

# Chapter 2

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## Baseline Scope, Schedule, and Cost





Chapter 2 presents the scope, schedule, and cost of the Environmental Management (EM) cleanup program. This chapter begins with a discussion of the approach taken by sites to the development of baselines and the relationship of those baselines to the Project Baseline Summaries (PBSs) used to aggregate the data in *Paths to Closure*. Following the discussion on baselines, the chapter provides a summary of the baselines for each Operations/Field Office, a profile for the completion of Environmental Management work at each site, a discussion of how the EM program is managing its cleanup schedule and a reconciliation with the Department's FY 1997 Financial Statement. The basic work scope, cost, and schedule data in this report has not changed since the publication of the February draft *Paths to Closure*.

## 2.1 The Development of Site Baselines

One of the fundamental improvements to the management of the EM program is the aggregation of units of work essential to EM's cleanup mission into projects. The creation of projects enables Field managers to develop detailed projections of scope, schedule, and cost (that is, a baseline) for each site, based upon the aggregation of logical, discrete units of work. Historically, during the nuclear weapons production phase, sites used mostly level-of-effort methodologies to develop estimates. In contrast, site baselines, built from individual project baselines, are the foundation for cost projections in *Paths to Closure*. The direct link of scope, schedule, and cost estimates in site baselines to estimates in *Paths to Closure* means that the quality of data in the document is linked directly to the quality of site baselines.

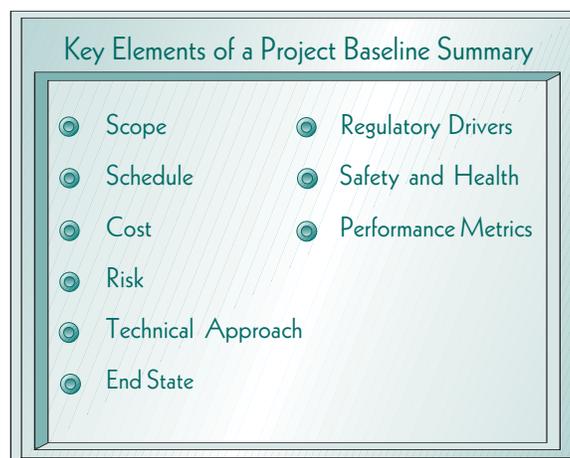
One key determinant of quality is the definition of scope. It is more difficult to develop a baseline for a technically challenging, first-of-its-kind project than for a clearly-defined project that is based on an established approach. The EM program is responsible for a massive environmental cleanup effort, much of which is the first of its kind. A good example of the type of challenge that the Environmental Management program faces is the cleanup of high-level waste tanks at the Hanford Site, a project which is estimated to cost \$30 billion (constant 1998 dollars) over the life cycle. The Hanford high-level waste project has been

characterized as one of the most challenging engineering projects ever undertaken. Given the technological challenges and the uncertainties involved with the characterization of tank waste, the chemical interactivity of the constituents, the method of removal of waste from the bottom of the tanks, and the processing method that will be applied once the material has been removed from the tanks, the overall baseline for this project encompasses a great deal of uncertainty.

Despite uncertainties, EM's knowledge has increased substantially over the past several years, supporting the development of better baselines. The development of conceptual approaches to the storage, treatment, and disposal of all waste types at all sites is an example of the progress that the EM program has made. Such conceptual approaches, reflected in schematic diagrams called **disposition maps**, provide a picture of the scope of the EM program's environmental restoration and waste management activities. In addition, the maps simultaneously identify uncertainty related to overall scope and disposition. Each site also has improved its understanding of its **critical closure path**, that is, the universe of activities that must be completed on time in order for EM activities to be completed as scheduled. Disposition maps and critical closure paths are works in progress that help document the scope, schedule, and cost of the EM program at each site. A short-term priority for the EM program is to continue to improve its understanding of the scope of the cleanup program through the refinement of baselines and related tools, including disposition maps and critical closure paths.

