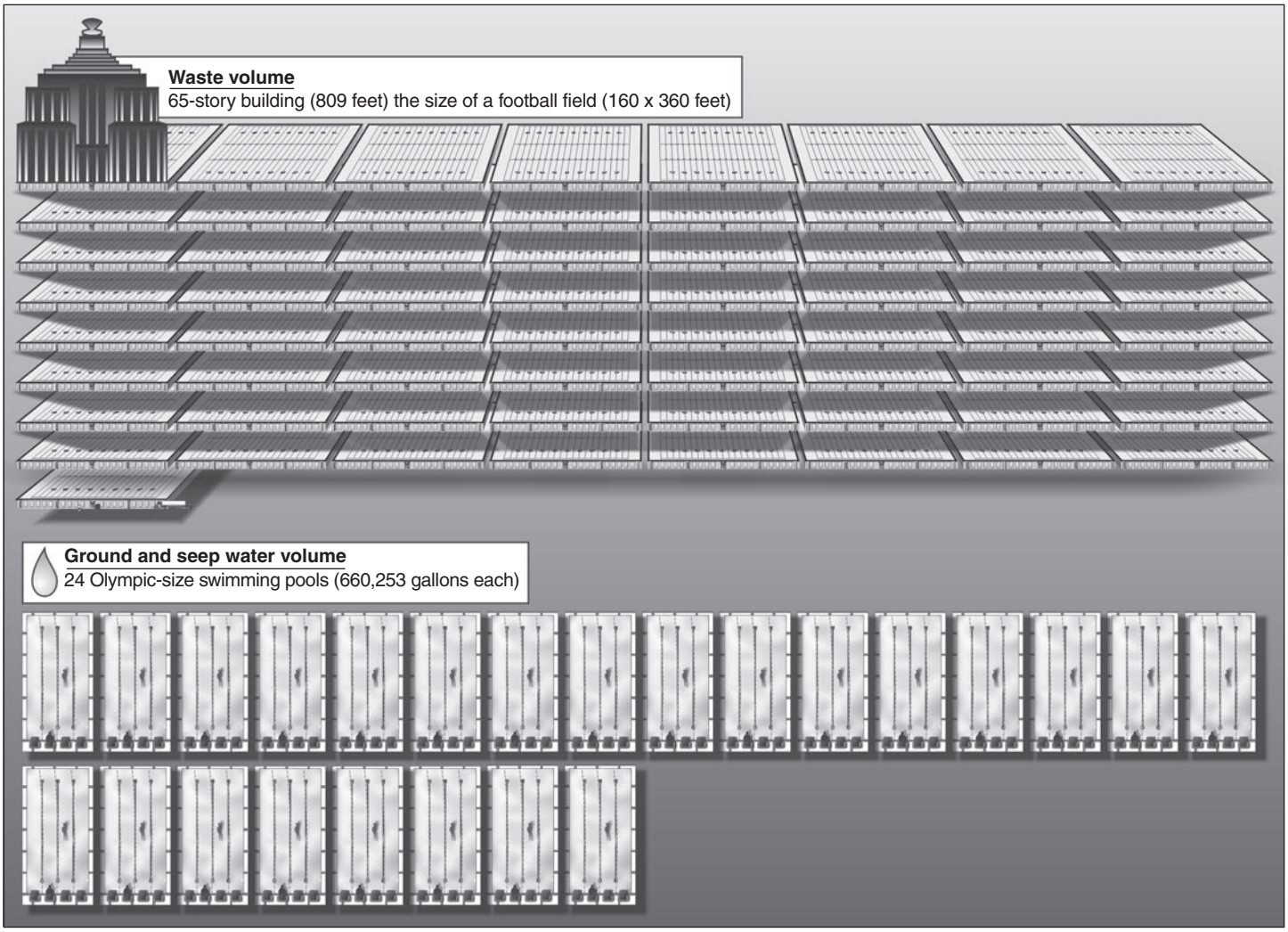
Major cleanup accomplishments at Rocky Flats

- Shipped off site an amount of cleanup waste equivalent to a 65-story building the length and width of a football field, including more than 15,000 cubic meters of transuranic and other radioactive waste, more than 500,000 cubic meters of low-level and other radioactive waste, more than 800,000 cubic meters of sanitary waste, and more than 4,300 cubic meters of hazardous waste (see fig. 6).
- Treated more than 11 million gallons of contaminated groundwater and 5 million gallons of contaminated seep water—enough to fill 24 Olympic-size swimming pools (see fig. 6).

- deactivated, decontaminated, removed, and cut up 690 tanks, and disposed of them off site;
- installed covers at two landfills;
- investigated and remediated, as necessary, 421 areas of known or suspected contamination, including 360 cleanup areas such as individual hazardous substance sites and contamination located under buildings; and
- installed three barriers and a seep collection system to treat contaminated groundwater plumes; installed passive treatment systems to protect surface water quality.

Figure 6 illustrates the equivalent amounts of waste removed and contaminated water treated at Rocky Flats during the cleanup.

Figure 6: Waste Removed and Contaminated Water Treated at Rocky Flats



Sources: GAO.

Figure 7 shows the site as it was in 1995, when the contractor began its cleanup job, and on October 13, 2005, when the contractor declared its job done.

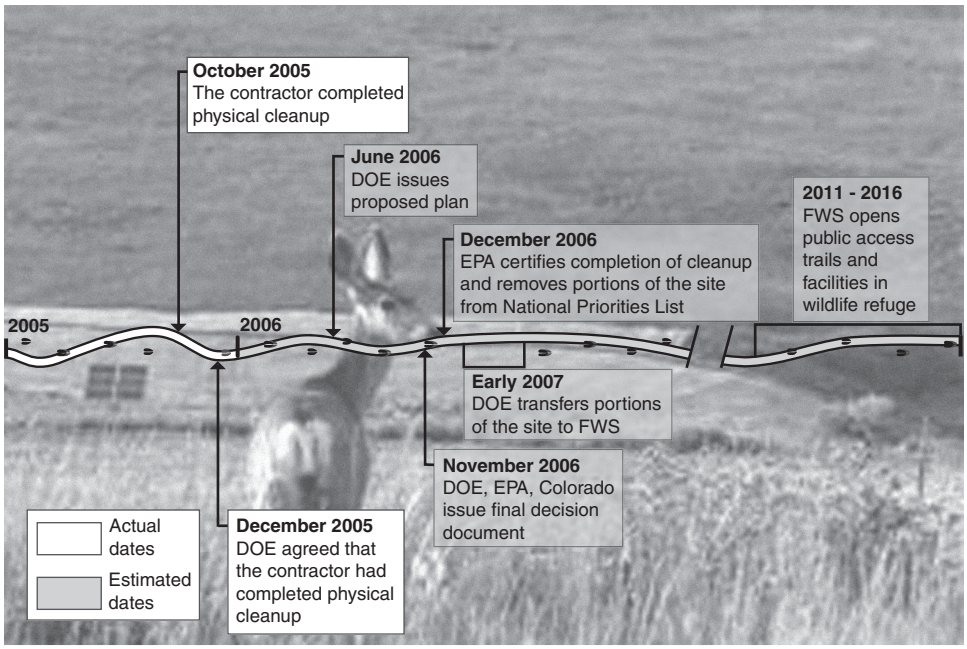
Figure 7: Rocky Flats, before Cleanup, in 1995 (left), and after Cleanup (in 2005)

Source: DOE.

The contract provided that when the contractor declared the cleanup finished, DOE would have 90 days to either accept the project as complete or provide the contractor with a list of items to address. In November 2005, DOE provided the contractor with the final list. In December 2005, after reviewing cleanup documentation, doing a final walk-through of the site, and ensuring that the contractor had completed the remaining items, DOE agreed that the contractor had fulfilled all of the cleanup actions specified in the contract and the cleanup was complete.

The next steps include the review, revision, and final approval of the remaining regulatory documents. Figure 8 shows the key steps in Rocky Flats' transition from a cleanup site to a wildlife refuge.

Figure 8: Key Steps in Rocky Flats' Transition to a Wildlife Refuge



Sources: GAO, based on information provided by DOE, EPA, and FWS.

Those steps are as follows:

- **July 2006:** DOE expects to issue its proposed plan, specifying its preference for future monitoring and remediation of the site from among the following alternatives outlined in an RI/FS: (1) no further action, with monitoring; (2) monitoring plus both institutional and physical controls; and (3) monitoring and both institutional and physical controls, plus additional targeted removal of plutonium-contaminated soil in an isolated area to reduce the excess cancer risk for wildlife refuge workers from 1 in 500,000 to 1 in 1,000,000. The proposed plan will also specify the area to be retained by DOE rather than transferred to FWS. As agreed between DOE and the regulatory agencies, the plan will be issued for a 60-day public comment period, which will include a public hearing.

- **November 2006:** After considering public comments on the proposed plan, EPA and Colorado expect to finalize and issue the final joint decision document.[36] The final decision document will specify what additional cleanup, if any, is necessary at the site and what monitoring and institutional and physical controls, if any, will be necessary. The document will also include a "responsiveness summary" that responds to questions from the public and other stakeholders on the proposed plan.

- **December 2006:** EPA expects to certify that the cleanup is complete. It may then remove portions of the site from the National Priorities List.[37]

- **Early 2007:** DOE expects to transfer jurisdiction of the majority of the site (approximately 5,400 acres) to FWS. The specific acreage to be transferred will be specified in the final decision document and will be contingent upon DOE's purchasing privately owned "essential mineral rights" (i.e., the right to mine sand and gravel) affecting about 700 acres. Under the legislation authorizing DOE to purchase these essential mineral rights, the refuge will not include land that is subject to sand and gravel mining or is being actively mined by private parties.[38]

- **2012 through 2022:** FWS expects to open public access trails and facilities in the wildlife refuge, as described in the agency's Final Comprehensive Conservation Plan.[39] FWS's ability to implement its conservation plan is contingent on funding availability. In the first year following land transfer and refuge establishment, if funds are available, FWS will open one 1.75-mile pedestrian trail, which will follow the

[36]This final decision document will be a joint CERCLA record of decision and RCRA corrective action decision.

[37]In the future, some part of the DOE-retained lands may also be deleted from the National Priorities List. A site may be deleted from the list even though operation and maintenance of a remedy continue. Accordingly, at some point EPA may agree to delete the surface of the DOE-retained lands but not the subsurface or the groundwater.

[38]Such lands are excluded from the refuge until the essential mineral rights are purchased or the surface land is mined and reclaimed by the mineral rights holder(s). National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 3112(b)(7)(B), 119 Stat. 3136, 3542.

[39]U.S. Fish and Wildlife Service, *Rocky Flats National Wildlife Refuge: FINAL Comprehensive Conservation Plan and Environmental Impact Statement* (Denver, Colo., Sept. 16, 2004).

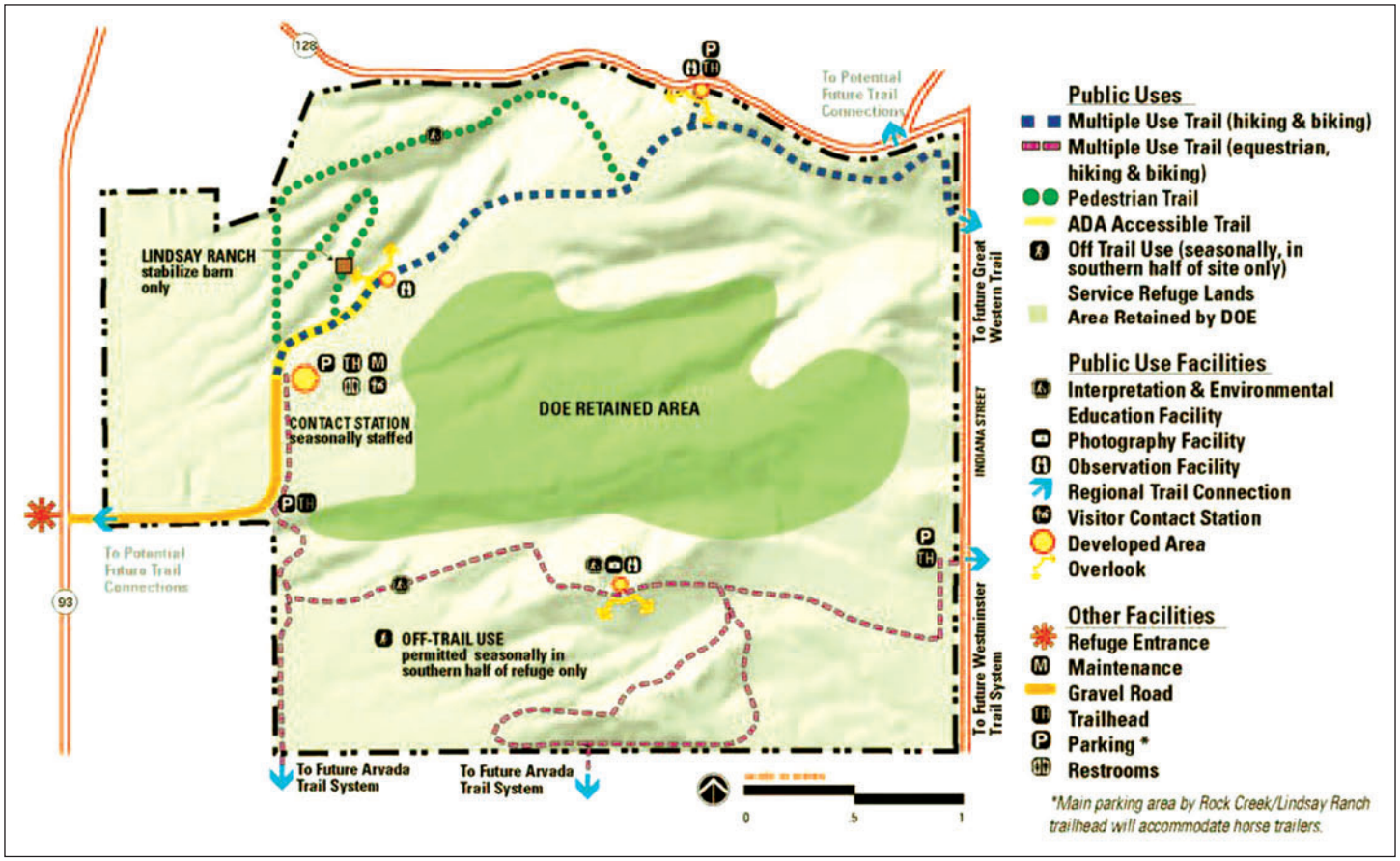
existing road to the Lindsay Ranch homestead site, which dates from the early 1940s (see fig. 9).

Figure 9: The Lindsay Ranch

Source: DOE.

Before opening other trails, FWS officials said they will concentrate on restoring wildlife and plant habitat, controlling noxious weeds, removing roads and culverts, and restoring the prairie grasslands. As funding permits, between 2012 and 2022, they plan to phase in the remaining 15 miles of trail as well as other public-use facilities, such as parking lots, a visitors' kiosk, wildlife-viewing blinds, and scenic overlooks. Figure 10 depicts FWS's plan for visitor use at the refuge, including about 16 miles of trails, parking, and developed overlooks.

Figure 10: Plan for Public Access Trails and Facilities at the Rocky Flats National Wildlife Refuge



Source: U.S. Fish and Wildlife Service.

Even after the wildlife refuge opens, some stewardship activities will likely continue at the site for an indeterminate time. For example, DOE will maintain groundwater monitoring wells and treatment facilities as long as necessary, subject to approval of the regulatory agencies. Additionally, as required by CERCLA,[40] DOE will review the site at least every 5 years to determine whether remedies continue to be fully protective of human health and the environment. DOE, EPA, and Colorado reviewed parts of the site in 2002; the next review is scheduled for 2007.

Further, DOE negotiated an environmental covenant with Colorado for one of the landfills at the site, called the Present Landfill. The purpose of this covenant is to ensure protection of human health and the environment by preventing intrusions into the landfill or damage to the various engineered structures on adjoining lands and preventing exposure to hazardous wastes. The covenant, which runs with the land in perpetuity, is binding on DOE and all other interested parties (including persons using the land), as well as their heirs and successors. Activities prohibited by the covenant include digging, drilling, tilling, grading, and excavating, as well as any activities that could damage or impair the proper functioning of the landfill cap and runoff controls, the passive seep intercept and treatment system, or the groundwater monitoring wells. According to a DOE official, DOE and the state anticipate that the covenant for the Present Landfill will be supplanted by a broader covenant for the DOE-retained lands; this broader covenant will become effective with execution of the final decision document (the combined corrective action decision/record of decision).

The long-term care of the site is a subject of continuing debate and, for some, concern. The long-term condition and care of the site were the concerns most mentioned by community group survey respondents. Of the 17 (of 25) survey respondents who said they had remaining concerns about the cleanup, 15 mentioned concerns about what would happen at the site in the future.

Rocky Flats Cleanup Cost about $10 Billion, Including Long-Term Costs

The total cost of the cleanup—about $10 billion—comprises costs incurred from 1995 through 2005 and estimated long-term costs through about 2080. Costs incurred to date include the following:

[40]CERCLA § 121(c); 42 U.S.C. § 9261(c). EPA and Colorado also have a significant role in the 5-year review process.

- The 2000 closure contract cost DOE over $4.1 billion through October 2005—nearly half the total cost of cleanup through closure. This cost includes the $510 million incentive fee that DOE paid the contractor.

- The 1995 cleanup contract cost DOE nearly $3.6 billion through early 2000, including a $120 million fee to the contractor.

- The cost of DOE's Rocky Flats Field Office from fiscal year 1995 through October 2005 was nearly $760 million. This cost included staff salaries, site utilities, litigation support, regulatory oversight, and other expenses.

- The cost incurred by other DOE sites in support of the Rocky Flats closure was approximately $138 million, for such activities as certifying shipping containers, providing transportation for nuclear materials and wastes, and receiving and storing Rocky Flats' materials and wastes.

In addition, in January 2006, Congress authorized DOE to spend up to $10 million on the purchase of designated "essential mineral rights" at the Rocky Flats site.[41] The law provided that these mineral rights at the site can be purchased only from willing sellers and that the cost must not exceed fair market value. In January 2006, DOE shared the results of an appraisal of the mineral rights with the three ownership groups at Rocky Flats. DOE will meet with various natural resources trustees, including the Department of the Interior, to determine how to facilitate the sale of the designated essential mineral rights.

DOE anticipates that long-term costs will exceed $1.3 billion. The bulk of these costs will be the cost to DOE for pensions and postretirement benefits (primarily medical and life insurance coverage) for the contractor's Rocky Flats employees. These costs will likely exceed $1 billion, including about $822 million in medical benefits alone. DOE is liable for such costs under the provisions of not only the 2000 contract, but also previous site management contracts with Kaiser-Hill and its predecessors. Postretirement benefits and pensions are part of the total allowable compensation for DOE contractor employees, and DOE considers them to be necessary to attract the most qualified employees. DOE Order 350.1 provides that when operations at a DOE facility are terminated and no

[41]National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 3112, 119 Stat. 3136, 3540 (2006).

other work is to occur under the contract (as in the case of Rocky Flats), pension and postretirement health benefit continuation will be provided by DOE for those contractor employees who earned retirement benefits in these plans. According to actuarial estimates prepared for DOE by a consultant, payments for contractor employees at Rocky Flats will continue until about 2064.

