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HAZARDOUS WASTE

Selected Aspects of Cleanup Plan for Rocky Mountain Arsenal

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National Security and
International Affairs Division

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August 29, 1986

The Honorable Ronald V. Dellums, Chairman
The Honorable Ken Kramer, Ranking Republican
Member
Subcommittee on Military Installations
and Facilities
Committee on Armed Services
House of Representatives

On June 27, 1986, you requested us to provide the Subcommittee with our views on the cost and economic assumptions in the Department of the Army's June 1986 draft plan to accelerate the cleanup of the Rocky Mountain Arsenal near Denver, Colorado. Under section 822 of the Military Construction Authorization Act of 1986 (Public Law 99-167), the Army's plan is required to be submitted to the Congress by September 1, 1986, and to include cost estimates for completing, not later than September 30, 1993, the cleanup of contaminated sites, structures, equipment, and natural resources at or near the Arsenal.

The cost and economic assumptions included in the draft plan appear to be well documented for the types of cleanup activities considered. However, there is substantial uncertainty about the volume of contaminated material and the methods of treatment and disposal. Consequently, the projected cost of cleaning up the Arsenal is not yet an adequate estimate. A remedial investigation and a feasibility study are currently underway to further develop options for cleaning up the site, and to select a cost-effective alternative that meets cleanup goals and protects the public health and the environment, as required by the Comprehensive Environmental Response, Compensation, and Liability Act. These studies are scheduled to be completed by April 1988. Until they are completed and all alternatives are considered, cost estimates for cleaning up the Arsenal should be considered preliminary.

Specific results of our work are summarized in appendix I, a summary of cost elements is in appendix II, and the objective, scope, and methodology of our review are discussed in appendix III.

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this briefing report until 30 days from the date of issuance. At that time, we will send copies to interested parties and make copies available to others upon request.

If you need additional information, please call me on 275-4262.

Harry R. Finley
Senior Associate Director

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ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EPA	Environmental Protection Agency

COST AND ECONOMIC ASSUMPTIONS IN THE ARMY'S ACCELERATED CLEANUP PLAN FOR THE ROCKY MOUNTAIN ARSENAL

Beginning in 1942, the Army used Rocky Mountain Arsenal for the manufacture and assembly of chemical intermediate and toxic end-item products, incendiary munitions, and chemical warfare agents. During the period 1945 to 1950, the Army used the Arsenal for the destruction of chemical agents and obsolete World War II ordnance. The Shell Chemical Company has leased a portion of the Arsenal for the manufacture of various pesticides and herbicides since 1952. The problem of contaminants migrating from the Arsenal into offsite groundwater has been recognized since 1954. Pollution abatement efforts have been implemented since that time in an attempt to control contaminant migration. In 1982, the Army, the Colorado Department of Health, the Environmental Protection Agency (EPA), and the Shell Chemical Company entered into a Memorandum of Agreement under which the Army agreed to prepare a qualitative assessment of alternative measures needed to remove or remedy all contamination at the Arsenal so that the property could possibly be released for unrestricted (industrial or commercial) use.

As a result of that agreement, the Army, in 1984, initiated a remedial investigation and a feasibility study to select an appropriate remedy that will adequately protect the public health and welfare and the environment. The remedial investigation and the feasibility study are key components for developing remedial actions in accordance with the National Contingency Plan (40 Code of Federal Regulations, Part 300). The plan established procedures and standards for responding to releases of hazardous substances, pollutants, and contaminants. The Army's selection of an appropriate remedy is not scheduled to occur until April 1988, after completion of the study.

The Army is required by section 822 of the Military Construction Authorization Act of 1986 (Public Law 99-167) to submit to the Congress by September 1, 1986, a comprehensive plan as well as cost estimates for completing, not later than September 30, 1993, the cleanup of contaminated sites, structures, equipment, and natural resources at or near the Arsenal. The Army, in a prior study, had estimated that site cleanup would not be achieved until the year 2000.