As part of the overall guidance for developing baselines, sites were given a funding guideline of \$5.75 billion per year, which is consistent with recent appropriations. Some site baselines currently exceed their share of the \$5.75 billion per year funding guideline to show compliance requirements. In response to concerns expressed by stakeholders, regulators, and Tribal Nations, the EM program requested that the sites include assumptions of enhanced performance (reductions in cost achieved through increased efficiency), integration assumptions, and other cost-saving assumptions only in cases in which sites were confident that such performance could be demonstrated or where stakeholders, regulators, and Tribal Nations have approved them.

Sites provided information from their baselines to support *Paths to Closure*, primarily in the form of PBSs. Appendix A presents a complete list of PBSs. A **PBS** is not the project baseline, but rather a management tool that summarizes information about each project (see text box). PBSs are used for planning, budgeting, and evaluation. Appendix B provides a sample PBS.



## 2.2 Operations/Field Office Estimates of Cost and Closure

The PBS for each project includes information about scope, schedule, and cost from 1997 through 2070. While all EM cleanup activities are scheduled for completion before 2070, some long-term surveillance and monitoring and stewardship activities will continue beyond 2070. *Paths to Closure*, however, includes only costs through 2070. In each PBS, Operations/Field Offices reported costs in current year dollars; therefore, the cost estimates have already been adjusted for inflation (assumed to be 2.7 percent per year) and indicate the cost at the expected time of the outlay. Inflation lowers the “buying power” of each dollar over time, so a project that costs \$5 million current year dollars in 1998 is more expensive, in relative terms, than a project that costs \$5 million in current year dollars in 2006. The use of constant 1998 dollars in discussions of cost estimates in *Paths to Closure* ensures the comparability of costs over time, eliminating those variations that are the result solely of inflation.

The EM program baseline is based on 353 PBSs. The cost estimate (1997 through 2070) for the EM program—\$147.3 billion in constant FY 1998 dollars—aggregates costs for all 353 PBSs. Exhibit 2-1 shows the overall estimate by Operations/Field Office. The 53 sites in the “Number of Sites Completed” columns include sites planned for completion in 1998 and beyond. Historically, 60 sites were completed through 1997. Appendix C provides a complete list of geographic sites with their actual or planned completion dates.

Exhibit 2-1 shows that the current site baselines support the 2006 vision of completing cleanup at most sites by 2006. However, it also shows that by 2006, completion of EM activities occurs primarily at the Department’s smaller sites. After 2006, EM’s greatest challenge will be to complete cleanup at some of the largest and most technically complex sites. In fact, 77 percent of the estimated costs after 2006 are accounted for by the Savannah River Site, the Hanford Site (managed by Richland), and the Idaho National Engineering and Environmental Laboratory.

Exhibit 2-1  
EM Costs by Operations/Field Office

Operations/ Field Office	Estimated EM Costs (1997-2006)	Estimated EM Costs (2007-2070)	Total Estimated EM Costs (1997-2070)	Number of Sites Completed	
	(All costs in billions of constant 1998 dollars)			1998- 2006	After 2006
Albuquerque	2.1	2.0	4.1	12	1
Carlsbad <sup>a</sup>	1.8	5.9	7.7	0	1
Chicago	0.3	0.0	0.3	5	0
Headquarters/ National Programs	5.7	5.6	11.3	NA	NA
Idaho	5.0	11.3	16.3	0	1
Nevada	0.9	1.3	2.2	8	2
Oakland	0.7	0.3	1.0	8	1
Oak Ridge	5.4	7.7	13.1	3	2
Ohio	4.6	0.2	4.8	5	1 <sup>b</sup>
Richland	13.0	37.3	50.3	0	1
Rocky Flats	5.3	1.0	6.3	0	1 <sup>c</sup>
Savannah River	12.0	17.7	29.7	0	1
<b>TOTAL<sup>d</sup></b>	<b>57.0</b>	<b>90.3</b>	<b>147.3</b>	<b>41<sup>e</sup></b>	<b>12</b>

53

<sup>a</sup> Costs for the Carlsbad Area Office include the costs associated with operating the Waste Isolation Pilot Plant as the national repository for the disposal of transuranic waste and the costs of decommissioning the site after disposal operations have ended.