At Rocky Flats, 2,815 (43 percent) of 6,616 contractor employees were eligible for postretirement benefits.[42] These employees worked for either the prime contractor (Kaiser-Hill) or one of its major subcontractors, and retired between January 1, 1995, and December 31, 2005. The estimated cost of over $1 billion does not include pensions and postretirement benefits for employees who would have become eligible if the site had closed on its original target closure date of December 31, 2006. When the site closed more than a year ahead of schedule, the early closure date preceded the eligibility date for full pensions and postretirement benefits of 34 employees, according to a contractor official.

Costs for the long-term stewardship of the site are estimated at $303 million. Long-term stewardship includes site surveillance and maintenance, as well as management of site records and information systems. For many decades to come, DOE will need to monitor environmental conditions at the site and maintain the systems and structures that remain there (e.g., groundwater treatment systems, ponds and surface water control features, and landfills). According to draft DOE guidance, surveillance and maintenance refers to "all activities necessary to ensure protection of human health and the environment following cleanup at a site, in perpetuity." Thus, while long-term stewardship costs are estimated through about 2080, some costs will continue beyond that, depending on the extent of stewardship needed.

[42]Plan benefits were different for the eligible salaried employees (1,546 employees), hourly employees (1,187 employees), and security policy officers (82 employees).

Our 2001 report noted that the total cost could rise if any claims for monetary damages were brought against DOE to compensate for injuries to natural resources. Under CERCLA, federal, state, and Indian tribal officials who have been designated as trustees can file claims for monetary damages for injuries to natural resources (including wildlife, fish, and lakes) resulting from releases of hazardous substances. Damages are usually for injuries that were not rectified by the cleanup and are to be used to restore, replace, or acquire equivalent resources. In a November 2005 report,[43] DOE's Inspector General said that DOE had not yet conducted the required Natural Resource Damage Assessment at Rocky Flats and that only the completion of that assessment would determine whether additional costs will be ultimately incurred.

But speculation about the potential cost of natural resource damage claims at the site was laid to rest with passage of the 2006 National Defense Authorization Act. Under the act, a natural resource damage liability claim would be considered to be satisfied by the purchase of mineral rights for $10 million, as authorized by the act, or the payment of the authorized $10 million to the natural resource trustees, or a combination of the two, for a total payment of $10 million.[44] Although DOE had agreed with the Inspector General's recommendation to immediately initiate the damage assessment, the subsequent provisions of the Defense Authorization Act rendered the damage assessment requirement moot.

[43]DOE, *Management Controls over Assessing Natural Resource Damage at Rocky Flats*, OAS-M-06-02 (Washington, D.C., Nov. 25, 2005).

[44]Pub. L. No. 109-163, § 3112(b)(4), 119 Stat. 3136, 3540-41. For the Rocky Flats site, according to the cleanup agreement, the designated natural resource trustees are the Secretary of Energy, the Secretary of the Interior, the Executive Director of the Colorado Department of Public Health and Environment, the Colorado Attorney General, and the Deputy Director of the Colorado Department of Natural Resources.

Numerous Measures Were Taken to Assess the Cleanup's Sufficiency, but DOE Could Improve Its Oversight of Data Quality and Clarify Its Verification Policy

Numerous measures were and are being taken to assess the sufficiency of the cleanup; although these measures appear adequate, DOE did not carry out some aspects of its oversight responsibilities. Cleanup assessment measures include (1) the completion of the CERCLA and RCRA regulatory process, (2) DOE's verification of the contractor's remediation of radiologically contaminated soil, and (3) other reviews by federal agencies and independent consultants. The first assessment measure—completion of the CERCLA and RCRA regulatory review and approval process—relies on remediation data collected throughout the cleanup. Our review showed that the contractor appeared to have comprehensive quality controls for data. Nevertheless, DOE did not independently review the quality of these data. A DOE official said that, while he had no explanation for DOE's not conducting the required reviews, DOE officials' day-to-day review of data did enable them to detect data issues as they arose. The second assessment measure—DOE's verification of the contractor's actions to remediate radiologically contaminated surface soil—was not completed. DOE decided to eliminate parts of the planned independent review of the accuracy of contractor-conducted scans for remaining radiological contamination because DOE officials decided that the likely results would not justify the completion of an independent review. The third assessment measure—outside reviews—included a consultant review that convinced DOE to revise a key water management strategy at the site, and a federal review that found no public health hazard for the communities surrounding Rocky Flats.

DOE Did Not Independently Review the Quality of Cleanup Data Crucial to the Regulatory Process

DOE did not independently review the quality of the data obtained throughout the cleanup—data crucial to the first assessment of the cleanup's sufficiency, the CERCLA and RCRA process. As discussed earlier, the final steps of this regulatory process are still in progress,[45] but much of the process is complete. Key data were obtained through a four-step process of remediating 360 individual areas at Rocky Flats, and EPA and Colorado documented their approval of these cleanups in closeout reports, giving DOE officials confidence that the site will meet the final cleanup requirements. The closeout reports also include data on residual contamination (i.e., the contamination that remains following completion of the cleanup action). The residual contamination data were analyzed in a

[45]As discussed earlier, the regulatory agencies anticipate issuing the final decision document at the end of 2006.

draft comprehensive risk assessment that was part of the remedial investigation/feasibility study, which determined that the site's overall risk falls within EPA's acceptable risk range. Because the data from the accelerated actions are crucial to the regulatory agencies' final decision on the sufficiency of the cleanup, we reviewed the controls in place to ensure the quality of these data. We discussed these data quality policies and procedures with DOE, EPA, Colorado, and contractor and subcontractor officials and determined that, although the contractor's data quality controls appeared robust and comprehensive, DOE could improve its oversight of them. Further, our review of several closeout documents revealed that the policies and procedures were generally followed.

Soil Cleanup Actions Followed a Four-Step Process

At Rocky Flats, accelerated soil cleanup actions were generally completed and approved through a four-step process.[46] As of May 2006, EPA and Colorado officials said they had approved the closeout reports on all 360 areas of known or suspected contamination at Rocky Flats and had concluded that no further accelerated cleanup actions were necessary for those areas.[47] Closeout reports are the last step of a regulatory approach that documented the accelerated cleanup actions taken, quantified contaminants remaining after the cleanup actions were completed, and documented whether the project goals had been met. The remediation of each area of soil contamination at Rocky Flats followed a four-step process: characterization, contaminant remediation, confirmation sampling, and clean fill and project documentation.

The first step—characterization—identified whether contamination had occurred. The contractor had to design a sampling and analysis approach for each specific cleanup area and receive DOE's approval before submitting the approach to the regulatory agencies for their review and

[46]Much of the contamination at Rocky Flats was confined to the soil. Hazardous and radioactive waste was buried in trenches, and soil in areas where spills or leaks had occurred was contaminated with solvents and other hazardous chemicals.

[47]Our references to closeout reports include data summary reports, which were prepared and approved in lieu of closeout reports if no cleanup was necessary at a cleanup area.

approval.[48] Once a potentially contaminated area was identified, the contractor would propose one of several approaches to collect the necessary samples. For example, the contractor might choose a standard statistical sampling approach, which entails designing a sample grid capable of identifying an elevated area of contamination with 90 percent confidence, then applying that grid to the actual cleanup area. Sample collection involved taking small scoops of dirt, which were analyzed in a laboratory for a variety of contaminants such as metals, volatile organic compounds, and radionuclides.

The second step—contaminant remediation—cleans up any contaminants that characterization found to exceed acceptable levels. Again, the contractor would prepare a remediation plan, based on a standardized approach for removing soil,[49] in consultation with EPA, Colorado, and members of the public, for EPA and Colorado to approve. Once approval was granted, the contractor could proceed with the actual cleanup. Cleanup typically involved digging out the contaminated soil, packaging it, and shipping it to a licensed treatment or disposal facility. The depth to which soil was removed varied depending on the type and severity of contamination. In some areas, less than a foot of soil needed to be removed; in other areas, 20 feet of soil needed to be removed. The contractor took samples throughout the remediation to identify when the remediation goal had been met and could then move on to the third step. According to officials of both EPA and Colorado, they frequently directed their staff to observe the cleanup actions to ensure they were being implemented as agreed. Colorado officials said that, while the frequency and duration of their oversight varied by project, daily interaction and observation by Colorado staff was typical.

The third step—confirmation sampling—required taking small scoops of dirt from areas where the contractor believed remediation was complete, and having them analyzed for the presence of previously identified contaminants. The samples could be analyzed at an on-site laboratory or

[48]The characterization approach is documented in a Sampling and Analysis Plan Addendum. Occasionally, when schedule concerns existed and the planned work was routine in nature, DOE allowed the contractor to send draft documents to the regulatory agencies while DOE was reviewing them.

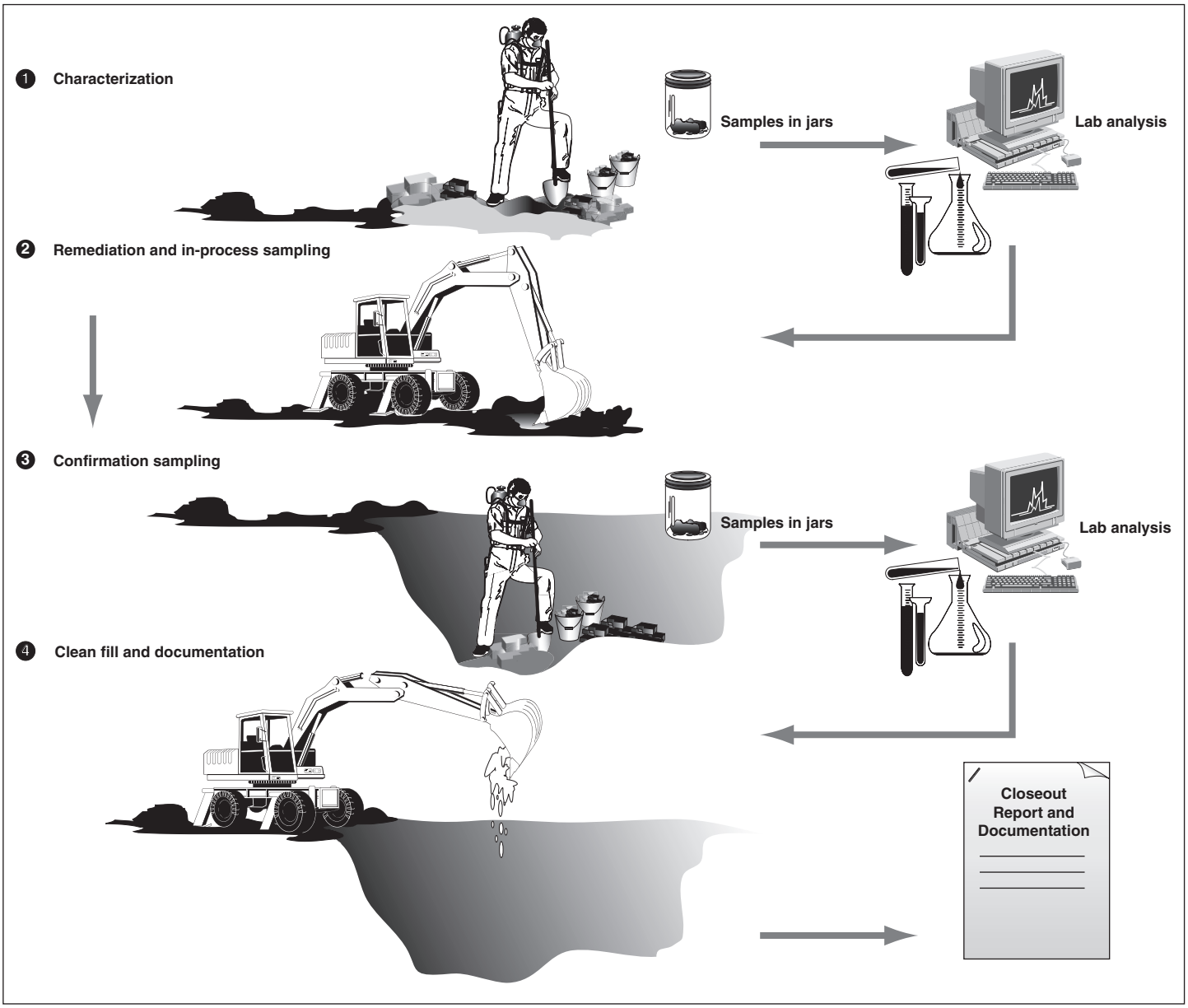
[49]Depending on the complexity and the time required to complete the remediation, the remediation plan was set forth in an interim measure/interim remedial action, a proposed action memorandum, or a Rocky Flats Cleanup Agreement standard operating protocol.

sent off site, depending on the types of contaminants. If the laboratory confirmed that the contaminants had been removed to an acceptable level, the contractor could move on to the next step. If the laboratory results showed an unacceptable level of contaminants, then additional soil would be removed, followed by additional confirmation sampling. Additional soil removal and sampling rarely occurred, however, because field measurements and analyses were used to guide the remediation work before the final confirmation samples were taken.

The fourth and final step—clean fill and project documentation—included filling the excavated area and preparing a closeout report that documented that the cleanup had met the stated goals and quantified any residual contamination. The contractor generally filled the excavated area with Rocky Flats alluvium, a mixture of sand, dirt, and gravel. Documentation of residual contamination was important to the regulatory process because these data were instrumental in completing the remedial investigation and feasibility study, including the comprehensive risk assessment.[50] After DOE approved the closeout report, it was delivered to the regulatory agencies for final approval. The regulatory agencies' approval meant that the cleanup was sufficient and that no further accelerated action was needed. This four-step remediation process is illustrated in figure 11.

[50]The comprehensive risk assessment, prepared under CERCLA and included in the draft remedial investigation and feasibility study, is an evaluation of the potential adverse impacts to human health and the environment that may exist from contaminated environmental media associated with site-related activities. See 40 C.F.R. § 300.430(a)(2).

Figure 11: Four-Step Remediation Process for Individual Areas of Known or Suspected Contamination



Source: GAO.

Although soil remediation was the primary cleanup focus at Rocky Flats, some groundwater required remediation for elevated levels of uranium, nitrates, and volatile organic compounds. Three passive systems were installed to treat the contaminants in the groundwater. At one former waste-drum storage area, for example, remediation of a carbon tetrachloride plume, along with other volatile organic compounds, involved excavating about 700 cubic yards of contaminated soils, treating them through thermal desorption,[51] and then constructing a passive treatment system that uses iron filings to cleanse contaminants from the groundwater. Figure 12 shows the cleanup of a plume of carbon tetrachloride and other volatile organic compounds (VOC) that originated from a waste-drum storage area at Rocky Flats.

[51]Thermal desorption is a remedial technology that uses heat to physically separate (desorb) volatile organic compounds (VOC) from excavated soils. As the soils are subjected to high heat (e.g., 900 degrees Fahrenheit), the VOCs change into gas (vapors) and evaporate out of the soil. Essentially, the process involves collecting the vapors and further heating them (to as much as 1,800 degrees), which causes oxygen to react with the hydrogen and carbon in the VOC vapors, forming water and carbon dioxide. Hydrochloric acid is also formed from the chlorine in the VOCs. The carbon dioxide, water, and hydrochloric acid are then neutralized, forming water and salt. The treated soils are tested to ensure that they meet cleanup objectives; the soils can then be returned to the excavation area.

Figure 12: Treatment of Contaminated Soils by Thermal Desorption; Installation of a Passive Treatment System at the Mound Storage Site, Rocky Flats

Source: DOE.

Because of the tendency of plutonium and americium particles to cling to soil, a primary concern among stakeholders was the potential off-site transport of soil contaminated with plutonium and americium via surface water. Contaminated soil washes into ditches and streams when it rains or snows. Accordingly, cleanup efforts have focused on the surface soils to reduce the source of radionuclides that could be susceptible to erosion and eventual transport off site via Walnut and Woman Creeks. Also, surface water is managed and monitored both on site—through a series of holding ponds—and at the points where it leaves the site. The ponds, which DOE constructed decades ago to retain any major release during operations, are used to ensure that water leaving the site meets all applicable water quality standards.[52] DOE operates the final pond in each series as a "batch and release" system; that is, releases from those ponds occur only after water sampling has confirmed that the water meets water quality standards. The

[52]The ponds were not constructed as a remedial action; rather, they are historical features of the site that were left in place and serve as insurance that contaminated surface water does not leave the site. Further, they serve as excellent flood control mechanisms. One of the objectives of the cleanup is for all surface water on site to meet Colorado water quality standards. Rocky Flats currently has a waiver—for nitrate, nitrite, and organic parameters—in one stream segment; that waiver will expire in 2009.

efficacy of the accelerated cleanup actions taken to protect water quality will be evaluated in the remedial investigation/feasibility study. Figure 13 shows the terminal pond in one series.

Figure 13: Terminal Pond in the B Series of Ponds

Source: GAO.

Draft Comprehensive Risk Assessment Concluded That Residual Risk Is Acceptable

The draft sitewide comprehensive risk assessment, one of several documents that will contribute to the final regulatory decision on the sufficiency of the Rocky Flats cleanup, concluded that the cumulative remaining risk to human health and the environment at Rocky Flats is acceptable. The draft comprehensive risk assessment—part of the larger remedial investigation and feasibility study—concluded that the cumulative risk to human health, after completion of the accelerated cleanup actions, falls at the more protective end of EPA's "excess cancer

rate" risk range of between 1 in 10,000 and 1 in 1,000,000.[53] This is the range that EPA considers to be adequately protective of human health.

As discussed previously, the Rocky Flats cleanup was designed so that any residual contamination after completion of the accelerated cleanup actions would be documented in closeout reports and subsequently analyzed in accordance with the exposure assumptions in the sitewide comprehensive risk assessment. The comprehensive risk assessment incorporated approximately 2 million data records and examined both human and ecological risk. Specific tasks included

- identifying remaining contamination at Rocky Flats and determining whether it can adversely affect humans, animals, or plants;
- determining whether pathways exist whereby human or ecological receptors may come into contact with these contaminants, for example, through inhalation or ingestion of surface water;
- assessing the contaminants' potential effects, including cancer, on the human and ecological receptors, where complete pathways exist; and
- calculating the potential risk to the human and ecological receptors, based on the pathways and the levels and toxicity of the contaminants.

The human health risk assessment calculated the risk that residual contaminants posed to wildlife refuge workers and visitors. The assessment identified five residual contaminants at the site that could affect human health, including plutonium located adjacent to the most contaminated precleanup areas of the site. The risk model assumed that the primary pathways for plutonium were either through inhalation or through skin contact. Based on assumptions about how frequently a wildlife refuge worker would be exposed to residual plutonium at the site, the model calculated an EPA acceptable risk of 1 in 500,000 excess cancers, and an even lesser risk for a refuge visitor.