The June 1, 1986, draft plan on the accelerated cleanup, prepared by Environmental Science and Engineering, Inc. (the contractor), considers four alternative scenarios for site cleanup. All scenarios assume that site cleanup activities will not be initiated until after the selection of an appropriate remedy in April 1988. Costs to clean up the Arsenal are

estimated at $964 million to $4.2 billion (1985 dollars), depending upon the scenario selected. A summary of these estimates is in appendix II.

COST ESTIMATES AND ECONOMIC ASSUMPTIONS

Cost data used to estimate site cleanup costs were obtained from three primary reference sources: prior technical and cost estimate studies conducted for the Army[1], vendors, and construction cost estimate manuals used by industry. We do not know if cost estimates obtained from prior studies are reasonable, due to our limited review of this data. However, because of the constraints imposed on the contractor to develop the draft plan, we believe the use of costs from prior technical and cost estimate studies was a reasonable approach. We found that costs derived from the other sources were supportable and reasonable.

The draft plan contains few economic assumptions. The major economic assumption concerns the rate of inflation used to project total cleanup costs for each scenario. The rate used to inflate costs was the rate developed by the Office of Management and Budget to escalate military construction costs.

Cost estimates

The methodology used by the contractor to prepare cost estimates of cleaning up the Arsenal included the collection, review, and selection of pertinent cost data bases; compilation of unit cost elements; performance of sizing or material handling calculations; and calculation of capital, operations and maintenance, and replacement cost estimates. Most of the cost information was obtained from engineering estimates contained in prior reports prepared for the Army.

Specifically, the costs of material excavation and loading, onsite disposal, and incineration were obtained from prior technical and cost estimate studies. The unit costs in these references were updated to 1985 costs. According to the contractor's program manager, these costs were obtained from previously published reports because of (1) the short time frame available to prepare the plan, (2) the emphasis on the scheduling of the cleanup activities and the secondary importance of cost in developing the draft plan, (3) the

[1]Decontamination Assessment for Land and Facilities at Rocky Mountain Arsenal, D'Appalonia Consulting Engineers, Inc., June 1984; Concept Design of Hazardous Waste Landfill Facility, IT Corp., September 1984; and Review and Assessment of Incineration as a Decontamination and Transportation Volume Reduction Technique for Rocky Mountain Arsenal, D'Appalonia Consulting Engineers, Inc., October 1983.

limited sources of data on the unique onsite containment structure and incinerator, and (4) the common practice, which is acceptable in industry, of relying on previously published material to develop cost estimates. We performed only a limited review of the cost estimates contained in these prior studies; therefore, we do not know if the cost estimates used from these studies are realistic or supportable. However, given the constraints under which the contractor was operating in order to prepare a plan by September 1, 1986, we believe that the use of costs from prior technical and cost estimate studies as a basis for estimating accelerated site cleanup costs was a reasonable approach.

In order to develop the remaining cost data, the contractor obtained 1985 vendor quotes and utilized construction cost estimating manuals for building and construction costs. The cost of offsite disposal was developed by contacting commercial hazardous waste landfill operators and railroad officials to obtain 1985 cost estimates for hauling and disposing of the 16 million cubic yards of hazardous material. Similarly, the cost to backfill the site with uncontaminated fill dirt was obtained through vendor quotes for material, loading, and transportation. The cost to compact the backfill was derived from a 1985 construction cost index.

We found sufficient support and documentation of costs derived from vendors and construction cost manuals. To determine if the vendor quotes were reasonable, we contacted the vendors to verify a number of the quotes used, including landfill costs, backfill costs, and rail and truck transportation costs. We found that costs cited in the draft plan were generally consistent with those we obtained. However, officials at landfill sites in both Colorado and Utah expect landfill costs to escalate significantly more than projected in the draft plan.

The Army project office, to assure that costs contained in the draft plan were appropriately compiled, requested an internal comprehensive review and validation of the study. According to Army regulations, such reviews are appropriate for planning documents and are intended to assure that appropriate costs are internally consistent and reasonable; assumptions made are logical, reasonable, and complete; support documentation is adequate; and inflation factors are appropriate. The March 14, 1986, review found only minor problems. According to an Army project official, these problems were corrected before the draft plan was published.