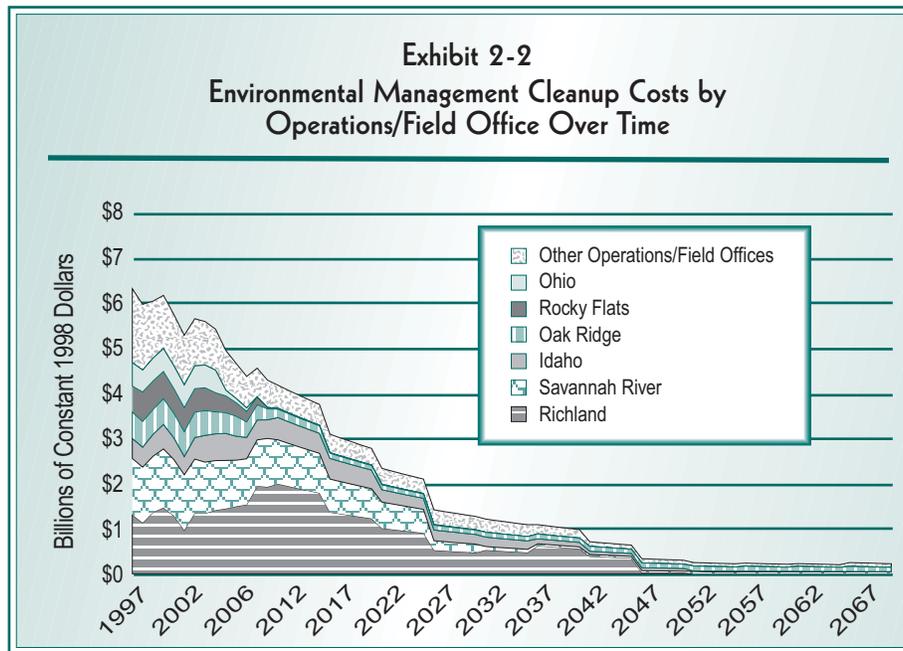
<sup>b</sup> The one site after 2006 is the Fernald Environmental Management Project (FEMP). It is expected that cleanup at FEMP also will be completed before 2006, although the baseline currently indicates completion in 2008.

<sup>c</sup> The current baseline for the Rocky Flats Environmental Technology Site reflects a 2010 closure. However, the baseline is being revised to reflect the commitment to complete closure by 2006.

<sup>d</sup> Individual costs may not sum to totals due to rounding.

<sup>e</sup> With the accelerated goal of cleaning up the Rocky Flats Environmental Technology Site and the Fernald Environmental Management Project (by 2006 and 2005 respectively), the number of sites completed by 2006 would be 43.

Exhibit 2-2 displays the life-cycle cleanup costs of the EM program, over time, by Operations/Field Office. “Other Operations/Field Offices” in Exhibit 2-2 includes Albuquerque, Carlsbad, Chicago, Headquarters/National Programs, Nevada, and Oakland.

