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September 22, 2005

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

The Honorable Wayne Allard
United States Senate

Subject: *Nuclear Cleanup: Preliminary Results of the Review of the Department of Energy's Rocky Flats Closure Project*

For about 40 years, the Department of Energy's Rocky Flats site, near Denver, served as a production facility that made plutonium triggers, or "pits," for nuclear weapons. That role resulted in radiological and chemical contamination of many of the site's buildings and its soil and water. Cleanup of the site, which commenced in 1996, has been a monumental undertaking. The cleanup is being conducted under the Rocky Flats Cleanup Agreement, which is the legally binding agreement that provides the framework for the cleanup effort.¹ The cleanup agreement specifies the roles of the Department of Energy (DOE) and the two regulatory agencies for the site: the Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (Colorado). In February 2001, when GAO last reported on DOE's project to clean up and close the Rocky Flats site,² the project was slightly over cost and behind schedule. The vast amount of work remaining to be done at that time, along with various major challenges facing the cleanup contractor, made it doubtful that the contractor could achieve its December 2006 closure goal. But now the contractor hired by DOE (Kaiser-Hill Company, L.L.C.) plans to complete the physical cleanup portion of the work early and under budget. The regulatory agencies' final decision on the adequacy of the cleanup will take another year or so after completion of the physical cleanup, and the majority of the planned wildlife refuge will not open to the public for at least 5 years.

¹In addition, the cleanup must be conducted in accordance with all applicable statutes, including the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, also known as *Superfund*; and the Resource Conservation and Recovery Act of 1976, as amended.

²GAO, *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).

In this context, you asked us to determine (1) the key factors that contributed to the progress of the Rocky Flats cleanup; (2) when the Rocky Flats cleanup is scheduled to be completed, and at what total cost, including long-term stewardship costs; and (3) what measures DOE and the regulatory agencies are taking to determine that the cleanup will achieve a level of protection of public health and environment consistent with the cleanup agreement.

To address these objectives, we reviewed and analyzed project activity reports; decontamination and demolition accomplishments; financial documents; and scientific analyses, such as a study of how actinides³ 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 review the science underlying them. We also visited the site and observed cleanup activities, and we interviewed officials of DOE's Office of Environmental Management, Kaiser-Hill, EPA, Colorado, the Department of the Interior's Fish and Wildlife Service, and other entities. Further, we attended monthly meetings of the Rocky Flats Coalition of Local Governments and the Rocky Flats Citizens Advisory Board. We briefed you and your staff on the preliminary results of our review. This report summarizes our briefing, and the enclosure contains the briefing slides presented. We reviewed the data used to prepare this report and determined that they were sufficiently reliable for the purposes of the report. We conducted the work for this report from March through September 2005 in accordance with generally accepted government auditing standards. Our work is continuing, and we expect to issue a final report on the Rocky Flats cleanup project in March 2006.

Key Factors that Contributed to the Cleanup's Progress

According to DOE, the contractor, and the regulatory agencies, four key factors contributed to the cleanup's progress to date. These key factors are as follows:

- The cost-plus-incentive-fee contract provided Kaiser-Hill with strong profit incentives to complete the work quickly and safely. These profit incentives drove site workers to look for innovative and creative cleanup solutions because, for example, workers could receive bonuses for cost-saving suggestions. The incentives also led to a continuing focus on safety, as one significant safety infraction could shut down work in a building or throughout the site.
- EPA's Superfund accelerated cleanup process allowed cleanup actions to proceed much more quickly and collaboratively than would have happened under the traditional Superfund process. As the cleanup progressed, DOE, Kaiser-Hill, EPA, and Colorado staff often worked side by side in the field, participating in or observing soil removal actions and confirmatory sampling procedures.

³Actinides are a series of radioactive chemical elements with atomic numbers 89 (actinium) through 105 (hafnium).

- A confluence of site-specific events—climatic, geologic, chemical, and structural—aided the cleanup effort by confining both its scope and its complexity. For example, the dry Colorado climate and the alluvial fan⁴ on which the site is situated help to minimize erosion, thereby inhibiting offsite migration of contaminants. Also, the thick shale and clay stone that underlies the site prevents contaminants from seeping into the deep drinking-water aquifer. The chemical nature of key contaminants of concern at the site, plutonium and americium, also inhibit their migration, according to a study undertaken in the late 1990s. That is, these contaminants are relatively insoluble in water and tend to adhere to soil. Further, the robust construction of the plutonium production buildings at the site resulted in under-building contamination that was both less severe and less extensive than feared.
- The major challenges facing the contractor at the time of our last report have been resolved, except for safety, which has since improved but nonetheless will remain a concern as long as work goes on at the site. Some of the challenges identified in our 2001 report were overcome through innovation, as workers constantly sought ways to complete their tasks more quickly and at less cost. 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. Other challenges—such as uncertainties about the end use of the site—were overcome through congressional action, such as passage of the Rocky Flats National Wildlife Refuge Act of 2001. Resolution of the end use question led to resolution of the uncertainty about what cleanup levels were appropriate; this uncertainty was resolved through collaboration with the community and the regulatory agencies. Challenges posed by a balky plutonium packaging system were also overcome, as were challenges posed by insufficient numbers of available transportation casks and inadequate loading capability for certain wastes.