Economic assumptions

The two economic assumptions contained in the draft plan relate to the escalation of project costs and the basis of the 1985 cost estimates. The escalation of the project costs over time

to allow for the completion of the cleanup is a necessary assumption. Cleanup costs will not be incurred all in one year, but will occur periodically until the project is completed. To escalate costs estimated in 1985, the contractor used yearly escalation factors developed by the Office of Management and Budget for military construction costs based on actual military construction experience. Given that this cleanup is a large scale military excavation and construction project, these escalation factors appear appropriate.

The second economic assumption concerns the status of the local economy both now and in the future. For example, the contractor assumes that sufficient contract labor will be available in the local area during scheduled activities and that other construction projects in the area will not affect its ability to obtain adequate labor. Currently, the Denver area economy, both mining and construction, is relatively depressed, and therefore contains surplus labor. If the economy were to strengthen, adequate labor may still be available but at a higher cost than in 1985. We cannot say to what extent the costs discussed in the plan may change if the labor supply of the region changes. However, given the general level of uncertainty inherent with area economic forecasts, this assumption appears reasonable.

OTHER FACTORS MAY SIGNIFICANTLY AFFECT PROJECTED COSTS

The draft plan contains assumptions about the volume of contaminated material, method used to treat hazardous waste, and availability of commercial landfill space. The types and volumes of contaminated material have not been identified. Also, the technologies best suited for waste treatment and disposal have not been selected. The remedial investigation and feasibility study will provide more detailed and reliable information on these key assumptions. However, it will not be completed until October 1987, and the selection of a final response action is not scheduled until April 1988.

The uncertainty of the estimates, we believe, underscores the need to complete the remedial investigation and the feasibility study before reaching a final decision on how to clean up the Arsenal.

Volume of hazardous material uncertain

One of the major factors affecting estimated cleanup costs is the volume of contaminated material at the site. The draft plan assumes about 16 million cubic yards of contaminated buildings, equipment, and soil. This assumption is based on the results of a study completed in 1984, which identified 88 polluted sites on the Arsenal. The estimated volume of hazardous waste in that study was developed either through actual data or, for the majority of the sites, through calculations based on best

engineering judgement. The study estimated that the volume of contaminated soil for most of the land sites was accurate to within a range of -34 to +13 percent of the actual values.

According to Colorado Department of Health officials, there appears to be a significant misperception of the quantity and type of hazardous waste at the Arsenal. They believed that the 16 million cubic yard estimate was derived from incomplete and outdated data. These officials consider a volume of 7 to 8 million cubic yards of hazardous material as a more realistic estimate of what must be treated and/or disposed of. Contractor and Army officials agree that the 16 million cubic yard estimate is a conservative figure--i.e., could be overestimated to some extent. However, they believe that, based on the most recent data available, the final volume will not decrease by as large an amount as Colorado Department of Health officials indicate.

Regional EPA officials are reluctant to comment on the accuracy of the 16 million cubic yard figure until a more accurate estimate can be developed during the remedial investigation.

Waste treatment limited to incineration

The only technology considered for treatment of the contaminated materials was incineration. The incineration equipment will be large rotary kilns, up to 17.5 feet in diameter and 300 to 400 feet long. The cost of constructing the kilns is estimated at $18.5 million each and the operating cost is projected at $5 per cubic yard. Kilns of this size have never been constructed and have never been demonstrated to effectively treat hazardous waste. EPA and Department of Health officials from Colorado and Utah believe the $5 per cubic yard operating cost to incinerate waste is too low.

In commenting on the draft plan, EPA, the Colorado Department of Health, and the Shell Oil Company noted that the plan does not evaluate alternative measures of dealing with the contamination at the Arsenal. According to a Colorado Department of Health official, limiting waste treatment to incineration technology is highly questionable because final treatment of contamination at the Arsenal will probably involve numerous waste treatment technologies. This official believed that incineration was the most extreme and expensive option available to treat the waste.

A Denver environmental firm official commenting on the draft plan, also expressed concern over the incineration method proposed because he believed it would be extremely expensive and could potentially transfer hazardous waste problems from the ground into the atmosphere. EPA, as a result of its review of the draft plan, urged the Army to refrain from selecting a specific remedy for clean up of the Arsenal until other alternatives and technologies have been evaluated.