The ecological risk assessment estimated the risk that exposure to any residual contaminants would pose to species of concern, including the

[53]For example, an excess cancer rate of 1 in 1,000,000 means that, given exposure to the residual contamination at Rocky Flats at the end of the cleanup, one would expect only one additional (excess) cancer than would normally be expected in a million people.

Preble's Meadow jumping mouse, a protected species. After modeling risks to selected terrestrial and aquatic species, the risk assessment concluded that the residual contaminants at Rocky Flats do not represent a significant risk of adverse ecological effects to these species.

Nearly all respondents to our community group survey expressed confidence in the cleanup's outcome. Specifically, 11 of 25 respondents said they were very or extremely confident that the cleanup will be protective of public health and the environment, and another 12 said they were somewhat confident.

Rocky Flats Cleanup Data Quality Procedures Comprehensive, but DOE's Oversight Was Lacking

One of the most important aspects of the cleanup process was ensuring the validity of the data used to determine whether the site had been remediated to the agreed-upon levels. However, DOE did not complete the independent and management assessments required by the cleanup agreement to ensure that these data quality controls were working as intended. We identified four key data quality controls: establishing data quality objectives, using data quality parameters, verifying and validating data, and auditing laboratories that analyzed samples for Rocky Flats. Our review showed that the contractor generally followed these data quality controls and documented its compliance with them. Appendix IV contains additional information on the four data quality controls and our review of the contractor's compliance with them.

Although the data quality controls the contractor had in place appeared to be robust and comprehensive, DOE did not conduct independent assessments to ensure that this was the case. Specifically, DOE did not conduct the management and independent assessments called for by the quality assurance project plan.[54] A quality assurance project plan describes the planning, implementation, and assessment procedures for a particular project, as well as any specific quality assurance and quality control activities.[55] These independent assessments, according to DOE's *Management Assessment and Independent Assessment Guide*, are intended to measure the adequacy of work performance, among other things. Among the essential areas that should be assessed, according to the

[54]The Rocky Flats Quality Assurance Project Plan is included in the Industrial Area and Buffer Zone Sampling and Analysis Plan.

[55]The required assessments are based on DOE Order 414.1A on Quality Assurance, which directs field managers to perform independent assessments of their contractors to evaluate the adequacy and implementation of their quality assurance plans.

guide, are data quality controls such as calibration controls, computer software controls, and environmental management systems.

DOE's failure to conduct independent assessments is particularly troubling because of the importance of the cleanup and residual contamination data. These data were not only the basis for EPA's and Colorado's approvals of the accelerated cleanup actions, but also the foundation for EPA's and Colorado's pending decisions about the overall sufficiency of the site's cleanup. Without independent assessments of the contractor's data quality control measures, DOE had no assurance that the controls were working as intended. Also troubling was that EPA and Colorado—the regulatory agencies that jointly approved the site's quality assurance project plan and are responsible for ensuring its implementation—were unfamiliar with these assessment requirements. When we discussed with EPA officials DOE's failure to conduct independent or management assessments, they acknowledged that their confidence in the data quality would have been increased had DOE completed these assessments. A DOE official said he had no explanation for DOE's not conducting the required assessments, other than that DOE officials had reviewed sampling and analysis plans, remediation plans, and closeout reports, and discussed with the contractor any data quality issues that arose.

Colorado officials said they reviewed the data and the controls provided by the contractor, which is the state's standard procedure for determining the usability of data provided it, and that DOE's failure to conduct assessments of the data does not affect the decisions made by the state. Colorado noted that it did not have significant issues with the data provided, and that any data issues were resolved using the consultative process, including bringing in experts to discuss and resolve specific issues. In addition, Colorado said, it performed routine independent sampling and analysis of water samples, as well as occasional building samples, which confirmed the data results provided to the state. Accordingly, although DOE assessments might have provided another check on data quality and adequacy, the lack of these assessments had little adverse effect on the quality or usability of the data and does not cloud the results or appropriateness of the site's cleanup.

DOE's Planned Cleanup Verification Not Completed

The second assessment of the cleanup's sufficiency—DOE's planned verification of the contractor's remediation of radiologically contaminated soil—was inconsistent and not completed as planned. DOE policy currently requires radiological cleanup to be verified, but the policy is

unclear about how and why verification should be done. DOE's planned verification for the cleanup at Rocky Flats was twofold: First, DOE asked the contractor to develop a final scanning and sampling plan, and second, DOE asked its Oak Ridge Institute for Science and Education (ORISE) to develop a separate verification plan that included a review of contractor-conducted scans for remaining radiological contamination.[56] However, DOE chose not to complete several of the plan's objectives, including part of ORISE's review. A DOE official said they had decided that these activities would not provide sufficient additional information to justify their completion, but he had no documentation to support this decision. As a result, DOE lost the opportunity to independently verify the sufficiency of several aspects of the cleanup.

The respondents to our community group survey had mixed views on the degree to which the verification activities—in the aggregate—affected their confidence in the site's cleanup. Of the 21 (of 25) who provided responses, 13 said that the verification activities greatly or somewhat increased their confidence in the site's cleanup. Another 8 said the verification activities had no effect or a negative effect on their confidence. The remaining four said they either did not know or had no basis to judge.

DOE Policy Unclear on Application and Purpose of Verification

Although DOE has a general policy on radiological cleanup verification, its guidance is unclear on how the policy applies and what the verification goals are. In January 2001, the Secretary of Energy issued a memorandum that contained guidance on the release of radiological property and directed DOE field offices to "establish independent verification programs" that "should be commensurate with the potential for contamination, as well as the complexity and hazard."[57] Additional DOE guidance on verification is found in other documents, including draft guidance called "Control and Release of Property with Residual Radioactive Material;" this document implements guidance for DOE Order 5400.5, which includes requirements

[56]ORISE is a DOE facility operated by Oak Ridge Associated Universities, a multiuniversity, nonprofit consortium established in 1946. Over the past 2 decades, ORISE has performed radiological surveys and environmental assessments at sites contaminated with hazardous or radioactive materials. ORISE staff include health physicists, environmental specialists, radiochemists, and analytical chemists.

[57]Memorandum 2001-001288, January 19, 2001, Managing the Release of Surplus and Scrap Materials.

for the release of radiologically contaminated property.[58] The draft guidance, which was approved for interim use, includes a section on verification that states that "the DOE organization responsible for the release of property should verify or provide for independent verification of the radiological condition of the property before release." However, the draft neither contains specific guidance about verification techniques nor specifies the goals of verification. Accordingly, it was little help to Rocky Flats officials and may have contributed to the inconsistent implementation of the verification plan.

Lacking clear guidance, DOE's project manager at Rocky Flats said he took a common sense approach that, in his view, fulfills the intent of DOE's policy by cleaning the site up through the CERCLA and RCRA process. That is, he believes that the regulatory agencies' approvals of the radiological cleanup actions at the site constitute independent verification. However, the official acknowledged that there is room for interpretation and disagreement on this issue. Another area of confusion was what the goals of the independent verification should be. At Rocky Flats, DOE officials commissioned a cleanup verification plan that used a different methodology than the one used to implement the cleanup. The result was that while the cleanup verification confirmed that an area had met the standards of the cleanup agreement, it also identified "hot spots" that caused alarm among the public at the end of the 10-year cleanup. The Rocky Flats manager stated that clear guidance on independent verification would have been helpful, especially as to how it related to CERCLA cleanups.

DOE Did Not Fully Implement Its Planned Verification or Explain Its Reasons for Not Doing So

Although DOE agreed to ORISE's final verification plan, DOE did not fully implement it and did not offer a public explanation for its decision. Specifically, ORISE never completed two of its objectives—an assessment of the aerial and ground-based scanning and an assessment of the contractor's investigations of the results of the aerial and targeted ground-based scans. According to a DOE official, DOE decided in mid-September 2005 that it needed to re-evaluate the need for ORISE's work. DOE decided that because the contractor's aerial survey had failed to find any anomalies, ORISE's remaining work was unnecessary. DOE remained unsure about the final outcome of the ground-based scanning but still decided not to ask ORISE to complete the remaining objectives. A DOE official explained that

[58]Draft DOE G 441.1-XX, Control and Release of Property with Residual Radioactive Material, for use with DOE 5400.5, Radiation Protection of the Public and the Environment.

completing the work was not warranted, given the results of the aerial and ground-based scanning. According to an ORISE official, DOE's Rocky Flats Project Office notified ORISE on November 11, 2005, that it would not be asked to complete the remaining objectives. Additional information on DOE's independent verification is contained in appendix IV.

Independent Consultants and Other Federal Agencies Conducted Additional Cleanup Reviews, and Some Influenced DOE's Final Cleanup Strategy

Reviews conducted by independent consultants and other federal agencies commented on cleanup actions, and some reviews influenced the final cleanup strategy, thereby providing additional assurance to DOE and the regulatory agencies that their remedial decisions were correct. Independent consultants, hired by local stakeholder organizations, commented on several cleanup remedies, including surface and groundwater cleanup actions and landfill remediation. Some of these influenced the final cleanup; for example, a study on surface water management called for a specific pond discharge strategy, with which DOE concurred. On the other hand, DOE did not incorporate all comments and suggestions made by independent contractors, such as recommendations on how to close a landfill. Other federal agencies, including the Agency for Toxic Substances and Disease Registry and FWS, also conducted studies, one of which concluded that no health hazard existed for surrounding communities. Another study is still under way.

Several Recommendations from Independent Consultants Were Incorporated into Site Remedies, but Disagreements and Concerns Remain

Independent consultants, hired by local communities or through the Rocky Flats Coalition of Local Governments, conducted technical reviews of cleanup actions and provided recommendations, some of which DOE incorporated into its cleanup plan. The Rocky Flats Coalition of Local Governments sponsored these independent reviews to assure the local governments and the public that the cleanup would meet the regulatory guidelines. Overall, members of the Coalition initiated four technical reviews, which examined groundwater, surface water and pond management, and landfill remediation. The Coalition hired a consultant to comment on DOE's independent verification process.

One instance in which DOE incorporated a recommendation from a consultant involved surface water management. During Rocky Flats' operational days, a series of ponds was constructed as part of a surface water management system to ensure that no contaminated surface water

left the site.[59] As a safeguard to ensure that all water leaving the site meets the state's water quality standards, the water is tested prior to its release. An independent consultant's study raised the concern that DOE was allowing one of the terminal ponds to fill to a high level, thereby diminishing its ability to store large quantities of water should a heavy rainfall occur. Such an event could result in water being released without being tested. The independent review recommended that DOE maintain the pond at a lower capacity as a precautionary strategy, and DOE concurred. Another example was DOE's concurrence with the Coalition consultant's recommendation that ORISE include in its verification plan a 100 percent scan of certain areas to detect any residual contamination that might exceed established cleanup levels.

However, several of the independent consultants' reviews identified points of contention with DOE's ultimate cleanup approach. One area of contention involved the landfill that had been used at Rocky Flats in the 1950s and 1960s. DOE's characterization of the landfill suggested that uranium and volatile organic compounds were present.[60] DOE and the regulatory agencies subsequently agreed to implement an accelerated cleanup action that included buttressing the landfill to prevent the waste from slumping into Woman Creek; regrading parts of the landfill, which is located on a hillside, to prevent erosion; placing 2 feet of soil atop the surface to isolate the contaminants; installing storm water management berms to divert surface flows to perimeter channels; and seeding the entire cover, buttress, and channels with native grass species. An independent review disagreed with several aspects of this accelerated action, including that it did not include a biointrusion layer; these layers inhibit the ability of burrowing animals like mice and prairie dogs to bring contaminants up to the surface, where people at the site might be exposed to them. DOE and Colorado felt that a biointrusion layer was unnecessary because the accelerated cleanup action met the legal requirements for landfill closure, and the observed environmental conditions indicated that the landfill posed only a minimal risk. EPA added that the issue of biointrusion was examined during the remedy's design, with the conclusion that the steep slope (18 percent), combined with the native grass cover, would not be attractive habitat for burrowing animals. In the end, a biointrusion layer was not included in the landfill cover. Monitoring of Woman Creek and

[59]These ponds were not constructed as part of the CERCLA remedy.

[60]According to the contractor, four uranium hot spots were removed in July 2004.

wells will continue at locations both upgradient and downgradient of the landfill to ensure that no contaminants are escaping from the landfill.

Other Federal Reviews Concluded Minimal Risk or Are Still Under Way

The Agency for Toxic Substances and Disease Registry (ATSDR), part of the Department of Health and Human Services, conducted a public health assessment that concluded that Rocky Flats poses no health hazard.[61] Specifically, ATSDR concluded that the Rocky Flats data present a consistent picture that local residents' current and future exposures to contaminants from Rocky Flats are below levels associated with adverse health effects. ATSDR officials conducted their own data reliability tests on the site's data and concluded that the data were adequate to make public health decisions. The officials then assessed the contaminant pathways at Rocky Flats, including soil, air, and surface water and groundwater and concluded that environmental contamination at Rocky Flats posed no apparent public health hazard to surrounding communities. (However, ATSDR did not evaluate the health implications for people within the boundaries of Rocky Flats.) ATSDR offered several recommendations on how to ensure that the site's contamination will not pose a future risk to residents of surrounding communities, including continued monitoring of surface water along the eastern boundary of the site and groundwater wells. DOE is not required to officially respond to the ATSDR recommendations, but reported that the recommendations had already been included, or were under discussion with the regulatory agencies for inclusion, in the postclosure monitoring and maintenance plans.

Additionally, as discussed previously, the 5-year reviews required by CERCLA will continue to compile information about whether remedies at the site continue to fully protect human health and the environment. The first 5-year review, completed in 2002,[62] included areas of the site for which final decision documents (i.e., corrective action decisions/records of decision) had been completed, as well as areas where accelerated cleanup actions had been completed as of September 30, 2001. At that time, final

[61]ATSDR was established by CERCLA in 1980—CERCLA § 104(i); 42 U.S.C. § 9604—and, since 1986, has been required to conduct public health assessments of sites on CERCLA's National Priorities List— CERCLA § 104(i)(6); 42 U.S.C. § 9604(i)(6). In conducting a public health assessment, ATSDR officials review environmental data and assess pathways, or how individuals might come into contact with the contaminants, and whether such contact would result in any health effects.

[62]Department of Energy, Rocky Flats Field Office, *First Five-Year Review Report for Rocky Flats Environmental Technology Site*, *Golden*, *Colorado* (Golden, Colo., July 2002).

decision documents had been completed for two areas (the 881 hillside and the off-site areas), and accelerated cleanup actions had been completed at several areas. Among the completed accelerated actions were the removal and, as necessary, treatment of contaminated debris and soil at several trenches; the installation of three groundwater treatment systems; the removal of contaminated sludge from solar evaporation ponds; and emptying and treating the contents of six underground storage tanks. The review concluded that the remedies for these two areas were protective and that the accelerated actions had addressed immediate hazards and were generally functioning as intended. The review of the off-site areas, though not required under EPA guidance,[63] was nonetheless conducted because of the substantial public interest in those areas. The off-site areas did not have a defined boundary, but rather referred to off-site contamination emanating from Rocky Flats in general, including surface contamination of lands to the east of the site, along with the Great Western Reservoir, Standley Lake, and Mower Reservoir. The review concluded that all calculated excess cancer risks in the entire unit were well within or below EPA's acceptable risk range of 1 in 10,000 to 1 in 1,000,000.

Also, FWS sampled areas at Rocky Flats that are likely to become part of the future wildlife refuge. Prior to any transfer of land management authority to FWS, FWS typically surveys the property to identify any potential hazardous substances that pose a threat to fish and wildlife. In May 2006, consistent with its survey plan, FWS took 45 soil samples (including four duplicate samples), mostly along proposed trails as indicated in the Comprehensive Conservation Plan for the refuge. The samples will be examined for a range of potential contaminants, including metals, radionuclides, organics, and polychlorinated biphenyls, commonly referred to as PCBs. FWS took an additional 12 vegetation samples (including one duplicate sample), principally to ensure that any future prescribed burns will be safe. An FWS official said that the results of the laboratory analyses of the samples are due in early July, at an estimated cost of $70,000. If the results identify contaminants that concern them, FWS officials will notify DOE, EPA, and Colorado; the agencies will then determine what steps would need to be taken.

[63]EPA's 2001 Comprehensive Five-Year Review Guidance requires 5-year reviews of remedial actions resulting in any hazardous substances, pollutants, or contaminants remaining above levels that allow for unlimited use and unrestricted exposure. The contaminants remaining in the off-site areas were at low enough levels to allow unlimited use and unrestricted exposure.

DOE Implemented Some Lessons Learned at Rocky Flats but Has No Requirement to Ensure That Lessons Learned Are Implemented at Other Sites

Although DOE has identified and implemented at other cleanup sites some lessons learned at Rocky Flats, DOE does not require applicable lessons learned at one cleanup site to be implemented at others. The Rocky Flats project offers many lessons about innovative techniques, risk- and cost-sharing contract provisions, accelerated cleanup processes, involvement of community groups, oversight of contractor controls over data quality, and cleanup verification processes. However, DOE has not developed a system to ensure that all lessons are captured and implemented as appropriate at other DOE sites. As a result, DOE may be missing valuable time- and cost-saving opportunities at other sites that are planning or undergoing cleanup.

DOE Identified Lessons from Rocky Flats and Assessed Their Applicability to Other Sites

DOE has gathered and disseminated to some other DOE sites numerous lessons learned at Rocky Flats. These lessons included the following:

- Clearly define government oversight of the contractor, and limit the number of DOE personnel providing direction.
- Conduct external reviews of the project baselines to build credibility and provide objective recommendations for project improvement.
- Use employee incentives to reward high-performing individuals.
- Use a flexible project management approach that allows the contractor to complete the project in the safest and most cost-effective manner.
- Establish a clear “end state” vision and risk-based cleanup defined in conjunction with specific future land/site use.
- Develop and use an integrated project baseline schedule and budget.
- Use government-furnished services and items to integrate and manage the delivery of items not within the contractor’s control.
- Implement new technology that significantly accelerates the schedule and reduces total costs, such as techniques for reducing the number of radioactive waste shipments off site for disposal.

In October 2002, DOE authorized a corporate review team to determine the effectiveness of DOE cleanup efforts. In 2003, the team reviewed work

activities, management processes, and contract administration practices at selected sites, and used a checklist of more than 50 lessons learned at Rocky Flats to assess their applicability and potential benefits to each site. The review team issued nine reports with findings and recommendations. With the exception of one report, which was part of the preliminary review effort, each report also included the team's determination of whether the lessons on the checklist applied to the sites, and the progress the sites had made toward implementing applicable lessons learned.

DOE Lacks a System for Ensuring Continued Collection and Implementation of Lessons Learned at Its Cleanup Sites

During 2004 and 2005, DOE's Office of Performance Assessment conducted follow-up reviews of many of the sites the corporate review team had reviewed earlier. These follow-up reviews, however, did not assess whether the sites had implemented the lessons learned from Rocky Flats. According to the DOE official responsible for tracking the status of these reviews, DOE does not require sites to implement applicable lessons from Rocky Flats (or from other cleanup sites). Instead, he said, each site is responsible for tracking its implementation of these lessons. Although he said he believes the sites are taking steps to implement those lessons and are continuing to improve their systems for managing cleanup, he had no documentation to support his conclusions.