Cleanup Schedule and Cost

The contractor plans to finish the physical completion portion of the cleanup at Rocky Flats in late October 2005. “Physical completion” means that the contractor has met all contractual requirements, which include, for example, removing all buildings, waste, vehicles, and signage from the site and remediating contamination to the appropriate levels.⁵ After the contractor finishes its cleanup work, a number of regulatory and land-transfer events must occur before the Rocky Flats National Wildlife Refuge will open to the public. The estimated dates of some significant events include the following:

⁴An alluvial fan is a fan-shaped wedge of sediment that typically accumulates in arid or semi-arid climates on land where a stream emerges from a steep canyon onto a flat area.

⁵Should any problems arise following physical completion, such as additional contamination that the contractor should have remediated, under the terms of the contract, Kaiser-Hill would be responsible for coming back to the site and resolving the problems, according to DOE and Kaiser-Hill officials.

- December 2005 -- DOE determines that the contractor has completed physical cleanup.
- June 2006 -- DOE issues draft decision documents for public comment.
- November 2006 -- DOE, EPA, and Colorado issue final decision documents specifying the final remedy.
- December 2006 -- EPA certifies completion of the cleanup and removes portions of the site from Superfund's national list of cleanup sites.
- Early 2007 -- DOE transfers portions of the site to the Fish and Wildlife Service.
- 2011 through 2016 -- Fish and Wildlife Service opens public access trails and facilities in the wildlife refuge.

The cleanup project will cost about \$7 billion (since 1995), according to DOE, which includes an approximately \$510 million incentive fee to the contractor.⁶ DOE estimates additional long-term surveillance and maintenance costs of at least \$7 million per year; this estimate is for fiscal years 2007 through 2011, although some of these costs may continue indefinitely. For contractor employees at Rocky Flats, DOE's pension and postretirement benefits liability in fiscal year 2004 amounted to nearly \$100 million. DOE expects to continue paying between \$64 million and \$110 million per year for such benefits; the actual amount paid will fluctuate within this range depending on market and actuarial conditions and is expected to decrease after about 25 years. This estimate of benefit costs does not include up to an additional \$15 million expected to be funded to cover additional payments for contractor employees whose benefits would be affected by the cleanup's physical completion a year ahead of schedule. Additional costs associated with Rocky Flats include pending legislation that proposes authorizing up to \$10 million to purchase some privately held mineral rights at Rocky Flats, and a growing number of claims under the Energy Employees Occupational Illness Compensation Program Act of 2000 for harmful beryllium exposure at the site.⁷

Measures Taken to Determine Cleanup's Adequacy

Numerous measures have been and are being taken to provide assurance to DOE and the regulatory agencies that the cleanup will achieve a level of protection of public health and the environment consistent with the cleanup agreement. These measures include EPA's and Colorado's regulatory approvals of interim and final cleanup actions, DOE-initiated cleanup verification reviews, and independent reviews by scientific organizations and contractors. The primary cleanup assurance measure to

⁶Unless otherwise specified, all values are DOE estimates as of 2005, in current dollars.

⁷The act required implementation of a program to provide compensation to employees of DOE, its predecessor agencies, and its contractors and subcontractors involved in nuclear weapons production and testing programs.

date consists of regulatory approval of interim cleanup actions completed at individual hazardous substance sites. As of mid-September 2005, the regulatory agencies had approved the cleanup of 337 of the 360 individual sites. Another 21 sites were awaiting regulatory approval, and cleanup work at the 2 remaining sites had been completed, but the closeout report had not been finalized and sent to the regulators. Regulatory approval of these individual sites' cleanup, along with other regulatory documents, will provide support for the final regulatory approval, which EPA estimates will occur in late 2006.