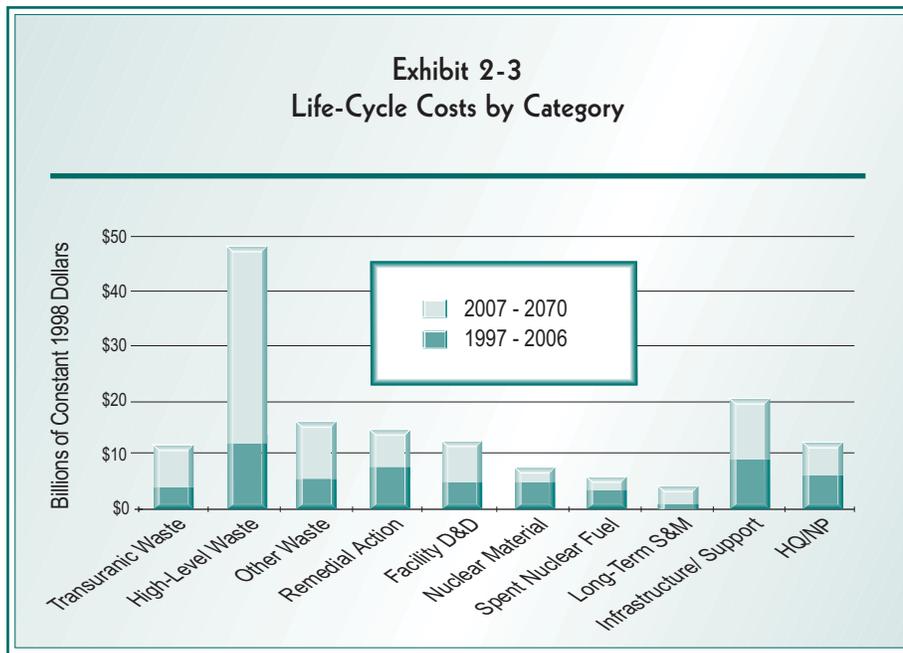


### 2.3 Details of Life-cycle Costs

This section presents details of the life-cycle cleanup costs for the EM program. First, the section relates costs to the types of work EM performs, thereby outlining major cost drivers for the program. Second, the section breaks out EM costs by state. Third, the section explains other scope and costs that, while not the focus of *Paths to Closure*, are nevertheless important to put this report in context. Finally, the section displays costs by a system of categories that parallels EM’s current budget structure, shows the benefits of aggregating units of work into projects, and illustrates the EM program’s focus on the completion of specific projects by 2006.

### 2.3.1 Cost by Category of the EM Work Scope

The \$147.3 billion life-cycle cost estimate includes the costs of completing all known EM work scope. To provide additional insights on cost, each Operations/Field Office estimated the distribution of costs by scope category. These supplementary data by category are presented in Exhibit 2-3. Brief explanations of the categories follow the exhibit.



**High-level Waste.** Currently, the EM program is responsible for the storage, treatment, and stabilization of hundreds of thousands of cubic meters of highly radioactive waste generated from decades of nuclear weapons production, mostly at the Savannah River Site, the Hanford Site, and the Idaho National Engineering and Environmental Laboratory. High-level waste also is found at the West Valley site in New York. High-level waste management is by far the largest cost driver for EM; it is estimated to account for 32 percent of the total cost of the EM program over the life cycle. Approximately 74 percent of these costs will remain after 2006.

**Transuranic Waste.** The EM program is responsible for the storage, treatment, and disposal of approximately 130,000 cubic meters of contact- and remote-handled transuranic waste from known defense-related testing and experimental projects. This estimate includes the volume of transuranic waste that is currently stored and that which is expected to be generated. The EM program expects to dispose of an additional 40,000 cubic meters of such waste generated from continuing and future missions as well as decommissioning and other defense-related projects of DOE. Before it can be shipped, transuranic waste requires safe storage and sometimes requires treatment. Currently,

transuranic waste activities are estimated to be seven percent of the total cost of the EM program through 2070. Sixty-six percent of the cost for transuranic waste will be incurred after 2006.

**Other Waste.** The EM program must manage millions of cubic meters of other types of waste including low-level radioactive waste, hazardous waste, and mixed low-level waste (containing both radioactive and hazardous constituents). Some of that waste is in storage awaiting treatment and disposal; more such waste will be generated during the cleanup process. Virtually all sites manage one or more of these types of waste. The EM program currently is estimating that 11 percent of its total cost will go toward addressing these types of waste over the life cycle.