DOE's Office of Performance Assessment reviewed lessons learned at Rocky Flats in the March 2004 and June 2005 Rocky Flats baseline performance review reports. In the 2004 report, DOE noted that valuable information and processes from Rocky Flats should be available to other sites that are beginning the cleanup process. The report noted that DOE's Rocky Flats office had begun a program to archive project cost information that could be used to prepare cost estimates for future contracts at other sites, and recommended that the office develop a database that identifies the number of personnel and time durations required to perform specific cleanup tasks. According to the Rocky Flats DOE manager, the cost-archiving program continued to provide periodic information updates, and provided the final download of project data to DOE's Office of Engineering and Construction Management in December 2005. The 2005 Rocky Flats baseline performance review report included 30 additional lessons learned at Rocky Flats. Among these were improved contract language that established a close working relationship between DOE and the contractor, made measurement of progress easier, and reduced the need for contract changes; improved safety processes at the site; consolidated procurement functions; and streamlined methods for handling and shipping radioactive waste and disposing of excess property. One of the lessons identified in the

2005 report actually resulted from a request from another cleanup site. A DOE official in the Office of Performance Assessment told us that officials at DOE's Office of Environmental Management visited Rocky Flats in 2005 to document lessons learned from the demolition of a plutonium-processing building. They visited Rocky Flats at the request of DOE officials at the Savannah River site who were designing a similar facility and sought information from the Rocky Flats demolition that might improve the design of their building.

Although DOE has a database of environmental safety and health lessons, it does not have a database of broader lessons learned across the DOE complex. DOE has a nationwide database managed by the Society for Effective Lessons Learned Sharing, a volunteer DOE organization dedicated to identifying, sharing, and using lessons learned in order to improve the safety, efficiency, and effectiveness of DOE work processes. These lessons focus primarily on individual safety incidents and how to prevent their recurrence. However, the database generally does not capture lessons dealing with broader issues such as contract management, pricing, and working with regulatory agencies. Consequently, DOE may not be maximizing the use of valuable information that could save time and money.

DOE's Office of Engineering and Construction Management commissioned a study in the fall of 2003 to correlate components of project performance with project success, and identify best practices to improve DOE project performance. The July 2004 report on the study's findings identified many factors that influenced the success of DOE projects, including the importance of an effective lessons learned program. The report did not examine the effectiveness of DOE's lessons learned programs, but it noted examples at DOE where lessons were effectively transferred from one project to another. It concluded that

> "DOE Headquarters has a responsibility to assure that such lessons are being transferred across sites with similar facilities. Sharing lessons learned needs aggressive attention; without it valuable savings are lost and frustrations compounded. Lessons learned are useful for mitigating risk and providing training material for project directors/managers.[64]

[64]Civil Engineering Research Foundation, *Independent Research Assessment of Project Management Factors Affecting Department of Energy Project Success* (Reston, Va., July 12, 2004).

The report also recommended that DOE proactively encourage the sharing of lessons learned. According to a DOE headquarters official, a national database of lessons learned from closure sites would allow DOE to proactively share experiences that would benefit future closure operations.

Rocky Flats Offers Additional Lessons That May Be Applicable to Other DOE Sites

During our review, we gathered additional lessons learned at Rocky Flats that could be useful for other DOE sites. These lessons include the following:

- **Safety is a priority.** According to DOE officials, this lesson was reinforced throughout Rocky Flats' cleanup. Early in the cleanup, DOE officials recognized that a significant investment in hazard identification, safety planning, and safety implementation (i.e., the integrated safety management system) during the actual work would ensure that the work was performed without unacceptable risks or unnecessary delays. Later, DOE officials said they came to understand that this focus on safety not only helped work progress, but also facilitated efficiency by building trust and engaging the workforce. Safety was both consistent with, and essential to, effective project execution.

- **Performance-based contract incentives improve results.** According to DOE officials, the first contract they had with Kaiser-Hill demonstrated that attaching incentives to clearly defined performance measures vastly improved actual results. The 2000 contract took the concept to the next level, providing large incentives to the contractor and the workers to safely and compliantly complete the cleanup within the target schedule and cost. The additional incentives for schedule and cost savings resulted in closure more than a year ahead of schedule and $530 million under budget. However, as previously noted, such incentives are not always this successful, and the financial incentive offered at Rocky Flats was only one of many factors contributing to the cleanup's early completion.

- **Take a consultative approach to cleanup decisions.** As previously discussed, the collaborative process was essential to the cleanup's early completion. According to DOE officials, the cleanup was successful because all of the stakeholders were engaged in the process and supportive of the ultimate goal. The input of numerous key figures, including members of Congress, senior DOE managers, state and local elected officials, and officials of federal and state regulatory agencies,

was actively solicited and ultimately met with the convergence of the cleanup agreement, the contract, and the desired end state. DOE officials said they communicated openly and often with stakeholders to seek the best solutions, and they came to value input from formerly dogmatic opponents. Moreover, Colorado, EPA, DOE, and the contractor worked closely together on cleanup decisions from the beginning through the end. As cleanup proceeded on an area, Colorado had access to meetings and detailed information about the cleanup. In the event that Colorado or EPA considered a particular activity to be unsafe, the Rocky Flats cleanup agreement granted them the authority to stop work.

- **Don't let unresolved issues delay progress.** DOE officials said that if they had focused on what they could not do or delayed work until all questions were answered, the project would not have been completed and the target completion date would probably still be in question. Colorado officials emphasized, however, that this does not mean that work progressed without the appropriate approvals from Colorado and EPA. It is Colorado's understanding that the consultative process, with all of its oversight and meetings to discuss activities and issues, ensured that all issues were addressed and resolved in a timely manner before activities occurred.

- **Obtain stable project funding.** As discussed earlier, consistent project funding was a key factor in the cleanup's early completion. According to DOE and EPA officials, congressional and departmental commitment to stable funding over the life of the project aided tremendously in project planning and execution. Also, the stable funding helped in regulatory interactions and credibility with the general public.

- **Involve the future site manager in remedial decisions.** According to FWS, when a former DOE site is considered for conversion to a wildlife refuge, it is "vastly preferable" for FWS to be involved early in the cleanup process and have a decision-making role. DOE officials agreed and said they have actively involved FWS since passage of the Refuge Act. According to DOE officials, FWS substantially influenced cleanup decisions, even in areas of the site that will not become part of the future refuge. For example, they said, FWS's input effected a major change in the cover design for the present landfill. Additionally, FWS influenced the composition of the revegetation seed mixes sitewide and the methods of protecting sensitive habitat and endangered species. But

DOE did not incorporate all of FWS's suggestions, such as characterizing and disposing of waste in the original landfill, incorporating barriers around landfills to discourage intrusion by burrowing animals, and using irrigation and soil amendment to enhance the success of seeded native vegetation. According to DOE officials, the two agencies' different perspectives on cleanup methods highlight the difficulty of coordination between two federal agencies that have different missions. These difficulties can persist even when staff of the two agencies are collocated and interact daily, as was the case at Rocky Flats. In retrospect, DOE officials said, it would have been better to recognize that difficulty early and obtain an executive–level consensus on the vision for the outcome.

- **Be aware of potential beryllium contamination.** According to a senior contractor official, beryllium was "ubiquitous" at the site; it was found even in containers of metals and oxides. In terms of worker safety, beryllium was more of a predemolition challenge than other contaminants because there is no effective way to monitor beryllium on a real-time basis.

- **Question accepted technologies.** The contractor was able to save substantial money and time at Rocky Flats by questioning the usual disposal and remediation processes. For example, the accepted practice was that a glovebox or any part of one was, by definition, transuranic waste. However, the contractor found a way to decontaminate gloveboxes and dispose of them much more easily and less expensively as low-level waste. According to a senior contractor official, this particular technical lesson learned at Rocky Flats may be applicable to DOE's cleanup work at the Hanford site.

- **Contain contaminated water.** According to an official with the Colorado Department of Public Health and Environment, lessons learned at Rocky Flats included the importance of ensuring that there are no underground drainage systems or conduits when large amounts of water are used during a cleanup. This lesson stemmed from an unfortunate experience in the cleanup of building 771, when water used in decontamination efforts seeped into underground conduits that had not been adequately plugged. The water flushed contaminants through the conduits, resulting in elevated levels of americium in one series of ponds at the site. This turned out to be an expensive lesson, as the contractor had to bring in equipment and treat about 26 million gallons of americium-contaminated water.

Although DOE captured and implemented at other sites some of the lessons it learned at Rocky Flats, others risk being lost. For example, contractor and DOE officials said that at Rocky Flats, and at other cleanup sites, many lessons that could be gleaned from records and data will be lost if not recorded, summarized, or otherwise captured and shared. According to the Rocky Flats manager, an effort termed the "Legacy Project" was begun in 2001 to start collecting the project knowledge and lessons before the institutional memory was lost. This effort continued intermittently through the summer of 2005, drawing upon record documents, working papers, and personal experience. Also, DOE Rocky Flats officials said that officials of DOE's Legacy Management office in Grand Junction, Colorado, had shared with them lessons learned from the Grand Junction office's experience working with the long-term management of sites formerly contaminated by uranium mill tailings. According to the Rocky Flats manager, these lessons will be brought to Rocky Flats as Legacy Management executes its responsibilities for site management and maintenance. As the mission scope of Legacy Management expands, it will continue to carry experience from Rocky Flats to other sites that are transferred to it for long-term care. Also, although DOE officials told us in March 2005 that they were planning a workshop on lessons learned at Rocky Flats in decontamination and demolition, that workshop has not been held. According to the Rocky Flats manager, several technical assist visits occurred with contractor and DOE personnel from sites in Idaho, Ohio, and Washington. These visits were believed to be more focused and efficient than a workshop format. At this time, a general workshop is not planned; however, technical assist and assessment visits to facilitate the sharing of lessons are continuing.

DOE officials at Rocky Flats have drafted the Rocky Flats Closure Legacy report, a lengthy document that captures the 4-year effort of the Legacy Project. It is currently at DOE headquarters for review and comment and is expected to be released in June 2006.

Conclusions

Strong DOE oversight of data quality is important because accurate and complete data are paramount to DOE's, EPA's, and Colorado's decisions about the sufficiency of the Rocky Flats cleanup. At Rocky Flats, DOE placed undue reliance on the contractor to have appropriate data quality controls, and did not complete the required management and independent assessments of the data's quality. Our review showed that the contractor at Rocky Flats appeared to have comprehensive data quality controls, but this does not negate DOE's responsibility to independently monitor and assess

those controls throughout the cleanup. Also, although DOE policies call for independent verification of cleanup results, the applicability of the policies to cleanups conducted under CERCLA or RCRA is unclear. Lacking clear and specific guidance on cleanup verification, DOE officials at Rocky Flats undertook what they thought was a reasonable approach. However, DOE did not complete all of the cleanup verification activities it had planned; it also did not publicly explain its rationale for not doing so. As a result, DOE lost a valuable opportunity to increase public awareness of, and confidence in, the verification results. Ironically, although the verification activities were undertaken to increase public confidence in the cleanup, the results sparked additional questions from the public. Finally, although DOE has implemented at other cleanup sites some of the lessons learned at Rocky Flats, DOE does not require that lessons learned at one site be implemented, where applicable, at other sites. As a result, DOE stands to lose the benefits that such lessons have to offer.

Recommendations for Executive Action

To improve DOE's oversight of cleanup activities, its conduct of cleanup verification activities, and its monitoring of lessons learned at DOE cleanup sites, we recommend that the Secretary of Energy take the following three actions:

- Ensure that DOE independently assesses contractors' controls over data quality.
- Clarify guidance on whether and how to conduct cleanup verification activities.
- Assess the costs and benefits of developing a method to track the lessons learned from cleanup activities at DOE sites across the nation, including methods for determining whether lessons are being applied at applicable locations.

Agency Comments and Our Evaluation

We provided a draft of this report to DOE, Interior, EPA, Colorado, and Kaiser-Hill for their review and comment. DOE, Interior, Colorado, and Kaiser-Hill provided written comments (see apps. V, VI, VII, and VIII, respectively). EPA did not provide official written comments but did provide editorial and technical suggestions, as did the other agencies, that we incorporated, as appropriate.

DOE commented that it found the report to be comprehensive, generally thorough, clear, and well structured. DOE agreed that a robust and effective lessons learned program would be beneficial and said it intends to follow through and revitalize such a program within DOE's Office of Environmental Management. DOE reiterated the importance of teamwork and agency support in accelerating the cleanup of the Rocky Flats site, noting that the regulatory agencies, community groups, and local government organizations worked tirelessly along with DOE and contractor organizations to overcome obstacles. DOE also emphasized that the high priority given the Rocky Flats cleanup within the DOE complex and at the congressional level, together with the provision of level annual funding, was critical to the success of the project.

DOE did not agree or disagree with our recommendations that it ensure independent assessments of data quality and clarify its guidance on cleanup verification. In its specific comments, however, DOE noted that there is direction and guidance on independent verification and other independent assessments, and referenced several documents that provide such guidance. We were aware of these documents and had discussed several of them with DOE officials at the Rocky Flats Project Office, who said the documents were not helpful in guiding their decisions about whether to conduct verification activities or how to ensure compatibility between available verification strategies and the cleanup strategies undertaken at the site.

In its specific comments, DOE also stated that there is an additional regulatory step DOE must take before releasing the site to the Department of the Interior, pursuant to the requirements of DOE Order 5400.5 governing the release of real property with residual radioactive material. DOE suggested that we reference this regulatory requirement in the report section dealing with additional steps to be taken. We did not adopt this suggestion because our report's discussion of regulatory steps focused on those that remain to be taken by EPA and Colorado, the regulatory agencies at the site. We do, however, reference DOE Order 5400.5 and its draft implementing guidance in our discussion of cleanup verification activities. We noted that the draft implementing guidance neither contains specific guidance about verification techniques nor specifies the goals of verification and, consequently, was little help to Rocky Flats officials and may have contributed to the inconsistent implementation of the verification plan.

The Department of the Interior generally agreed with the information that pertains to the Fish and Wildlife Service. The department said that at this point, it is unable to determine when Rocky Flats will be open to the public, due to the uncertainty of the completion of the transfer of the site. We incorporated the department's suggestion that we focus on the transfer of administrative jurisdiction from DOE to the department rather than focusing on when the public may access the Rocky Flats National Wildlife Refuge. Also, as the department suggested, we clarified the discussions of actions EPA must take to facilitate the transfer and the acquisition of privately owned mineral rights.

Colorado commented that the report provides an appropriate recognition of issues and actions occurring during the remedial activities at Rocky Flats. Colorado emphasized that it has been an integral participant in Rocky Flats' cleanup and closure; it provided continual in-depth regulatory oversight of the investigative and remedial activities for both building decontamination and demolition and environmental restoration. Colorado cited the dedicated efforts of its staff, along with the consultative process, as expediting completion of an accelerated cleanup that resulted in significant cost savings for DOE and for U.S. taxpayers.

Kaiser-Hill commented that the report was thorough, well-written, and accurate in its description of Kaiser-Hill's role in the cleanup of Rocky Flats. Kaiser-Hill agreed with the report's focus on the contribution of Kaiser-Hill's workforce, and stated that the incentive contract played an important role in the success of the cleanup project. Kaiser-Hill noted that the success of the project was also due to the cooperative decision-making process that evolved among DOE, Kaiser-Hill, EPA, Colorado, and local communities, aided by a firm political commitment to accelerate the cleanup.

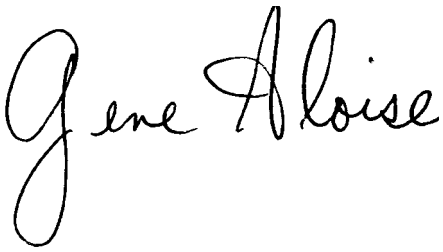
Kaiser-Hill said it believes that the report's calculation of the total cost of the cleanup is misleading because it includes tangential costs such as health and pension benefits, which alone add about $1 billion to the cost reported. Kaiser-Hill noted that a significant portion of these benefit costs were accrued by previous contractors. Kaiser-Hill acknowledged, however, that such costs represent financial obligations to the taxpayer. For our purposes, inclusion of these costs was necessary to report total costs of the cleanup since 1995, including long-term costs.

Additionally, Kaiser-Hill commented that because the final disposition of trench T-7 (the fourth individual cleanup project we reviewed in depth)

required only minimal cleanup, it was completed through the standard "no further accelerated action" justification process. According to the contractor, the justification documentation for such areas (those requiring minimal cleanup) should include information on data quality and adequacy, but not at the same level of detail as was required for other cleanup areas. We recognize that areas closed out through the "no further accelerated action" process may not necessitate the same level of data quality documentation as other areas. Nevertheless, the Rocky Flats Cleanup Agreement requires that the justification documentation for "no further accelerated action" areas include information on data quality and usability. The documentation we reviewed for trench T-7 did not include such information.

We are sending copies of this report to the Secretaries of Energy and the Interior, the Administrator of the Environmental Protection Agency, the Executive Director of the Colorado Department of Public Health and Environment, the President and Chief Executive Officer of Kaiser-Hill Company, interested congressional committees, and other interested parties. We will also make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or aloisee@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix IX.



Gene Aloise
Director, Natural Resources
and Environment

Objectives, Scope, and Methodology

Our review objectives were to determine the (1) factors that contributed to the early completion of the physical cleanup at Rocky Flats; (2) work remaining as well as total project costs, including long-term costs; (3) measures in place to assess whether the cleanup achieved a level of protection of public health and environment consistent with the Rocky Flats Cleanup Agreement; and (4) lessons the Rocky Flats project may hold for other Department of Energy (DOE) cleanup projects.

In conducting our work, we visited the Rocky Flats site and reviewed documents and data prepared by DOE, the Environmental Protection Agency (EPA), the Colorado Department of Public Health and Environment (Colorado), the Department of the Interior's Fish and Wildlife Service (FWS), the contractor, and various scientific organizations. We also interviewed officials of these entities.

To determine the factors that contributed to the physical cleanup's early completion, we interviewed DOE, EPA, Colorado, and contractor officials and reviewed agency and contractor documents on cleanup accomplishments and techniques, project activity reports, and decontamination and demolition accomplishments. Information on innovative cleanup techniques is presented in appendix III.

To determine the work remaining as well as total project costs, including long-term costs, we reviewed documents and data prepared by DOE, EPA, Colorado, FWS, and the contractor, and interviewed officials of these entities. We reviewed documents and discussed issues pertaining to the cleanup requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), and the Resource Conservation and Recovery Act of 1976, as amended (RCRA). We also reviewed documents and discussed issues pertaining to the plans for the Rocky Flats National Wildlife Refuge, cost records and estimates, and pension plan provisions. We also analyzed documents related to the cost-plus-incentive-fee contract, including contract negotiation documents, the contract cost and fee structure, and contract modifications, but we did not evaluate the cost-effectiveness of the contract.