A number of officials, including those at the Colorado Department of Health and EPA, believe the $5 per cubic yard operating cost to incinerate waste is low. At commercial facilities, current operating costs range from $50 to $1,000 per cubic yard. They believe $100 per cubic yard operating cost may be more realistic considering that cost elements such as labor, maintenance, power supply, and waste treatment for incineration processes and scrubbers (air cleaners) need to be included.

A contractor official who helped prepare the draft plan told us that disposal of wastes by incineration was purposely singled out because it is a proven technology and can treat the variety of waste at the Arsenal. As a result, he said it simplified plan preparation because a variety of waste treatment technologies did not have to be included. The contractor project manager, commenting on the $5 per cubic yard operating cost, agreed that it would appear low in comparison to operating costs cited by commercial incinerating companies. However, this official believed the cost was a reasonable estimate because of the large capacity of the incinerator, the low cost of coal used for fuel, and the exclusion of any overhead or profit.

Commercial landfill storage is limited

Commercial offsite landfill capacity was assumed to be sufficient to accept the volume of contaminants to be disposed of from the Arsenal. The plan cites offsite disposal at $100 per cubic yard. The charge for disposal in Colorado and Utah increases to $114 and $173 per cubic yard, respectively, when transportation and unloading costs are added. We found that the two landfill sites discussed in the draft plan may not be able to accept large volumes of waste and if so, costs may be significantly higher than projected in the draft plan.

The facility at Last Chance, Colorado used as an in-state landfill in the draft plan, has not yet been permitted as a hazardous waste disposal site. While the permit is expected to be granted later this year, the site may only be able to accommodate a small portion of the Arsenal's waste. Permitting will allow the construction of 16 storage cells with a total capacity of about 2.5 million cubic yards of hazardous waste. This is significantly less than the 16 million cubic yards referred to in some of the disposal scenarios described in the draft plan.

The Utah hazardous waste disposal site, referred to in the plan as the out-of-state landfill facility, is also limited to a capacity of about 1.4 million cubic yards of waste. According to Utah Bureau of Solid and Hazardous Waste officials, it is doubtful whether this facility will be able to expand since it is surrounded by public lands and it may not be possible for the

commercial operator to obtain a permit to use public lands for a disposal site.

Not only is the availability of commercial landfill space questionable, the future cost to dispose of waste commercially is also uncertain. According to the contractor's project manager, the cited price of $100 a cubic yard will probably increase significantly in the future. For example, Army estimates show that the cost of hazardous waste disposal has tripled from 1982 to 1985. Factors affecting the future cost of disposal at commercial landfills include

--more stringent environmental regulations governing commercial landfills,

--dwindling commercial landfill space, and

--litigation.

According to the project manager, granting permits for hazardous waste landfills has slowed dramatically. The commercial industry will place a heavy burden on existing landfill space when additional funding is provided for private industry's hazardous waste remedial actions and when sanitary landfills are prohibited from disposing of hazardous household products. The project manager estimates that costs could jump to $500 a cubic yard by the time disposal occurs.

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WILL PROVIDE ADDITIONAL DATA

The Army is conducting a remedial investigation and a feasibility study, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan. These efforts will provide more information on the extent and type of contamination on the Arsenal. Also, the study will consider various technologies to best clean up the hazardous waste.

Extensive soil and water samples are being taken to determine, more precisely, the nature and extent of hazardous materials at the Arsenal. At present, sampling is about 50 percent complete and is projected to continue through early 1987. According to a contractor official, preliminary sampling results indicate that several areas previously believed to contain toxic waste are actually not polluted. Conversely, some areas thought to be clean have been identified to contain hazardous waste.

Various alternative disposal technologies will be investigated during the feasibility study, which is scheduled to be concluded by October 1987. Numerous disposal technologies will be evaluated on the basis of cost, technical feasibility, and

compliance with environmental requirements. The final decision on how best to dispose of the waste is not expected to be made until April 1988. A final waste disposal method, according to an Army project office official, may or may not include any or all of the alternatives described in the plan. In all probability, numerous waste treatment technologies and methods will be used to clean up the Arsenal.