A second cleanup assurance measure consists of three DOE-initiated actions to verify that the radiological surface soil contaminants have been sufficiently remediated. These actions, which began in the summer of 2005, consist of an aerial scan of the site, targeted ground-based scans of previously remediated areas, and the Oak Ridge Institute of Science and Education's (ORISE) independent verification of portions of the surface soil cleanup. The preliminary results of these actions indicate the existence of some additional areas of contamination; DOE has remediated some of these already and plans to remediate the others. ORISE has not yet completed its planned verification work, pending ongoing discussions with DOE. Ironically, although these verification activities were undertaken to increase public confidence in the cleanup, the preliminary results have sparked additional questions from the public about the cleanup. Furthermore, outside cleanup reviews have also served as a cleanup assurance measure. For example, the Agency for Toxic Substances and Disease Registry completed a public health assessment of Rocky Flats in May 2005. This assessment concluded that, owing to the lack of exposure pathways, residual contamination at Rocky Flats posed no adverse health risk to the local population. Other reviews include studies by independent consultants hired by local communities to review cleanup actions associated with the original landfill and surface and groundwater issues. Recommendations from these studies have been shared with DOE, which is now in the process of responding to them. Finally, the Fish and Wildlife Service plans to take surface soil samples in areas corresponding with proposed trails in the future refuge.

Preliminary Observations

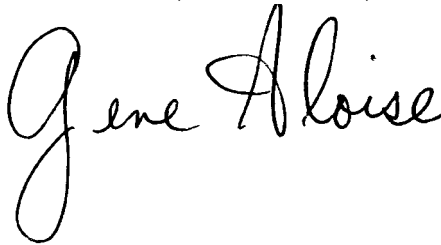
- The cleanup effort at Rocky Flats has been a massive and challenging undertaking, but it is not yet complete. Although the contractor plans to complete its work in late October 2005, regulatory activities will continue, as will any additional remediation required as a result of their conclusions. The final decision about the cleanup's adequacy is EPA's to make and will take at least another year. Even then, monitoring and maintenance activities will go on for decades.
- Throughout the cleanup effort, DOE, the contractor, the regulatory agencies, and the Fish and Wildlife Service garnered valuable lessons. Some of these lessons, such as innovative cleanup techniques, may be useful to other DOE sites undergoing or planning cleanup. Other lessons, however, may not be transferable. For example, knowledge gained about the migration of plutonium and americium through soil at Rocky Flats may not be helpful to

cleanup efforts at sites located in wet climates, where migration of other types of contaminants is extensive.

We provided the contents of this report to DOE's Office of Environmental Management, Legacy Management, and Rocky Flats Project Office; Kaiser-Hill; the Colorado Department of Public Health and Environment; EPA; and the Fish and Wildlife Service. We obtained views on the report contents from officials of these offices who were involved in or knowledgeable about the Rocky Flats cleanup. These officials generally agreed with the content of this report. In addition, the officials offered technical clarifications that we incorporated as appropriate.

As agreed with your offices, we will make copies of this report available to others upon request. This report will also be available at no charge on GAO's 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. Major contributors to this report include Daniel Feehan, Assistant Director; Claire Cynak; Glenn C. Fischer; Pam Tumler; and Keith Rhodes, GAO's Chief Technologist.

A handwritten signature in black ink that reads "Gene Aloise". The signature is written in a cursive style with a large, looping initial "G".

Gene Aloise
Director, Natural Resources and
Environment

Enclosure

Briefing Slides



Nuclear Cleanup: Preliminary Results of the Review of the Department of Energy's Rocky Flats Closure Project

**Briefing for
Chairman, Subcommittee on Strategic Forces
Committee on Armed Services
United States Senate**

and

**The Honorable Wayne Allard
United States Senate**

September 22, 2005



- For nearly 40 years, the Department of Energy's (DOE) Rocky Flats site served as a nuclear weapons production facility, manufacturing plutonium triggers for nuclear weapons.
- Most of the production work occurred in the 385-acre industrial zone and resulted in the radiological or chemical contamination of about 200 of the site's more than 800 structures and its soil and water. The remainder of the 6,300-acre site served as a buffer zone.
- DOE is responsible for cleaning up Rocky Flats and awarded Kaiser-Hill Company, L.L.C., a contract to decontaminate and remove structures and remediate environmental contamination at the site.
- The Rocky Flats Cleanup Agreement is legally binding and provides the framework guiding the effort. The regulatory agencies are the Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (Colorado).



- (1) What key factors have contributed to the cleanup's progress at Rocky Flats?
- (2) When is the Rocky Flats cleanup scheduled to be completed, and at what total cost, including long-term stewardship costs?
- (3) What measures are DOE and the regulatory agencies taking to determine that the cleanup will achieve a level of protection of public health and environment consistent with the cleanup agreement?



To answer the objectives, we

- reviewed and analyzed scientific analyses and project planning and budgetary documents;
- visited the Rocky Flats site and observed the cleanup work; and
- interviewed officials of DOE; Kaiser-Hill; EPA; Colorado; Interior's Fish and Wildlife Service; and various community stakeholder groups, scientific organizations, and consultants.