To determine the measures in place to assess whether the cleanup would achieve a level of protection of public health and environment consistent with the Rocky Flats Cleanup Agreement, we reviewed documents and discussed issues pertaining to cleanup verification strategies and results. We also reviewed scientific analyses, such as a study of how contaminants migrate through soil and water and an assessment of the public health risk

posed by contaminants remaining at the site. We reviewed the general content of these analyses but did not evaluate the science underlying them.

In addition, because decisions about the sufficiency of the cleanup have been and will be based on remediation data, we assessed the soundness of the agencies' and contractor's processes and procedures for ensuring data quality. We visited the subcontractor that performed data verification and validation activities, and we reviewed the results of audits of the key laboratories used by the contractor to analyze samples of radioactively contaminated soil.

We also selected a nonprobability sample of four accelerated cleanup actions, based on several criteria, including whether EPA or Colorado was the lead regulatory agency and whether the contamination was in the surface soil or under contaminated buildings.[1] Because radionuclide contamination was the primary concern at the site, we selected cleanup actions of plutonium-contaminated soil. For each selected cleanup action, we reviewed data quality controls pertaining to data quality objectives, data quality parameters, and data verification and validation. We did not evaluate the remedial data or analyses themselves. Information on our data quality review results and details of DOE's verification activities are presented in appendix IV.

To determine the lessons the Rocky Flats project may hold for other DOE cleanup projects, we reviewed information and interviewed officials of DOE, EPA, FWS, Colorado, and the contractor about lessons learned at Rocky Flats and other sites. We reviewed documents related to and reports from DOE's Society for Effective Lessons Learned Sharing database, and we interviewed DOE officials involved in various efforts to capture and disseminate lessons learned (from Rocky Flats and elsewhere throughout the DOE complex).

Further, to obtain citizen views about issues such as community input to the cleanup and the effect of various cleanup verification activities, we attended monthly meetings of the two local community groups that served in an advisory capacity to DOE: the Rocky Flats Citizens Advisory Board and the Rocky Flats Coalition of Local Governments. We also surveyed

[1]Results from nonprobability samples cannot be used to make inferences about a population, because in a nonprobability sample, some elements of the population being studied have no chance or an unknown chance of being selected as part of the sample.

current and past members (and current staff) of these two groups to obtain their opinions on questions such as how DOE engaged the groups in the cleanup process, how DOE used the groups' input, how satisfied or dissatisfied they were with the cleanup's results, and the degree to which DOE's cleanup verification activities affected their confidence in the cleanup. We pretested the survey twice and revised the questions accordingly. We documented the responses and verified 100 percent of the documentation. Response rates and summary responses are presented in appendix II.

We conducted our work in accordance with generally accepted government auditing standards from March 2005 through May 2006.

GAO Survey Methodology, Response Rates, and Summary Responses

To obtain citizen and local government views on the Rocky Flats cleanup, we surveyed current (as of December 2005) and past members and current staff of the two local community groups that served in an advisory capacity to DOE: the Rocky Flats Citizens Advisory Board and the Rocky Flats Coalition of Local Governments.[1] The survey included questions about how DOE engaged the groups in the cleanup process, how DOE used the groups' input, what level of confidence group members had in the cleanup's results, the degree to which DOE's cleanup verification activities affected their confidence in the cleanup, and any remaining concerns they might have.

Survey Methodology

We designed the survey questions to elicit clear and unbiased responses. We pretested the survey twice and revised questions accordingly. We transferred the survey responses into a spreadsheet and the comments into a narrative document; we then verified that 100 percent of the information was transferred accurately from the individual surveys.

In total, we sent surveys to 58 members (current and past).[2] We obtained group members' e-mail addresses (or mailing addresses, when e-mail addresses were not available) from the directors of the Rocky Flats Citizens Advisory Board (Advisory Board) and the Rocky Flats Coalition of Local Governments (Coalition). After e-mailing the survey, we e-mailed two reminder notices to encourage members to respond. Additionally, we attended both groups' January 2006 meetings and personally encouraged members to submit their surveys.

Survey Response Rates

We received a total of 25 responses, or 43 percent of the total surveys sent. By subgroup, however (e.g., current members of one group, past members of one group), response rates varied widely. For example, the response rate for current members of the Advisory Board was 71 percent, whereas the

[1]The Rocky Flats Citizens Advisory Board and the Rocky Flats Coalition of Local Governments began phasing out their activities in early 2006; as of March 2006, the Rocky Flats Stewardship Council took over as the local oversight group.

[2]Our references to group members include the groups' staff (two per group), whom we included in our survey because of their experience and knowledge about the Rocky Flats cleanup.

response rate for current members of the Coalition was 35 percent. Table 1 shows the response rates by subgroup and in total.

Table 1: Survey Response Rates, by Subgroup

Subgroup	Number of surveys sent	Number of responses received	Response rate (percent)
Current Advisory Board	14	10	71
Current Coalition	23	8	35
Subtotal, current members	**37**	**18**	**49**
Past Advisory Board	14	6	43
Past Coalition	7	1	14
Subtotal, past members	**21**	**7**	**33**
Total	**58**	**25**	**42**

Source: GAO.

Summary Responses

Following is a summary of the survey responses, by question, along with selected illustrative comments by respondents. Narrative responses are not provided in their entirety because we did not wish to introduce a perceptual bias. For some questions, that is, a majority of respondents offered positive and concise comments, but one or two respondents provided negative and lengthy comments. To present all of the comments in their entirety would thus give an unfair perception of emphasis, at least by sheer volume of narrative, to the negative minority and would diminish (again by volume) the positive majority. Accordingly, we summarized the comments to reflect the preponderance of responses, whether positive or negative.

The summary responses begin with question 5, as questions 1 through 4 sought information about whether the respondent was a current or former member of either the Advisory Board or the Coalition and about the length of time the respondent had served as a member of the group.

5. How satisfied or dissatisfied are you with how DOE engaged the [group—the Board or the Coalition] in the cleanup process?

Very satisfied	8
Somewhat satisfied	13
Neither satisfied nor dissatisfied	1
Somewhat dissatisfied	2
Very dissatisfied	1
Don't know/no basis to judge	0

6. Please explain or provide examples of how DOE engaged the [group] in the cleanup process.

Comments from 6 of the 21 respondents who reported being "very satisfied" or "somewhat satisfied" (in response to question 5) included the following:

- "DOE actively engaged the Coalition and local communities in a variety of ways. . . [DOE] provided opportunities for the Coalition to participate in certain decision-making processes, provided [a] regular series of technical meetings keeping Coalition staff informed on various remediation activities, [and] . . . basically interacted with the Coalition on an almost daily basis during the course of the site's cleanup."

- DOE's engagement "varied from one manager to another but was generally good. More important, the CDPHE [i.e., Colorado], EPA and Kaiser-Hill consistently solicited the advice of the Board. In particular, the Board was given access to draft documents and decisions while they [were] still being discussed. This permitted the Board to actively participate in the decision process and influence the decision instead of simply responding to a done deal."

- The "most important three items [were] board makeup, board decision-making process, and board meeting time. The members include a couple of ex-nuclear submarine personnel, a couple of college professors, a groundwater expert, a mining expert, peace activists, etc.; in addition, the attendance and participation of DOE, regulators, cleanup contractors, FWS, and the general public provides technical, emotional, and general interest review on items. Board decisions require that all agree on all formal Board decisions, which forces constructive give and

take in the decision making process. Meeting in the evening not only permits the general public to attend, it also permits regulators, DOE, contractors, FWS, etc., etc., to all attend and discuss items—[it] may be the only time they all get together and discuss some of the items. DOE attends all [Board] meetings, presents data on requested topics, answers questions, and provides follow-up data as requested. We may not always agree but at least we get the data out there and discuss the issues. Operating as [a] federal board is very important."

- "I believe that the DOE did a good job in answering reasonable requests from Board members. [DOE] did not always jump through every hoop presented nor should they have. Some requests were unreasonable; some would have been impossible, e.g., cleaning up soil to levels that technology couldn't accomplish."

- DOE "seemed to listen to the Board and take their recommendations seriously, when it fit their plan. . . ."

- "For the most part, DOE provided copies of documents for review and comment and provided presentations on cleanup and closure issues and decisions. But, the closer to completion the site became, the harder it was to get documents in a timely fashion. As an example, we were usually provided documents at the same time as the regulators, but at the end we received them much later than the regulators. Legacy Management [LM] completely ignored the city's input to LM's Public Involvement Plan."

7. How satisfied or dissatisfied are you with how the [group's] input was used by DOE?

Very satisfied	3
Somewhat satisfied	16
Neither satisfied nor dissatisfied	2
Somewhat dissatisfied	2
Very dissatisfied	2
Don't know/no basis to judge	0

8. Please explain or provide examples of how the [group's] input was used by DOE.

Comments from 5 of the 16 respondents who reported being "somewhat satisfied" (in response to question 7) included the following:

- "The RSAL [radionuclide soil action level] issue was one on which the DOE listened to the [Advisory Board] and other public groups."
- "In some cases DOE added information to documents or adjusted processes based on the Board's input."
- "The Board's concerns about the original soil action levels were met with DOE's agreement to fund the independent review."
- "Our input was used on a number of fronts—pond management, ensuring [that] the site would not be a disposal site, and [the] strategy for remediating the original landfill, to name [a] few. Most important is [DOE's] revising the RFCA [Rocky Flats Cleanup Agreement] to better reflect community priorities. The reason I checked 'somewhat satisfied' instead of 'very satisfied' is that we could never get DOE to incorporate stewardship planning into the cleanup process in a substantive manner. For DOE and the regulators, stewardship was an afterthought that got bucked to the end of the project and into regulatory closure space. We are now at the end of the project and we are still left wondering how DOE will address key questions concerning institutional controls."
- "In the Independent Verification process, the Coalition pushed, and the DOE made some changes to their original proposal."

9. Overall, what kind of effect, if any, do you believe the [group's] input had on the cleanup process?

Very positive effect	6
Somewhat positive effect	17
Neither negative nor positive effect	1
Somewhat negative effect	0
Very negative effect	0
Don't know/no basis to judge	1

10. Please explain or provide examples of how the [group's] input affected the cleanup process.

Comments from 7 of the 23 respondents who believed that their group's input had a "very positive" or "somewhat positive" effect (in response to question 9) included the following:

- "Opposition of the [Board] and other entities to the 651 pCi/g RSAL for plutonium adopted for [Rocky Flats] in the 1996 [cleanup agreement] resulted in DOE funding a citizen oversight panel to hire independent scientific specialists to calculate radionuclide soil action levels (RSALs) for the site. Out of this study came the recommendation that the plutonium RSAL be reduced by 95% from 651 pCi/g to 35 pCi/g. While DOE did not accept this recommendation, it did work with the regulators to reduce the action level for [plutonium] in surface soil (top 3 feet) from 651 to 50 pCi/g. DOE and the regulators, however, pushed a tradeoff, in that in exchange for this better surface cleanup (top 3 feet) the public would have to accept having larger quantities of plutonium left in the subsurface environment—between 1000 and 7000 pCi/g at a depth of 3 to 6 feet below the surface, with no limit on the concentration allowed below 6 feet."

- "The Board has had an impact on all areas of the cleanup process . . . from how the landfill caps were constructed, to the overall level of cleanup, to how buildings were safely removed. . . ."

- "I understand that in the beginning the Board had a tremendous impact on the cleanup. Because of the Board and community members, the surface soil cleanup levels were changed to be more conservative, from 651 pCi/g to 50 pCi/g. I feel [that] the Board had less of an influence later in the process. However, because of the Board, DOE was aware that the community was watching, and I believe the community got a better cleanup because of that."

- "DOE solicited a large amount of input from the Coalition over the course of the site's cleanup. Although not all of the Coalition's input was incorporated into cleanup plans, a substantial amount of Coalition positions were incorporated into the cleanup. As a result, local community buy-in into the process was enhanced. DOE, Kaiser-Hill, the regulators, and the Coalition were successful partners in the site's closure."

- "We were able to influence the level of cleanup. We were also able to get more cleanup in areas like the 903 pad in exchange for leaving building foundations in place—771 & 371."

- "By the Coalition engaging in depth on matters of technical feasibility, schedule, cost, worker safety, D&D [decontamination and demolition] design and implementation, contaminant control and monitoring, it forced the DOE, regulators and Kaiser-Hill to focus and impart progress and planning to the Coalition board and public."

- "The Coalition affected the cleanup on a number of levels. We were the best supporters and the most effective critic. We helped maintain congressional support for the project and held DOE, Kaiser-Hill and the regulators accountable. We were central to determining the future use of the site and to revising the cleanup priorities to better match the needs of the community. We brought DOE to the table in a public forum which, along principally with the [Citizens Advisory Board], was central to ensuring the dialogue remained open. We pushed for a free flow of information."

11. Please explain or provide examples of what, if anything, DOE might have done differently to change the effect of the [group's] input on the cleanup process.

Respondents offered a number of suggestions and comments, including the following:

- "The only change would be on the future monitoring of the site i.e., LSO [the Local Stakeholder Organization] which has been completely controlled by politics and not by DOE and the board. . . ."

- "I always believed that if DOE had approached it more as a partnership with their end customer the cleanup process would have been done better."

- "[DOE] did continue with a very active public participation process to address [the soil action levels] and all aspects of the cleanup. However, rather than doing this process via the [Board, which was] established in 1993 to advise DOE on the cleanup, DOE created a new body, the RFCA [Rocky Flats Cleanup Agreement] Focus Group . . . The value of the Focus Group was that it allowed more intense discussion of details than was usually possible in a [Board] meeting. But shifting the principal

discussion of the cleanup to the Focus Group . . . had the effect of undermining and marginalizing the [Board]."

- "DOE could have engaged the Board better in terms of budgeting. We were never asked to partner with the site in requesting funds for our participation through the federal budget process. . . . We also will not be funded for what we saw as a valuable project to develop risk communication tools to help alleviate concerns about the residual contamination at the site. We have heard from citizens who live near the site that they are concerned that contamination has been left behind. There is no way that these citizens are going to read and understand the immense multi-volume Remedial Investigation study and Comprehensive Risk Assessment. If there are any further water quality exceedences, even if they are not life threatening, they are going to call into question the protectiveness of the cleanup. DOE had better hope this doesn't happen, because they appear to have no plan or the tools to address concerns that might be raised by the less knowledgeable in the community."

- "DOE at times declined to allow members of the Board to observe internal meetings between DOE, [Kaiser-Hill], and the regulators. This made it more difficult for the Board to thoroughly understand the technical details of a cleanup decision and respond in an educated way."

- "One recurring Coalition theme was the lack of long-term stewardship considerations in remedial action planning and documents. Instead of incorporating the long-term stewardship considerations into the documents, it was left to post-physical closure documents. . . . The Coalition position has always been that long-term stewardship planning should be an integral part of the remedial activities and not relegated to post-closure status."

- "As the clean up was underway in early 2005, DOE seemed to agree that ORISE should conduct a [*Multi-Agency Radiation Survey and Site Investigation Manual*, or MARSSIM]-based final clean up verification. Since this approach was apparently not specified in the contract, Kaiser-Hill balked and DOE was left to fund an over-flight survey by a low flying helicopter to, for PR [public relations] purposes, attempt to pick up (detect) major hot spots. The overflight technology was not sufficiently sensitive to detect exceedences of the clean up level. In addition due to soil moisture and shielding in the industrial area, the overflight detection approach was of little credible value. By omitting this final

verification Kaiser-Hill was able to 'complete' physical closure early and collect an added 100 million dollar award."

We now have a few questions about the results of the cleanup. As you know, since 1995, when it was awarded the Rocky Flats cleanup contract, Kaiser-Hill has decontaminated and demolished hundreds of structures, installed groundwater treatment systems, and removed contaminated soil, among other cleanup tasks specified by the contract and the Rocky Flats Cleanup Agreement.

12. How confident, if at all, are you that the cleanup will be protective of public health and the environment?

Extremely confident	5
Very confident	6
Somewhat confident	12
Not very confident	1
Not at all confident	1
Don't know/no basis to judge	0

13. Please explain or provide examples that illustrate your view.

Comments from 4 of the 11 respondents who were "extremely confident" or "very confident" (in response to question 12) in the protective nature of the cleanup included the following:

- "I believe that phenomenal effort was very effective in cleaning up those sites that needed remediation, e.g., the 903 Pad and uranium trenches."
- "I am personally confident that the government will retain possession of the land and keep up the controls now in place so that visitors are safe and protected. I am convinced we got the best cleanup possible for the conditions, political climate, and money spent."
- "This process has been open and has benefited from intense public oversight, talented and committed regulators (especially at CDPHE [Colorado Department of Public Health and Environment]), and independent reviews of key assumptions and decisions such as the Actinide Migration Panel and the soil action level review. Further, the

surface water quality standards are extremely stringent and with rare exception they are getting met. That increases my confidence."

- "The main reason I am extremely confident that the cleanup will be protective of public health and the environment is because of the tremendous amount of excellent oversight work provided by the regulators (CDPHE and EPA). I can't say enough of how impressed I am with the technical staff of the regulatory agencies. They were everywhere during the course of the cleanup, ensuring that the remedial actions performed at the site were properly planned, implemented, and executed."

Comments from 4 of the 12 respondents who were "somewhat confident" (in response to question 12) in the protective nature of the cleanup included the following:

- "We don't know everything that is underground (e.g., landfills) and might seep out—cleanup is probably the most cost-effective that could be done . . ."

- "I think most of the contamination has been removed. However, I am concerned about isolated hot spots."

- "We were very disappointed that DOE changed course on the verification of cleanup. We were led to believe that the verification would be a MARSSIM based approach; what we really received was a process that had never been used for verification purposes (the aerial flyover); an ORISE review that was constrained by DOE and a limited scope review."

- "I believe the majority of the buffer area will be very low risk to the public. The ponds, the industrial area, the 903 pad, 903 lip and 903 wind blown area could expose the unsuspecting public to a higher risk depending on individual sensitivities even though the residual Pu [plutonium] level is at or below 50 pCi/g."

One of the 2 respondents who were "not very" or "not at all" confident (in response to question 12) about the cleanup's protectiveness said,

- "I don't believe that the cleanup was done to be protective of public health and the environment. Otherwise, DOE would not have pursued the wildlife preserve aspect. Basically, the wildlife preserve is an

"administrative" control to limit the future land use, limit public exposure to the existing contamination at the site, and allowed DOE to leave behind a lot of contamination."