**Remedial Action.** The EM program is responsible for characterization and cleanup of approximately 9,000 “release sites.” A release site is a specific area, within a larger geographic site, at which contaminants or contaminated materials might have been spilled, dumped, disposed of, or abandoned. The cleanup of release sites involves the remediation of soil, surface water, and/or groundwater. Some release sites require no further action while others require remediation or monitoring. Release sites range in size from very small spills to large dumping areas. Currently, it is estimated that 80 percent of the release sites will be cleaned up by 2006. Characterization and remediation of release sites are estimated to account for 10 percent of the total cost of the EM program over the life cycle.

**Facilities.** EM’s facilities range from small guardhouses to massive excess production facilities and nuclear reactors. Combined, the area of these facilities currently assigned to EM is more than 65 million square feet. This total square footage exceeds the area of 1,300 football fields. Most of the large buildings contain contaminated equipment, machinery, and pipes. Others store waste and nuclear materials. Most of the buildings require deactivation, decontamination, and decommissioning. These facilities are projected to account for eight percent of the total cost of the EM program over the life cycle.

**Nuclear Materials.** Nuclear materials include plutonium, uranium, and other materials in various forms (for example, metals, oxides, solutions, residues). These materials need to be stabilized and prepared for their ultimate disposition. EM plans to complete most of this work by 2006. The EM program anticipates that four percent of the total life-cycle cost of the EM program will be incurred by the stabilization, packaging, and management of nuclear materials.

**Spent Nuclear Fuel.** Spent nuclear fuel includes fuel, targets (excluding medical isotope targets), slugs, and sludge. The Idaho National Engineering and Environmental Laboratory, the Savannah River Site, and the Hanford Site generated most of the existing spent nuclear fuel. The EM program also manages foreign research reactor spent fuel. The EM program estimates that three percent of the total Environmental Management cost over the life cycle will go toward

spent nuclear fuel management. Most stabilization activities are scheduled for completion by 2006.

**Long-term Surveillance and Monitoring.** The Environmental Management program is responsible for the long-term surveillance and monitoring of up to 81 sites. Surveillance and monitoring activities currently account for three percent of the life-cycle estimate. However, some sites need to further refine estimates in this area. A site is considered to be complete before long-term surveillance and monitoring activities end; at some sites these activities will continue well beyond 2070.

**Infrastructure and Support.** The Environmental Management program maintains site infrastructure, conducts program management and oversight activities, and manages other efforts to ensure the safety and health of workers and the public and to protect the environment while conducting cleanup activities. At some sites, the EM program provides such services as utilities, security, road maintenance, facilities upgrades, and similar activities. The EM program estimates that 14 percent of its total life-cycle costs will be allocated to these activities. At some sites, these costs are allocated to specific waste management or remedial action activities. Therefore, some infrastructure/support costs are captured in other categories.

**National Programs and Headquarters.** This category includes program direction, which funds federal salaries and related costs for the entire EM complex (both Headquarters and the Field). National programs include such crosscutting projects as the National Transportation program, the National Pollution Prevention program, and the National Science and Technology program. The EM program expects that eight percent of its life-cycle costs will be expended on these activities.

### 2.3.2 Cost by State

As of the beginning of FY 1998, there were 53 sites in the EM program that still require cleanup and associated funding. EM will also continue to require funding for activities at other sites (such as long-term surveillance and monitoring for completed sites) and some amount for federal salaries at both Headquarters and in the Field. Exhibit 2-4 outlines the estimated costs of the EM program by state.