- According to DOE, the contractor, and the regulatory agencies, four key factors contributed to the cleanup's progress at Rocky Flats.
- The contractor's physical cleanup work is scheduled for completion in late October 2005, but key steps remain before the planned wildlife refuge will open to the public. The total cleanup cost will approach \$7 billion (since 1995), plus between \$64 million and \$110 million a year in pension liabilities (this cost will decrease after about 25 years), plus stewardship costs of about \$7 million a year that will continue indefinitely.
- DOE, the regulatory agencies, and others are taking numerous measures (e.g., surveys, samples, monitoring, and independent reviews) to determine that the cleanup will meet the terms of the cleanup agreement.



Four key factors, according to DOE, the contractor, and the regulatory agencies, have contributed to the cleanup's progress at Rocky Flats:

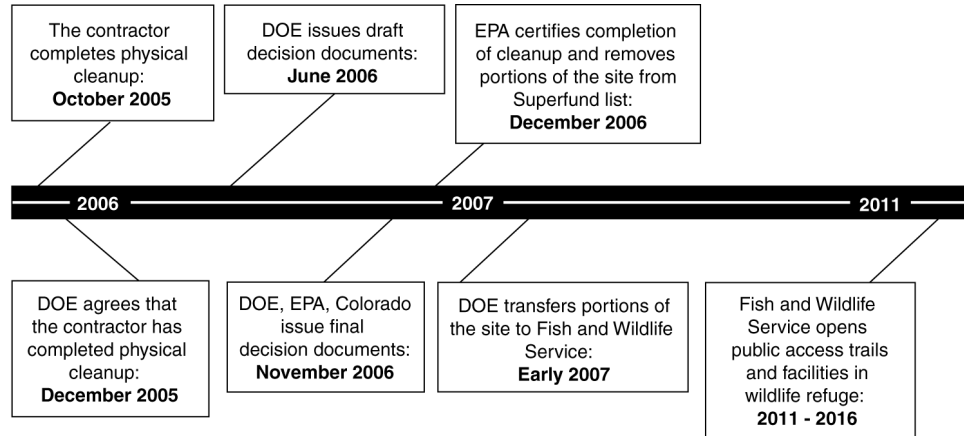
1. the cost-plus-incentive-fee contract structure, which encouraged the contractor to finish early and safely;
2. EPA's Superfund accelerated cleanup process, and the collaboration that this process encouraged among DOE, the contractor, and the regulatory agencies;
3. site-specific characteristics that confined the cleanup's scope and complexity, including climatic, geologic, structural, and chemical characteristics; and
4. overcoming the challenges we identified in 2001, such as completing the buildings' cleanup and demolition; getting all the waste packaged and shipped; and working safely, which has improved but remains a concern.



- The contractor plans to complete its physical cleanup work in October 2005, but the regulatory agencies' final decision on the adequacy of the cleanup will take another year or so, and the majority of the planned wildlife refuge will not open to the public for at least 5 years.
- Total cost of the cleanup project, from 1995 to present, will be nearly \$7 billion.
- DOE estimates additional long-term surveillance and maintenance costs of at least \$7 million per year, and some of these costs may continue indefinitely.
- DOE will likely pay between \$64 million and \$110 million per year for up to 25 years, with costs decreasing thereafter, for contractor pensions and medical and life insurance benefits.
- Up to \$10 million may be authorized to purchase some privately held mineral rights at Rocky Flats.



Estimated Dates of Significant Events at Rocky Flats



Sources: GAO, DOE, Environmental Protection Agency, Fish and Wildlife Service, and Kaiser-Hill.



DOE and others are taking numerous measures to determine that the cleanup will achieve a level of protection of public health and environment consistent with the cleanup agreement:

- Key scientific studies supporting cleanup actions
- Interim and final regulatory approvals by EPA and Colorado
- DOE-initiated verification of surface soil cleanup
 - Aerial scan
 - Targeted ground-based scans
 - Oak Ridge Institute of Science and Education's verification of portions of the surface soil cleanup
- Agency for Toxic Substances and Disease Registry's final public health assessment
- Reviews by outside consultants
- Fish and Wildlife Service's future property review



- A confluence of events defined the cleanup's parameters and contributed to DOE's and regulatory agencies' confidence in the cleanup. But the cleanup is not finished. Regulatory activities are continuing, and they may result in the need for additional remediation. The final decision about the cleanup's adequacy is EPA's to make and will take at least another year.
- The Rocky Flats cleanup has been a massive and challenging undertaking through which many lessons have been learned—by all parties. Many of these lessons may be applicable to DOE's cleanup efforts at other sites; others may not be. What worked at Rocky Flats may not necessarily work at a site whose geology, climate, and contaminants render the cleanup effort more extensive.

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