14. What, if anything, might have been done differently during the cleanup that would have increased your confidence?

Respondents offered a number of suggestions and comments, including the following:

- "If the original landfill and the deep basements had been removed, my confidence would be greatly increased. I do understand the reasons for this not occurring."
- "A 100 percent scan of the DOE-retained lands would give me a complete idea of what is out there. . . ."
- "The implementation of our consultants' recommendations and a "TRUE" MARSSIM based final survey."
- "Only after the Focus Group had been meeting for a full year was it finally made clear that the better cleanup sought by some participants was not in the cards because decisions placing a cap on what could be spent had already been made. To some of us involved in this enormously time consuming process, this announcement revealed that the public participation process was in large measure a sham. Some DOE personnel insist that DOE had been open about the fiscal cap, but the DOE official who made the announcement at the Focus Group later said that its effect on the meeting was 'like throwing a dead rat on the table.'"
- "I really do not have any concern about the site per se. I am concerned that the legal folderol . . . will continue forever."
- "Really we are relying on the best science known and so I am not sure that anything could have been done better."
- "The verification could have been performed earlier so that it could have been used as a tool in the cleanup."
- "With unlimited funds a total cleanup could have been accomplished—in our real world we have better than could have been expected. FWS now needs the resources to convert the site."

- "DOE and the regulators should have required independent [MARSSIM] based protocols to verify complete and comprehensive surface soil clean up levels site wide. This should have been done by an independent contractor."

15. At this point in time, do you have any remaining concerns about the cleanup?

Yes 17

No 8

16. Please provide examples or details of your remaining concerns.

Respondents offered a number of concerns, including the following:

- "The underground "stuff"—landfills and basements. Who knows what, when and how it might affect us in the future."

- "I am not certain how we will maintain control of [the] area for the centuries needed given that we did not know for certain that all contaminants were removed."

- "DOE needs to continue water quality monitoring on Woman Creek permanently!"

- "My remaining concerns with the cleanup have to do with how well the revegetation and erosion control measures function in the next few years. The site needs several good growing seasons to help re-establish vegetation covering the remediated portions of the DOE-retained land. Without adequate vegetative cover, erosion problems can arise which could ultimately result in the mobilization of actinides from the surface soil into surface water."

- "My concerns now lie in the importance of creating a robust stewardship plan and assuring that monitoring will continue well into the future as well as knowing that if we find that a remedy has failed the DOE will do what it takes to address this failure."

- "I worry about the magnitude of the long-time stewardship responsibilities. There are numerous examples at other sites of where controls fail because governments forget that there are institutional

controls which carry with them use restrictions. How we will protect Rocky Flats over the long-term remains somewhat of a mystery for me."

- "What will be done in the coming years, and by whom, to keep the public out of the contaminated areas?"

- "Plutonium and uranium take hundreds of thousands of years to decay. Even in 100 years, the site can change sufficiently so that subsurface contamination is exposed. Also, physical controls may well decay into dust by the time the next century rolls around and institutional controls could be forgotten. In the future, the site could be used for subsistence farming. Who knows what will happen? The uncertainty of the future contributes the largest concern I have about the cleanup."

In the summer of 2005, DOE arranged for a number of cleanup verification activities, including Kaiser-Hill's ground-based scans along the boundaries of previously remediated areas where contamination was once known to exist; Bechtel Nevada's[3] aerial scan of the site; and the Oak Ridge Institute of Science and Education's (ORISE) sampling and ground-based scanning of the 903 pad and lip area. We would like your views on the overall verification process, as well as your views on each of these three specific verification activities.

17. How, if at all, did the overall verification process affect your confidence in the site's cleanup?

Greatly increased my confidence	3
Somewhat increased my confidence	10
Neither increased nor diminished my confidence	5
Somewhat diminished my confidence	2
Greatly diminished my confidence	1
Don't know/no basis to judge	4

[3]Bechtel Nevada conducted the aerial survey.

18. Please explain or provide examples that illustrate how the overall verification process affected your confidence in the site's cleanup.

Comments from 5 of the 13 respondents who believed that the overall verification process "greatly increased" or "somewhat increased" their confidence (in response to question 17) included the following:

- "Although I felt there was a low probability of contamination being in the buffer zone, given the level of suspicion and the recent publication of several false and misleading books and articles I felt it was important. This is a good time to state that although almost all the public fear involved radiologic contamination, it is not the most hazardous."
- "Additional testing always adds to the vote of confidence."
- "The aerial scan was the most effective. The other parts of the verification were too confusing for the majority of the community to understand. When the hot spots were discovered in the 903 Pad Lip Area, those of us more familiar with statistical sampling methodology could understand that it was not that grave of a situation, but those who read newspapers I am sure were not comforted."
- "ORISE, although paid by DOE, is an independent [entity]. As such, I trust their results."
- "The targeted independent verification areas helped to assure my confidence level but did not greatly increase it. I do think the verification process was important to other board members and most of all to the general public. It probably did very little or nothing to assure already skeptical critics of the site cleanup."

Comments from 2 of the 5 respondents who said the activities "neither increased nor diminished" their confidence (in response to question 17) included the following:

- "I feel what was done was a waste of time and money and did not tell us anything new."
- "Was glad it was in place, but didn't give me 100% confidence."

And of the 3 respondents who said the activities "somewhat diminished" or "greatly diminished" their confidence in the cleanup (in response to question 17), 1 said,

- "It is by no means clear that the full site has ever been well characterized. Former workers are known to say that unknown areas of random dumping were never found by the characterizing methods used, especially the . . . method that took a very limited number of samples in relatively large areas and estimated the contamination in that area based on this very limited sampling. Further, . . . the verification methods used could not detect all hot spots or areas of unknown subsurface contamination."

19. How, if at all, did Kaiser-Hill's targeted ground-based scanning activities (using a high-purity germanium, or HPGe, detector mounted on a tripod) affect your confidence in the site's cleanup?

Greatly increased my confidence	4
Somewhat increased my confidence	7
Neither increased nor diminished my confidence	7
Somewhat diminished my confidence	3
Greatly diminished my confidence	0
Don't know/no basis to judge	4

20. Please explain or provide examples that illustrate how Kaiser-Hill's targeted ground-based scanning activities affected your confidence in the site's cleanup.

Comments from 4 of the 11 respondents who said that Kaiser-Hill's targeted ground-based scanning activities "greatly increased" or "somewhat increased" their confidence in the cleanup (in response to question 19) included the following:

- "It showed that there was basically no contamination above the cleanup levels left on the site."

- "I felt that the areas surveyed had a low risk of contamination. While it only somewhat increased my personal confidence I feel it was critical in increasing the public confidence."

- "They targeted areas of concern and proved through testing that cleanup levels had been achieved."

- "Showed that the area 'covered' by the scan met cleanup criteria."

Comments from 2 of the 7 respondents who said the activities "neither increased nor diminished" their confidence (in response to question 19) included the following:

- "There wasn't enough sampling conducted, and the sampling should have been conducted in more areas after remediation was done and before backfill took place."

- "Kaiser-Hill's scanning activities were part of the cleanup, not part of an independent review. So, I have confidence in what they did, but the question suggests that their scans would increase my confidence in their work. Independent review would have increased my confidence."

And of the 3 respondents who said the activities "somewhat diminished" their confidence in the cleanup (in response to question 19), 1 said,

- "DOE and [the contractor] have continued to approach the cleanup using methods designed to not find problems. An approach designed to verify that no problem exists cannot be used to discover problems."

21. How, if at all, did Bechtel Nevada's aerial scan of the site (using a helicopter-mounted array of sodium iodide detectors) affect your confidence in the site's cleanup?

Greatly increased my confidence	3
Somewhat increased my confidence	6
Neither increased nor diminished my confidence	8
Somewhat diminished my confidence	3
Greatly diminished my confidence	1
Don't know/no basis to judge	4

22. Please explain or provide examples that illustrate how Bechtel Nevada's aerial scan of the site affected your confidence in the site's cleanup.

Comments from 3 of the 9 respondents who said that Bechtel Nevada's aerial scan of the site "greatly increased" or "somewhat increased" their confidence in the cleanup (in response to question 21) included the following:

- "The [aerial scan] addressed the entire site, not just where one anticipated that contamination could exist."
- "The aerial scan just confirmed what DOE had been telling us all along."
- "Detection capabilities of aircraft scanners was not as sensitive as I would have liked. System was designed to detect higher concentrations of radionuclides than were expected at Rocky Flats."

Comments from 2 of the 8 respondents who said the activities "neither increased nor diminished" their confidence (in response to question 21) included the following:

- "While the technology, if properly applied, might have been sufficient, the results were less than reliable because of ground moisture, shielding in the industrial area by equipment, debris, etc., and over-lot grading, which would have buried contamination. If properly applied, the aerial scan could detect major hot spots but is not designed to detect small hot spots that exceed the cleanup level. The aerial scan was more a public relations ploy than a good science valid verification of site safety and reliable cleanup."
- [The aerial scan was] "a method that is suited for determining what has happened in a Three Mile Island [or] Chernobyl type event, not to verify [that] an action did what it was supposed to do."

And of the 4 respondents who said the activities "somewhat diminished" or "greatly diminished" their confidence in the cleanup (in response to question 21), 1 said,

- "The [remedial soil action levels] established for Rocky Flats set standards for plutonium and other materials that may remain in place according to depth. The aerial scan can only detect what is present on

the surface (not surface defined as the top three feet, but surface as limited to a small fraction of this amount). Further, the aerial scan detects hot spots only if they are quite large in extent and relatively high in concentration. The aerial scan is a very valuable tool but also a very limited one."

23. How, if at all, did ORISE's verification activities (e.g., soil sampling and surface scans using sodium iodide "FIDLER" scintillation detectors) affect your confidence in the site's cleanup?

Greatly increased my confidence	5
Somewhat increased my confidence	11
Neither increased nor diminished my confidence	2
Somewhat diminished my confidence	2
Greatly diminished my confidence	0
Don't know/no basis to judge	5

24. Please explain or provide examples that illustrate how ORISE's verification activities affected your confidence in the site's cleanup.

Comments from 6 of the 16 respondents who said that ORISE's verification activities "greatly increased" or "somewhat increased" their confidence in the cleanup (in response to question 23) included the following:

- "Unlike the two [other verification activities], the ORISE verification was essential in verifying that [Kaiser-Hill] did in fact perform the work they were being paid to do."
- [ORISE] "did find some hot spots that [Kaiser-Hill] then addressed, so a second check did help to increase belief in [the] cleanup."
- "This is the verification activity that turned up the 'hot spots' which were eventually remediated. I understand that according to the risk assessment formulas that were developed and the averaging nature of these formulas these 'hot spots' technically did not have to be remediated. The decision to remediate these, however, was important to help assure public confidence in the site cleanup."
- "The ORISE work ended up raising more questions and concerns by the public. Also, we are left with the impression at the end that their work is

incomplete because DOE did not provide them with funding to do the final review of the aerial survey. Also, trying to make MARSSIM fit into what was needed to verify the cleanup at the site was just too difficult to follow. . . . The ORISE work started out with great expectations, but things just got too confusing at the end. For the average citizen, I don't think the verification made any difference at all."

- "The ORISE budget was very limited—about $250,000—and was not sufficient to do an adequate job of site verification because the protocol they had to follow was disjointed."

- "ORISE'S work showed that for the area they reviewed, the statistical approach Kaiser-Hill used was valid. However, given that DOE limited ORISE's work it is hard to extrapolate their findings over a larger area of the site. So, their work was of a limited value."

Of the 2 respondents who said that the activities "neither increased nor diminished" their confidence (in response to question 23), 1 said:

- "The review became less and less than promised as time went by: from a MARSSIM-based approach, to an approach greatly restrained by DOE as to what would be reviewed and how the review would be conducted."

And of the 2 respondents who said that the activities "somewhat diminished" their confidence in the cleanup (in response to question 23), 1 said,

- "I believe the FIDLER device is a very good way to detect contamination in the surface soil. But its use by ORISE again was limited to areas of known contamination rather than to characterize portions of the site that have not been adequately characterized."

25. Do you have any additional comments you would like to provide?

Among the respondents' additional comments were the following:

- "[The Board] provides the only forum that has provided for the public, regulators, DOE, and contractor to discuss the issues and for everyone to have an equal voice. Hope there is someplace in the future (for a couple of years) for such activities to continue. The proposed LSO [long-term stewardship organization] appears to be a waste of government

funds—too large of a staff, restricted membership, and too little technical expertise. . . ."

- "I believe the lessons learned at Rocky Flats could be put to good use at other sites, especially Hanford."

- "In the future on any similar rad[iologically] contaminated sites, DOE should require as a contractual condition that an independent verification of the clean up be implemented using [MARSSIM] principles. In the 903 pad area where a [MARSSIM] sampling verification was implemented—hot spots substantially exceeding 50 pCi/g were found and picked up. It would seem reasonable to conclude that other areas of the 903 pad and the industrial area would have similar exceedences."

- "DOE, other state agencies, and communities should study what we did at Rocky Flats because we were on the cutting edge of how to work within the regulations but allow great latitude in engaging the community and for remediating a complex nuclear site."

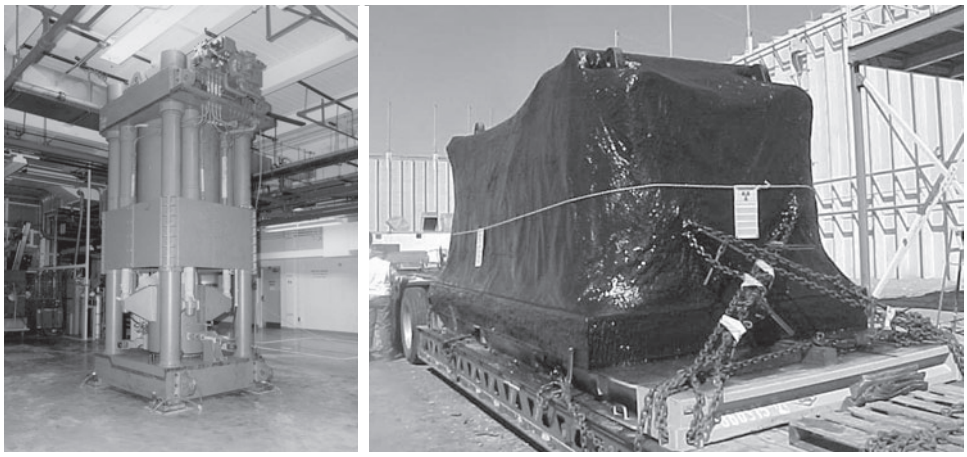
- "Standley Lake Cities still have serious concerns about Woman Creek's risk from [the original landfill and the fact that] Woman Creek has no terminal testing control pond!"

- "ORISE should have been allowed to survey more of the area and to do some surveying of the Buffer Zone."

Additional Information on Decontamination and Demolition Activities at Rocky Flats

The contractor used a number of innovative techniques to accomplish decontamination and demolition tasks at Rocky Flats. One of these, as discussed in the report, was the use of a cerium nitrate solution to decontaminate large pieces of equipment. Another innovative decontaminating technique was the contractor's use of InstaCote™ to encapsulate large surface-contaminated tanks and other equipment. InstaCote is a polyurea plastic coating that was sprayed on equipment. The InstaCote not only sealed in the contamination, but also served as the shipping conveyance and disposal package. According to DOE officials, use of the InstaCote saved "easily thousands of hours" and increased worker safety, as it eliminated the difficult and dangerous job of cutting contaminated equipment and packaging it for shipment. The InstaCote could be used even with extremely large pieces of contaminated equipment, such as a super-compacter used to reduce waste volume by crushing drums containing radioactive waste and drums that were empty but had formerly contained radioactive waste. Figure 14 shows the super-compacter before InstaCote was applied and with the InstaCote awaiting transport to a disposal facility.

Figure 14: Super-Compacter without (Left) and with InstaCote



Source: DOE.

One of the most difficult decontaminating challenges DOE and the contractor overcame was decontaminating concrete. When concrete became contaminated with liquid radioactive waste (e.g., by spills during nuclear material processing or waste disposal), the past practice was to fix

the contamination in place using sometimes several layers of an epoxy paint. Before a building containing contaminated concrete could be demolished, this paint had to be removed down to the base material, and the base material had to be decontaminated. The contractor removed the contaminated paint using various methods such as scabbling, shaving, or hydolasing. Scabbling chipped away the first layer of the surface with a pneumatic hammer; however, this option created dust and increased the potential for the release of contaminants into the air. Shaving removed layers of concrete with a machine, and was considered more efficient and less hazardous than hydrolasing for decontaminating concrete surfaces with deeper contamination. Hydrolasing, the preferred method for removing paint and shallow surface contamination, involved blasting away paint and the initial layer of the surface material with water, then self-containing the water and resulting debris. Figure 15 shows the hydrolase system in use in building 886 at Rocky Flats, a former nuclear laboratory known to have light contamination under painted surfaces.

Figure 15: Hydrolase System at Work Removing Contaminated Paint and Underlying Surface Contamination

Source: DOE.

But in some cases, according to a senior contractor official, contaminated liquid had seeped so deeply into the concrete that it could not be removed using any of these three methods. This was the case, for example, in the "infinity room" (so called because the level of radioactive contamination in the room was greater than instruments could measure) of building 771, which had often been referred to as "the most dangerous building in America." When concrete was contaminated to the core, the only option

was to cut it out and remove it. The entire "infinity room" floor had to be cut out and shipped as transuranic waste, as shown in figure 16.

Figure 16: Workers Cut Contaminated Concrete from Building 771's 'Infinity Room'

Source: DOE.

In other cases, when the contaminated concrete was far underground (i.e., in building foundations), it was decontaminated to the lowest levels reasonably achievable and left in place. DOE and the regulatory agencies agreed to decontaminate and leave in place the foundations of buildings 371 and 771/774, and cover them with clean fill dirt. According to DOE and contractor officials, leaving the foundations in place poses little risk to human health and safety because the foundations and the soil around them were decontaminated to specified levels before being covered.[1] Also, they

[1]Specifically, contamination on the surface of the foundations' concrete had to be remediated to less than 100 nanocuries per gram, and contamination by volume (measured through calculations of the foundations' depth) had to be remediated to less than 7 nanocuries per gram. If contaminated sections of the concrete could not be remediated to these levels, those sections had to be removed.

said, leaving the foundations in place was safer for the workers at the site than removing them, which would have required workers wearing respiratory protection systems that constrain movement and visibility to winch up massive, multiton pieces of concrete from a confined space. A Colorado official said he had agreed to the decision to leave the foundations in place after carefully considering the balance between the potential future risk of exposure with the real and immediate risk of worker safety. In lieu of removal, the contractor treated the foundations with a fixative to prevent contaminants from migrating during demolition activities, then covered them with a cushion of sand and a layer of clean fill dirt. According to DOE and contractor officials, plutonium should not migrate out of the foundations, and if it does, it should not migrate beyond the surrounding soil. This contention is supported by the results of the actinide migration study, which concluded that fixed actinide contamination does not readily move in the environment. Also, neither humans nor wildlife would be exposed unless a future major excavation activity were to take place. However slight it may be, the potential risk to human health and safety posed by leaving the foundations in place is the reason that controls such as groundwater monitoring wells and treatment systems will remain in place, according to Colorado officials.

Another innovative decontaminating and demolition strategy the contractor developed in conjunction with DOE and the regulatory agencies involved dividing the site into areas and completing most or all of the work in one area—from building decontamination to demolition—so that environmental remediation could begin in that area while decontamination and demolition work was being done in the next area. This strategy enabled the cleanup to proceed more quickly by allowing the earlier start of environmental restoration work and by allowing workers more time to address any unforeseen circumstances. The strategy also achieved economies of scale, as site services—such as water, steam, and power—could be eliminated throughout an entire area, rather than on a building-by-building basis.