It should be noted, however, that even after the remedial investigation and feasibility study is completed and the Army selects the most cost-effective response action plan from the various alternatives, the cost estimates for that plan will still be highly uncertain. According to EPA and contractor officials, the design details in a final response action for a CERCLA site are generally limited and only sufficient to prepare cost estimates to within a -30 percent and +50 percent accuracy.

SUMMARY OF ALTERNATIVE SCENARIO COST COMPONENTS

	Scenario cost			
	A	B	C	D
	---(millions of 1985 dollars)---			
Pre-remedial action costs	$309.6	$309.6	$309.6	$309.6
Remedial action cost components				
1. Clearing and surveying all contaminated sites	$3.3	$3.3	$3.3	$3.3
2. Support mobilization	8.0 to 8.5[a]	8.0	10.2	10.7
3. Building demolition	22.3	22.3	22.3	22.3
*4. Hazardous materials excavation and loading	75.0	75.0	75.0 to 77.8[b]	75.0
*5. Offsite commercial landfill	2,085.0 to 3,185.0[c]	0	546.0 to 834.0[c]	1,145.0 to 1,749.0[c]
*6. Onsite disposal	0	240.8	175.0	105.1
*7. Backfill	145.0 to 512.0[d]	83.0	99.6 to 197.0[d]	117.0 to 322.0[d]
*8. Incinerators (waste treatment)	68.0 to 86.5[e]	196.3	158.8	117.7
9. Closure	9.4	9.5	9.5	9.5
10. Surface water management	1.8	1.8	1.8	1.8
11. Groundwater treatment units	[f]	[f]	[f]	[f]
12. Groundwater containment facilities	12.0	12.0	12.0	12.0
13. Treatment/containment operation and maintenance (annual)	2.1	2.1	2.1	2.1

*Cost components selected for our analysis.

LEGEND:

Scenario A--Removal of all contaminants from the Arsenal, incineration of agent-contaminated materials, and disposal of all materials in a permitted landfill in or outside the state of Colorado.

Scenario B--Removal of all contaminants, with incineration of contaminated materials to allow disposal in an onsite facility.

Scenario C--Removal of all contaminants with disposal of nonagent-contaminated materials in an offsite facility until onsite incinerators and disposal facilities are available. Remaining materials will be treated and disposed of onsite.

Scenario D--Removal of all contaminants by disposal in both offsite and onsite facilities with incineration of materials prior to onsite disposal.

[a]Variance due to duration of each scenario.

[b]Variance due to number of cubic yards hauled onsite by truck.

[c]Variance due to location of landfill and volume of material.

[d]Variance due to source of backfill.

[e]Variance due to amount of material incinerated.

[f]Costs are included in cost estimates for groundwater containment facilities.

OBJECTIVE, SCOPE, AND METHODOLOGY

The objective of this review was to evaluate the adequacy of the cost and economic assumptions in the Army's draft plan to accelerate the cleanup of hazardous waste sites on the Rocky Mountain Arsenal. As agreed, we reviewed 5 of the 13 cost components which account for 91 to 98 percent of the total cleanup cost estimate. Because of the short time frame, we did only a limited analysis of these estimates. However, we verified vendor quotes and reviewed the Department of the Army's cost validation to determine if the costs cited were reasonable. We also analyzed and reviewed the adequacy of the economic assumptions used to develop the cost estimates.

To examine the potential impact of restrictions and assumptions made in the draft plan, we met with officials at the U.S. Army Toxic and Hazardous Materials Agency, Project Manager's Office for Rocky Mountain Arsenal, as well as officials from Environmental Sciences and Engineering, Inc., the contractor which prepared the draft plan. Discussions with these officials focused on the types of assumptions used to develop the projected estimated cost to clean up the Arsenal. We also reviewed comments received by the project manager's office on the draft plan and met with officials from EPA's Region VIII and the Utah and Colorado Departments of Health to obtain their views. The views and comments of these officials were incorporated in this briefing report where appropriate.

Our work was performed during July and August 1986 in accordance with generally accepted government auditing standards.

As requested, we did not ask the Department of Defense to review and comment on a draft of this briefing report.

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