Additional Information on the Quality of Remediation Data at Rocky Flats and on DOE's Planned and Actual Verification

This appendix presents additional information on our review of the processes and procedures in place at Rocky Flats to evaluate the quality of remediation data. It also presents additional information on DOE's planned and actual verification of the contractor's cleanup work.

Information on Controls over Data Quality

A critical aspect of the cleanup process was ensuring the validity of the data used to assess whether the site had been remediated to the agreed-upon levels. Accordingly, we reviewed the processes and procedures in place to ensure data quality, and we identified four key controls: (1) establishing data quality objectives, (2) using data quality parameters, (3) verifying and validating data, and (4) auditing laboratories that analyzed samples for Rocky Flats. Our review showed that, overall, the contractor generally followed these data quality controls and clearly documented its compliance with them for the four accelerated cleanup actions we reviewed in depth. For these four cleanup actions—at building 771, the 903 pad, the 903 lip area, and trench T-7—we assessed the closeout reports and the data supporting them to determine the extent to which the data collection and laboratory analyses adhered to data quality standards and procedures. We did not, however, evaluate the remedial data or laboratory analyses themselves.

To assess the use of the first key control—establishing data quality objectives—we identified the criteria documented in the Industrial Area and Buffer Zone Sampling and Analysis Plan. We then reviewed the cleanup project sampling plan addenda, remedial action plans, and cleanup project closeout reports for each of the four projects to determine whether the data quality objectives had been established and were considered during the projects' cleanup. To assess the use of the second control, we reviewed the four projects' closeout reports to verify that the data had been checked against the data quality parameters in accordance with the criteria located in both the Rocky Flats Implementation Guidance Document and the Industrial Area and Buffer Zone Sampling and Analysis Plan. These documents establish the guidelines for evaluating analytical data and address the overall quality of the data quality control. We examined the closeout reports for each of the four projects to ensure that the projects met the criteria for the third control—data verification and validation. And finally, to assess the use of the fourth control, we reviewed reports on audits of laboratories that analyzed data for the site's cleanup. Specifically, we reviewed source documentation from audits conducted by DOE's consolidated audit program and DOE's mixed analyte performance evaluation program. We concentrated our review on laboratory audit

results relevant to detecting plutonium for the 3-year period during which cleanup was under way for the four projects.

Establishing data quality objectives. DOE and the contractor established data quality objectives to act as planning tools for collecting data and for making decisions. The data quality objectives process is specified in the site's quality assurance project plan.[1] The process is intended to provide a systematic procedure for defining criteria for data collection, including when and where to collect samples, what level of decision error is tolerable, and how many samples to collect. In our review of the four selected cleanup areas, we found general adherence to the data quality objectives process. For three of the four projects we selected, we verified that both the characterization and confirmation sampling were planned according to the data quality objective process as defined in the Industrial Area and Buffer Zone Sampling and Analysis Plan. Because the fourth project required only minimal cleanup, it was completed through the standard "no further accelerated action" justification process. According to the contractor, the justification documentation for such areas (those requiring minimal cleanup) should include information on data adequacy, but not at the same level of detail as was required for other cleanup areas. We recognize that areas closed out through the "no further accelerated action" process may not necessitate the same level of data quality documentation as other areas. Nevertheless, the Rocky Flats Cleanup Agreement requires that the justification documentation for "no further accelerated action" areas include information on data quality and usability. The documentation we reviewed for trench T-7 did not include such information.

Applying PARCC parameters. EPA's policy requires it to apply data quality parameters for precision, accuracy, representativeness, completeness, and comparability—known as the PARCC parameters. Because radionuclides were involved, an additional data quality parameter—sensitivity—was used at Rocky Flats. These parameters provided information to the contractor and the regulatory agencies about the acceptability or utility of the data. For example, precision measures whether using the same analytical technique will result in the same results for a particular sample (i.e., analyzing the same sample twice and

[1]The Rocky Flats Quality Assurance Project Plan is included in the Industrial Area and Buffer Zone Sampling and Analysis Plan.

comparing the results).[2] According to the sampling and analysis plan, assessments of the data according to the PARCC parameters are documented in the closeout reports for the accelerated cleanup actions and, according to EPA officials, are checked through the verification and validation process discussed next. Our review of the four selected cleanup areas indicated that the PARCC parameters were consistently applied. For three of the four projects we selected, we verified that the data were reviewed in accordance with each of the data quality parameters. The fourth project required only minimal cleanup and was completed through the standard "no further accelerated action" justification process for which no formal data quality discussion was required.

Verifying and validating laboratory data. Data verification was required for 100 percent of the laboratory data at Rocky Flats. Data validation was required for 25 percent of the data, but because this requirement pertained to the Rocky Flats site as a whole, the percentage of data validated could vary considerably from one cleanup area to another. Data verification is a review of a laboratory's electronic data package summary to evaluate the extent to which the laboratory met specified quality control and reporting criteria. Data validation is a more in-depth review that includes not only verifying the data, but also examining the raw data and manually verifying calculations done by the laboratory. After a laboratory analyzed samples, it sent the results to a subcontractor that reviewed the data according to either the verification or the validation criteria and assigned codes indicating the data's quality. For example, one code would be assigned to data for which no problems were observed, whereas another code would be assigned to data that did not meet the quality control requirements.

Our review of the closeout reports on the four cleanup projects we selected indicated general adherence to the verification and validation requirements. Specifically, for three of the four projects, at least 98 percent of the overall data had been verified, and between 23 percent and 50 percent had been validated. The contractor provided several explanations for why 100 percent of the data had not been verified. For example, at the 903 lip area, because a number of samples were collected close to the time that the closeout report was submitted, verification and validation occurred after the report was completed. Additionally, the large number of

[2]At Rocky Flats, the contractor was required to take duplicate samples for 5 percent of all field samples.

samples collected in September 2004 (from the 903 lip area and other areas around the site) overloaded the verification and validation staff. Most of these records were verified or validated in late November or early December 2004, and all had been verified or validated by early 2005, according to the contractor.

Auditing laboratories. The 32 laboratories that analyzed samples collected from Rocky Flats were required to undergo annual technical audits to ensure the accuracy of their analytical results. Since 2000, contractor officials said they have largely satisfied the audit requirement by voluntarily participating in DOE's consolidated audit program,[3] with the exception of one on-site laboratory that the contractor audited. A typical DOE laboratory audit, according to the audit program manager, includes a 3-day visit to the laboratory by a team of five to six people. DOE certifies laboratory auditors in particular areas, including chemistry (e.g., radiochemistry or organic chemistry), and uses a standardized checklist to verify that laboratory practices meet DOE standards. When auditors identify problems, they can provide comments or issue priority I or priority II findings. Priority I findings are the most severe; they represent a serious breakdown in management controls that could render the laboratory unacceptable for use or unfit to perform services for DOE. Laboratories that receive priority I and II findings are required to develop and implement corrective action plans, and the contractor's policy stipulated that laboratories receiving priority I findings could do no more work for Rocky Flats until they had rectified the problem. Of the 118 audits conducted of laboratories analyzing Rocky Flats cleanup samples, only 10 priority I findings were issued, according to the subcontractor official responsible for laboratory audits at Rocky Flats.

We reviewed the performance of the two primary laboratories that analyzed confirmatory samples for plutonium 239 for the four selected cleanup areas and found no areas of concern with the laboratories' quality. To limit our review, we focused on two performance criteria: (1) laboratory audit findings from DOE's consolidated audit program documents on alpha spectroscopy, which is used to analyze confirmatory samples for plutonium; and (2) results from DOE's mixed analyte performance evaluation program, which assesses a laboratory's analytical abilities by

[3]DOE created the consolidated audit program in response to mid-1990s audit reports that cited inefficiency, redundancy, and ineffectiveness regarding DOE audits of analytical laboratories.

sending the laboratory a sample of a known quantity of a contaminant and comparing the laboratory's results with the actual quantity. Our review showed that the audit findings for alpha spectroscopy resulted in one audit observation.[4] Our review of the second performance criteria of the tests of the two laboratories' analytic ability found that, from 2002 through 2004, the two laboratories analyzed a combined total of 16 samples of plutonium 239, or alpha samples, and received acceptable test results in all but 3. Of those 3 samples, 2 samples were considered acceptable but were off by 20 percent to 30 percent, and 1 sample was not acceptable.

Additional Information on DOE's Planned and Actual Verification Activities

DOE revised two of the planned verification activities at Rocky Flats. First, due to time and cost constraints, DOE reduced the scope of the contractor's planned scanning and sampling activities. Second, DOE revised the Oak Ridge Institute for Science and Education's (ORISE) planned assessment of the contractor's scans of the 903 lip area. The revision incorporated an approach consistent with the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM). The actual verification activities conducted by both the contractor and ORISE identified "hot spots" of radionuclide-contaminated soil; these hot spots were subsequently remediated.

DOE Reduced Size and Scope of Scanning and Sampling Portion of Planned Verification

The first part of DOE's cleanup verification effort—the contractor-conducted scanning and sampling[5]—was reduced in scope due to time and cost constraints. In September 2004, the Rocky Flats site manager requested that the contractor develop a sitewide surface radiological survey using the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM). MARSSIM is the outcome of a joint effort by DOE, EPA, the Department of Defense, and the Nuclear Regulatory Commission to develop uniform guidance for conducting final surveys to demonstrate compliance with specified radiological cleanup levels. It recommends 100 percent scanning of areas most likely to be contaminated with radionuclides.

[4]DOE was unable to provide source documentation for 1 year for one of the two laboratories.

[5]Our use of the term "scanning" refers to both stationary in situ measurements taken via high-purity germanium detectors and mobile scans taken via sodium iodide scintillation detectors.

Scanning can be conducted through use of devices known as high-purity germanium (HPGe) detectors, as shown in figure 17, or sodium iodide scintillation detectors, known as FIDLERs. These devices can scan entire areas to determine whether certain radionuclides are present in a given area.

Figure 17: A High-Purity Germanium Detector Can Detect Certain Radionuclides

Source: DOE.

This scanning approach had been used several times by ORISE at Rocky Flats to demonstrate the sufficiency of radiological cleanup of buildings prior to their demolition. However, according to the contractor, DOE had limited experience using this approach to characterize surface soil and sediment. In its October 2004 letter responding to DOE, the contractor concluded that applying MARSSIM across the site would cost approximately $7.5 million and would take 19 months after the site cleanup had been completed. Further, the contractor said that implementing

MARSSIM at the site could constitute a "significant contract change," and could postpone completion of the cleanup. In essence, the difficulty was that the MARSSIM approach was inconsistent with the cleanup strategy. The approved site cleanup strategy was to remove contamination to a 90 percent confidence level, meaning confidence that at least 90 percent of the contamination had been remediated to agreed-upon levels. In contrast, MARSSIM, which was developed years after the Rocky Flats cleanup strategy had been approved and begun, recommends applying a 100 percent verification strategy—that is, scanning areas most likely to contain residual radionuclide contamination. Accordingly, MARSSIM was sure to find "hot spots"—particularly at the 903 pad and lip area, the extent and severity of which would then require investigation and potentially cleanup action. Not having anticipated the implications of applying MARSSIM at the site, in terms of both cost and schedule, DOE subsequently rejected that approach.

In March 2005, the contractor proposed a less expensive, less time-consuming plan for demonstrating the cleanup's compliance with the cleanup agreement. The plan's objectives were to verify, with reasonable certainty, that no unknown areas of radiological contamination remained at the site, that all remedial actions were complete, and that existing sampling data remained valid. The verification approach included scanning, sampling, and reviewing historical and existing data. Through such activities, the contractor intended to increase DOE's and the community groups' confidence that the cleanup objectives had been achieved. The plan purported to exceed the guidance laid out in MARSSIM, although an ORISE official refuted this claim. Further comments provided by a contractor hired by the Rocky Flats Coalition of Local Governments to provide input on the process added to DOE's concerns and resulted in DOE's rejecting the contractor's sampling methodology.

The contractor's final scanning and sampling plan, issued in May 2005, included two actions to meet the verification objectives. First, the entire site would be scanned with sodium iodide detectors affixed to a helicopter. According to the contractor, the detectors would detect, within the top several inches of surface soil, gamma rays indicating the existence of any residual plutonium that exceeded 50 picocuries per gram of soil, over a

range of 80 square meters—roughly the size of a two-car garage.[6] Figure 18 shows electrical poles that were felled to allow the helicopter to fly as low as possible over the site and the aerial scan of the site for residual plutonium in surface soil.

Figure 18: Felled Electrical Poles Allow Lower Flight; Helicopter Scans Rocky Flats for Residual Plutonium in Surface Soil

Sources: GAO; DOE.

Of the 21 community group survey respondents who expressed an opinion on the aerial scan, 9 said the scan greatly or somewhat increased their confidence in the site's cleanup. Another 8 said the scan neither increased nor diminished their confidence, and the other 4 said the aerial scan greatly or somewhat diminished their confidence in the site's cleanup.

Another component of the contractor's final plan was targeted ground-based scanning around the perimeter of previously remediated areas, including the perimeter of the major plutonium buildings and the 903 lip area. These scans were conducted with a high-purity germanium detector, as described earlier. Of the 21 community group survey respondents who expressed an opinion on the contractor's ground-based scans, 11 said these scans greatly or somewhat increased their confidence in the site's cleanup.

[6]The sodium iodide detectors on the helicopter can detect only gamma radiation, which does not directly measure plutonium 239/240 concentrations. However, it does measure americium-241, which can be multiplied by 5.7 to estimate plutonium 239/240. This conversion factor is based on a Rocky Flats Cleanup Agreement Contact Record (an agreement among DOE, EPA, and Colorado).

Another 7 said the scans neither increased nor diminished their confidence, and the other 3 said the ground-based scans greatly or somewhat diminished their confidence in the site's cleanup.

DOE Revised ORISE's Portion of Planned Verification to Incorporate MARSSIM

The second part of DOE's cleanup verification effort—ORISE's review of contractor-conducted scans for remaining radiological contamination—was revised to apply MARSSIM to the 903 lip area. ORISE's initial plan did not incorporate MARSSIM. However, the Rocky Flats Coalition of Local Governments' contractor suggested using MARSSIM at the 903 lip area because it had been one of the most contaminated areas. ORISE's proposed final plan included assessing the performance of the contractor's aerial and targeted ground-based scanning and the adequacy and completeness of the contractor's closeout reports for the 903 lip area using MARSSIM.

Results of the Contractor's Final Scanning and Sampling Cleanup Verification Plan and ORISE's Independent Verification

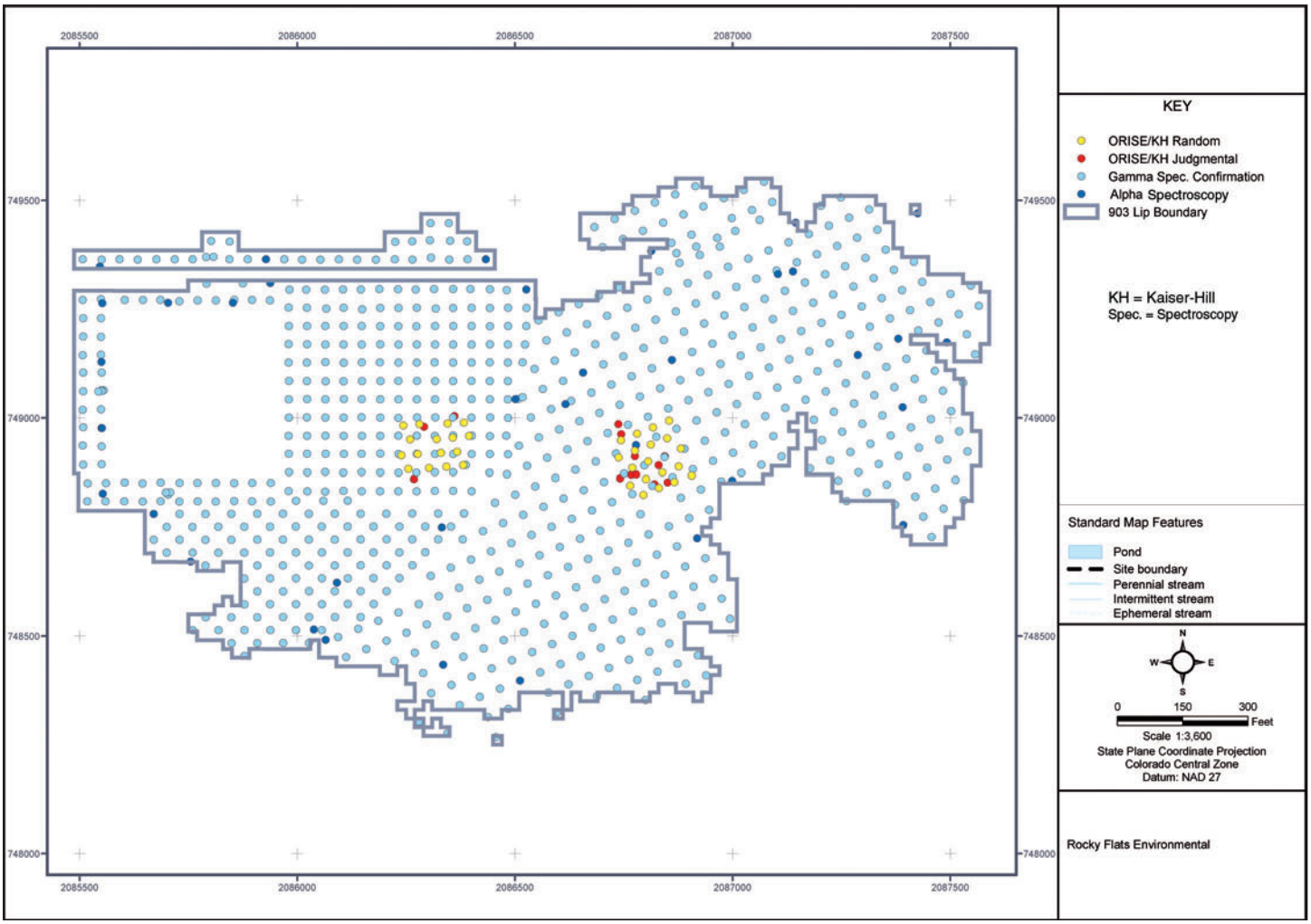
Both the contractor's and ORISE's verifications identified radionuclide-contaminated soil. At a September 1, 2005, public meeting hosted by the Rocky Flats Citizens Advisory Board, DOE and the contractor presented the results of the contractor's and ORISE's verifications. DOE and the contractor reported that the aerial scan had identified known areas of radionuclide contamination, such as areas where contaminated soil was stored pending its shipment off site. (The scan also identified an off-site area, but subsequent investigation found no contamination there.) However, the aerial scan did not achieve its projected sensitivity. Whereas detection of 50 picocuries of plutonium per gram of soil over 80 square meters was the criterion for success, according to the contractor's final plan, the scanner achieved this detection level for only 25 percent of the site, owing to the moisture content in the ground and the altitude of the helicopter's flyover. They also reported that the contractor's ground-based scan found five areas on the perimeter of the 903 lip area that contained contamination in excess of 50 picocuries per gram of soil, which were subsequently remediated.

In addition, DOE and the contractor reported that ORISE's MARSSIM sampling had identified 13 "hot spots," or areas with contamination above the cleanup agreement's action level of 50 picocuries of plutonium per gram of soil. Contamination in these 13 hot spots ranged from 65 to 425 picocuries of plutonium per gram of soil. However, a DOE official said that DOE would not remediate those areas because the regulatory agencies had already approved the accelerated cleanup actions, and those actions had been conducted in accordance with the cleanup methodology agreed to by

DOE and the regulatory agencies. The cleanup methodology required that at least 90 percent of any given area be remediated to the required levels; accordingly, there was a 10 percent chance that areas of elevated contamination remained. Even though the cleanup had been conducted in accordance with the approved methodology (which allowed for the chance of such elevated contamination remaining), DOE's initial refusal to remediate the hot spots caused concern for the Rocky Flats Coalition of Local Governments, according to the Coalition's executive director. Within 2 weeks, after consulting with EPA and Colorado, DOE agreed to have the contractor remediate the hot spots.

Overall, hundreds of samples were taken at the 903 pad and lip area, including initial and confirmatory samples. Figure 19 shows postremediation (confirmatory) samples taken by the contractor, as well as verification samples taken by ORISE.

Figure 19: Confirmation and Independent Verification Samples Taken at the 903 Lip Area



Source: DOE.

Note: This figure does not show the samples taken on the pad itself (the white square at the left). According to a contractor official, so many samples were taken within the pad that a depiction of them would appear as a solid mass.

Although DOE had agreed to ORISE's final independent verification plan, DOE did not have ORISE fully implement the plan, and it did not publicly explain its reasoning. Specifically, DOE did not have ORISE complete the planned assessment of the aerial and ground-based scanning or the planned assessment of the contractor's investigations of the results of the aerial and

targeted ground-based scans. According to a DOE official, DOE decided that the results of these remaining assessments would not justify their completion, particularly because the aerial survey had failed to find any anomalies.

Of the 20 community group survey respondents who expressed an opinion on ORISE's soil sampling and surface scans (using a FIDLER—a sodium iodide scintillation detector), 16 said the scan greatly or somewhat increased their confidence in the site's cleanup. Another 2 said the scan neither increased nor diminished their confidence, and the other 2 said the aerial scan greatly or somewhat diminished their confidence in the site's cleanup.

Comments from the Department of Energy

Department of Energy
Washington, DC 20585

June 9, 2006

Mr. Gene Aloise
Director
Natural Resources and Environment
U. S. Government Accountability Office
Washington, D.C. 20585

Dear Mr. Aloise:

Thank you for the opportunity to review the Government Accountability Office (GAO) proposed report entitled, *Nuclear Cleanup Of Rocky Flats: DOE Can Use Lessons Learned To Improve Oversight Of Other Sites' Cleanup Activities (Gao-06-352).* The Department of Energy has reviewed the report and our written comments are provided as an attachment to this letter.

The Department's comments are primarily directed to specific references in the report's text. We also offer some overall comments that pertain to the report taken as a whole that may not affect specific aspects of your final report.

We found the GAO proposed report to be comprehensive and generally thorough. We compliment your approach on covering complex topics and presenting important information in a manner that is clearly written and well structured.

If you have any questions or comments please contact Mr. Jay Rhoderick of my staff at (301) 903-7211.

Sincerely,

James A. Rispoli
Assistant Secretary for
Environmental Management

Enclosure

Comments on the
Draft GAO Report
"Nuclear Cleanup of Rocky Flats:
DOE Can Use Lessons Learned to Improve Oversight
Of Other Sites' Activities"

Overall Comments:

1. We agree that a robust and effective lessons learned program would be very beneficial for the Department and for other agencies. We welcome the GAO's recommendation(s) on how to institutionalize an effective lessons learned program across the complex. We intend to follow through and revitalize such a program within the Department of Energy (DOE) Environmental Management (EM). Any references that you could provide other government agencies that have successful lessons learned programs would be appreciated. EM has delayed a project plan to execute an EM lessons learned program that we expect will be operational by June 2006.

2. The GAO report recognizes the role that teamwork and agency support had in accelerating cleanup of the Rocky Flats site. We agree, and in fact believe the positive impact of these two factors can not be overemphasized. The regulatory agencies, community groups, and local government organizations worked tirelessly along with the DOE and contractor organizations to ensure that obstacles were overcome. This teamwork was imperative for timely completion of the project.

The high priority given the Rocky Flats cleanup within the DOE complex and at the Congressional level was also a critical factor contributing to the success of the project. The project was ensured level annual funding to enable both DOE and the contractor to meet stated contract goals and objectives. Appropriated funds were made available to the site to allow the site to proceed in the most effective manner to ensure safe, accelerated cleanup work. Many projects historically are not guaranteed level funding due to competing priorities. The lesson learned for the Department and Congress has been that giving this cleanup project a high priority and providing it with the certainty of funding allowed completion of the work as planned.

Specific Comments:

Page numbers in the draft report may differ from those in this report.

Page 9, Footnote 12: The text states, "… with half-lives greater than 5 years…."
Comment: This half life is not consistent with the definition at 40 CFR 191.02 (i) in EPA's high level waste and transuranic waste standards. There, the half life specified is 20 years. Recommend replacing 5 with 20 and checking the remainder of the definition to be certain it is consistent with the definition at 40 CFR 191.02 (i).

Page 19, in the first paragraph: The text states, "At the time of our 2001 report, DOE was concerned about the number and severity of safety violations that had occurred…."
Comment: Reference could be made to the DOE Rocky Flats Project Office Manager letter to the contractor of January 5, 2001, which documented these concerns with safety performance.

Page 27, in the Section entitled, "Regulatory Steps Remain before Site can open as a Wildlife Refuge:" There is an additional regulatory step DOE must take pursuant to its requirements. Specifically, DOE Order 5400.5 (Section II.5.a) states, "Release of real property (land and structures) shall be in accordance with the guidelines and requirements for residual radioactive material presented in Chapter IV." DOE Order 5400.5 (Section IV.4.d) states, "An authorized limit is a level of residual radioactive material that shall not be exceeded if the remedial action is to be considered completed and the property is to be released without restrictions on use due to residual radioactive material." Consequently, before real property is released to the Department of the Interior, DOE must comply with its radiation protection order. Recommend this regulatory requirement be referenced.

Page 31, last line: The text reads, "privately owned mineral rights…". Recommend modification to read, "privately owned essential mineral rights…" The legislation referenced in footnote 37 discusses "essential" mineral rights which is defined in Section 3112 (a)(1) and (a)(4). There are other mineral rights at Rocky Flats that are owned by private parties that are unaffected by the legislation and will not affect the establishment of the refuge.

Page 32, first sentence: The text refers to mineral rights and as per the explanation above for Page 31, the text should read "essential mineral rights".

Page 49, in the first sentence beginning on the previous page: The text states, "…but the policy is unclear about the how and why verification should be done." Comment: There is direction and guidance on independent verification and other independent assessments. The following references set forth this direction and guidance: 10 CFR 830, DOE 450.1, DOE 226.1, DOE P 450.5, DOE 5400.1, and Secretary Richardson's letter referenced in footnote 56.

Page 50, on the third line. The text states, "The draft guidance includes…." Comment: The draft guidance, "Control and Release of Property with Residual Radioactive Material," implementing guidance for DOE Order 5400.5, was approved for interim use. Insert after the word "guidance", the phrase "which was approved for interim use."

Page 70, footnote 65: The report states that the Rocky Flats Citizen's Advisory Board (RFCAB) was dissolved at the end of 2005; however, the RFCAB was funded this year. The RFCAB has continued to function in 2006 and the Board's last formal meeting is scheduled for June 1, 2006

Comments from the Department of the Interior

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JUN 0 2 2006

Mr. Gene Aloise
Director, Natural Resources and Environment
U.S. Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Aloise:

Thank you for providing the Department of the Interior (DOI) the opportunity to review and comment on the draft U.S. Government Accountability Office report entitled, "Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities," GAO-06-352, dated May 8, 2006. In general, we agree with the information that pertains to the U.S. Fish and Wildlife Service.

At this point, we are unable to determine when Rocky Flats will be open to the public, due to the uncertainty of the completion of the transfer of the site. We recommend that the report focus on the transfer of administrative jurisdiction from the Department of Energy to DOI, establishing a National Wildlife Refuge, rather than focusing on when the public may access it. We also recommend that GAO clarify the actions that the Environmental Protection Agency must take to facilitate that transfer of administrative jurisdiction as well as the discussion of the acquisition of privately-owned mineral rights.

The enclosure provides comments from the U.S. Fish and Wildlife Service. We hope these comments will assist you in preparing the final report.

Sincerely,

Acting Assistant Secretary for Fish and Wildlife and Parks

Enclosure

Page numbers in the draft report may differ from those in this report.

Enclosure

U.S. Government Accountability Office Draft Report
"Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities"
GAO-06-352

Specific Comments

1. Page 2, second paragraph: Please change the last sentence to: "With the exception of one pedestrian trail, most of the planned wildlife refuge will not be open to the public until at least five years after the refuge is established." Based on the uncertainties of when administrative jurisdiction will be transferred to DOI, and when funding for refuge operations is available, we prefer this language instead of indicating specific years when trails may be opened.

2. Page 6, first paragraph: Please change the third and fourth sentences to: "If the joint decision is that no further action is required, and EPA certifies that the cleanup and closure of Rocky Flats is complete, DOE will transfer primary administrative jurisdiction over the majority of the site to the Department of the Interior for use as a wildlife refuge. If funds are available, FWS plans to open one pedestrian trail in the first year after the transfer and to open the remainder of the public trails and facilities between the 5th and 15th years following transfer." EPA will not "turn over" the site to FWS. EPA will certify that cleanup and closure are complete and DOE will transfer primary administrative jurisdiction to the Department of the Interior. The goals of the refuge Comprehensive Conservation Plan are to complete all planned public use facilities within the 15-year life of the plan.

3. Page 26, third paragraph: Please change the first sentence to: "The physical cleanup at Rocky Flats is complete, at a total cost (including long-term costs) of about $10 billion; however several regulatory steps remain before land can be transferred to the Department of the Interior for establishment of the wildlife refuge." The remaining regulatory steps are related to land transfer and refuge establishment. Opening the future refuge to the public is dependent on FWS funding, not regulatory approvals.

4. Page 27, first paragraph: Please change the first complete sentence to: "If they decide that no further action is needed to remediate the site, EPA will delete portions of the site from the CERCLA National Priorities List and certify that the cleanup and closure of Rocky Flats has been completed; the Secretary of the Interior can then accept administrative jurisdiction of designated lands and establish the refuge in accordance with the Rocky Flats National Wildlife Refuge Act of 2001." The Refuge Act requires "completion certification" by EPA. EPA, DOE, and FWS have all agreed that certification should not precede deletion of future refuge lands from the NPL.

5. Page 31, third bullet. We recommend that GAO review this bullet statement with the EPA. The Refuge Act requires transfer of administrative jurisdiction to DOI within 30 days of EPA certifying completion of the cleanup and closure. EPA has agreed to follow the precedent set at Rocky Mountain Arsenal and provide "completion certification" at the time land is deleted from the NPL. The deletion process is a rule-making process that takes longer than one month. If the "final decision document" is issued in November 2006, we expect that NPL deletion and certification of completion by EPA could not occur in December 2006.

6. Pages 31-32, fourth bullet: In the second sentence, please insert the words "designated essential" before "mineral rights." In the last sentence in the bullet on page 32, please replace the words "mineral rights held" with "sand and gravel mining." The 2006 Defense Authorization Act authorizes acquisition of designated "essential mineral rights." DOI will accept some lands encumbered by privately owned mineral rights (e.g., oil, gas, coal), but the designated areas subject to surface gravel mining will not become part of the refuge until those rights are acquired or the land is mined and reclaimed.

7. Page 32, second paragraph: Please change the last sentence to: "In the first year following land transfer and refuge establishment, and if funds are available, FWS will open one 1.75 mile pedestrian trail, that will follow the existing road to the Lindsay Ranch homestead site, which dates from the 1940's." The Lindsay Ranch actually dates from after WWII. Although the Refuge Act requires that the Lindsay Ranch "shall be permanently preserved and maintained in accordance with the National Historic Preservation Act," the Lindsay Ranch is not included on, nor is it eligible for inclusion on, the National Register of Historic Places.

8. Page 33, first paragraph: Please change part of the second sentence to "… 15 miles of trails …" Also in the second sentence, please change "2011 and 2016" to "2012 and 2022." The FWS Comprehensive Conservation Plan calls for the additional trails and facilities to be operational between 5 and 15 years following refuge establishment, which is anticipated not before 2007.

9. Page 34, first paragraph: In the first line, please insert "EPA and the State" following "DOE." Although DOE will prepare the CERCLA Five-Year Review, EPA and the State of Colorado have a significant role in that process.

10. Page 35, last paragraph: Please insert the word "designated essential" before "mineral rights" where "mineral rights" occurs throughout the paragraph. DOE is authorized to acquire only specified essential mineral rights at Rocky Flats.

Comments from the Colorado Department of Public Health and Environment

STATE OF COLORADO

Bill Owens, Governor
Dennis E. Ellis, Executive Director

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Colorado Department of Public Health and Environment

June 13, 2006

Gene Aloise, Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street N.W.
Washington, DC 20548

Dear Mr. Aloise:

Thank you for the opportunity to comment on your agency's report, "Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities (GAO-06-352)".

The Colorado Department of Public Health and Environment (the department) has been an integral participant in the Cleanup and Closure of Rocky Flats. We provided continual in-depth regulatory oversight of the investigative and remedial activities for both Building Decommissioning and Demolition, as well as for Environmental Restoration. The accelerated completion of physical activities at Rocky Flats was in large part expedited by the dedicated efforts of this department to perform our required regulatory activities, work in a consultative relationship, and provide rapid responses that allowed the continuation of the accelerated cleanup. This was accomplished without compromising our regulatory authority, clean-up objectives, or personnel safety and resulted in significant cost savings for DOE and the U.S. taxpayers.

The GAO Report provides an appropriate recognition of issues and actions occurring during the remedial activities at Rocky Flats. With the exception of technical comments my staff forwarded to you previously, we have no further comments on the document. Thank you for the diligence of your staff and for the opportunity to share our comments.

Sincerely,

Dennis E. Ellis
Executive Director

cc: Gary Baughman, Director, Hazardous Materials and Waste Management Division
Susan Chaki, Hazardous Materials and Waste Management Division
David Kruchek, Hazardous Materials and Waste Management Division
Carl Spreng, Hazardous Materials and Waste Management Division
Joe Schieffelin, Hazardous Materials and Waste Management Division

Comments from Kaiser-Hill Company L.L.C.

KAISER•HILL
COMPANY

May 25, 2006 06-RF-00069

Gene E. Aloise
Government Accountability Office
441 G. Street, NW
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KAISER-HILL COMMENTS TO GAO DRAFT REPORT (GAO-06-352) – NRT-007-06

Dear Mr. Aloise:

Thank you for the opportunity to review and comment on the Government Accountability Office's (GAO's) draft report, Nuclear Cleanup of Rocky Flats: DOE Can Use Lessons Learned to Improve Oversight of Other Sites' Cleanup Activities (GAO-06-352). We believe that the report is thorough and well written, and accurately describes Kaiser-Hill's role in the cleanup of Rocky Flats. In addition to the technical comments we provided to you under separate cover, there are only a few issues that warrant additional comment from Kaiser-Hill.

We are particularly pleased with the focus on the contribution of our hourly workforce to this project's success. From the beginning, with DOE's strong encouragement, Kaiser-Hill was committed to empowerment of individual workers and an emphasis on a positive, team-oriented environment. While accomplishing some of the most challenging tasks ever faced in a DOE closure project, our workers had among the best safety record in the DOE complex. To achieve these positive results, the workforce was backed by financial incentives, which ranged from individual spot bonuses for unique contributions, to year-end incentive payments tied to overall safety goals and project performance, to post-employment workforce transition benefits.

Kaiser-Hill strongly agrees with GAO's conclusion regarding the role the incentive contract played in the success of the project. We believe the success of the financial incentives during the project was only fully realized because of the commitment to share these incentives with our workers, from senior management to union members performing the day-to-day physical work. This organization-wide distribution of financial incentives may explain the disparity between our incentive-based closure contract and the varied success of other incentive contracts.

The success of the project was also due to the cooperative decision-making process that evolved among DOE, Kaiser-Hill, EPA, the State of Colorado, and local communities. Beginning with a firm political commitment to accelerate and finish the cleanup of Rocky Flats, the parties worked to

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resolve contentious issues and reach common goals, ultimately developing a positive working relationship that is unique in the DOE complex.

Kaiser-Hill would like to offer two clarifications to the report. First, Kaiser-Hill believes the total calculation of the clean-up costs detailed in the report is misleading. GAO used a calculation that includes costs associated with physical work during the cleanup and other tangential expenses such as health and pension benefits. This latter item alone adds $1 billion to GAO's overall cost reporting. It is important to note that a significant portion of these post-closure benefit costs were accrued during management of the facility by other contractors, including during weapons production, well before Kaiser-Hill was hired to execute the finite scope of the cleanup contract. While these costs represent real financial obligations to the taxpayer, including the entire sum of Federal benefit obligations from the life-cycle of the site does not accurately portray the value of the cleanup work scope.

Second, Appendix IV characterizes the data quality review effort for the final disposition of Trench T-7 (i.e., "the fourth project") as being "completed through a separate process that had less stringent requirements." In fact, the process followed was the standard one approved by the regulatory agencies for a No Further Accelerated Action (NFAA) justification, which was used to disposition many areas of the site. The NFAA documentation required a thorough review and presentation of data adequacy and quality information, but did not require the same level of presentation as the PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters detailed analysis. As a result, no formal presentation of such information was included in the NFAA Addendum reviewed by GAO staff.

Kaiser-Hill appreciates the opportunity to share these comments.

Sincerely,

Nancy R. Tuor
President and CEO
Kaiser-Hill Company

cc:
Frazer Lockhart – DOE, RFPO
Pam Tumler, GAO, Denver Office

GAO Contact and Staff Acknowledgments

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Staff Acknowledgments

In addition to the contact named above, Dan Feehan, Assistant Director; Keith Rhodes, GAO's Chief Technologist; Claire Cyrnak; Glenn Fischer; Tom Kingham; and Pam Tumler made significant contributions to this report. Others who made important contributions included Kevin Bailey, Michael Derr, Doreen Eng, Tom Denomme, Tim DiNapoli, Alison O'Neill, Judy Pagano, Kim Raheb, and Omari Norman. Also, Brandon Haller, Mehrzad Nadji, and Judy Pagano made important contributions to the methodologies used in this report.

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