### 2.3.3 Other Scope and Costs

End state assumptions (i.e., assumed end points) in *Paths to Closure* differ from those made in previous EM life-cycle cost estimates to reflect current site end state assumptions. For example, *Paths to Closure* does not include the costs associated with decommissioning the Portsmouth Gaseous Diffusion Plant in Ohio and the Paducah Gaseous Diffusion Plant in Kentucky and may not include the full costs for decommissioning some facilities, such as the spent fuel pools and canyons at the Savannah River Site in South Carolina. As assumptions change,

Exhibit 2-4  
Estimated EM Life-cycle Costs by State<sup>a</sup>

State	Estimated Cost (in billions of constant 1998 dollars) <sup>b</sup> 1997-2070
California	\$0.8
Colorado	\$6.5
Florida	\$0.3
Idaho	\$16.4
Illinois	\$0.1
Kentucky	\$0.9
Missouri	\$0.4
Nevada	\$2.2
New Mexico	\$9.5
New York	\$1.5
Ohio	\$4.6
South Carolina	\$29.7
Tennessee	\$11.0
Texas	\$0.1
Utah	\$0.1
Washington	\$50.4
Multiple States (Long Term S&M)	\$2.3
Multiple States (Program Direction)	\$7.6
Multiple States (Science and Technology Development)	\$2.9
Multiple States (All Other, Including National Programs and HQ)	\$0.1

<sup>a</sup>Other states include Alaska, Iowa, Massachusetts, Mississippi, and New Jersey.

<sup>b</sup>Individual costs may not sum to \$147.3 billion due to rounding.

future updates to *Paths to Closure* will be adjusted accordingly. The effect of the adjustment to meet such needs could be significant. The 1996 *Baseline Environmental Management Report* estimated the cost of decommissioning such facilities at more than \$10 billion.

In addition to the baseline costs outlined in Sections 2.2 and 2.3, PBSs include other costs that require explanation. *Paths to Closure* was developed under the assumption that the EM program will not accept any newly-generated, non-EM waste after FY 2000. For the Operations/Field Offices that manage those wastes, especially those that manage waste at operating national laboratories (for example, Albuquerque, Chicago, Oakland, and Oak Ridge), responsibility is expected to be transferred to the generator after FY 2000, which is usually another program of the Department, such as the Defense Programs or Energy

Research. Exhibit 2-5 shows these costs in the column labeled “Costs Transferred to Other Programs.” The EM program expects to transfer EM budget target dollars associated with newly-generated, non-EM waste to the generators as well. Should this assumption change, the affected project baselines (and PBSs) will require revision.

Exhibit 2-5  
EM Baseline Costs and other Costs by Operations/Field Office

Operations/ Field Office	EM Baseline Cost <sup>a</sup>	Costs Transferred to Other Programs	Baseline Costs Paid by Other Entities
(billions of constant 1998 dollars)			
Albuquerque	4.1	4.5	<0.1
Carlsbad	7.7	0	0
Chicago	0.3	1.1	0
Headquarters/ National Programs	11.3	0	<0.1
Idaho	16.3	0	0
Nevada	2.2	0	0
Oakland	1.0	1.1	0
Oak Ridge	13.1	1.4	0.1
Ohio	4.8	0	0
Richland	50.3	0	0.5
Rocky Flats	6.3	0	<0.1
Savannah River	29.7	0	0.1

<sup>a</sup>Individual costs may not sum to \$147.3 billion due to rounding.

In other cases, costs may be paid by other DOE programs or entities outside of DOE to support the cleanup at EM sites. Some examples include state contributions to the Uranium Mill Tailings Remedial Action Project and the co-funding of some EM activities with DOE’s Office of Defense Programs. The EM program anticipates such funding will continue. The discussion in Section 2.2 excluded funds contributed by these other entities to cover such costs; however, such costs are shown in Exhibit 2-5 in the column labeled “Baseline Costs Paid by Other Entities.” Exhibit 2-5 also displays the EM baseline cost (from Section 2.2).

Finally, the current baseline assumes that the EM program will not accept additional surplus facilities for deactivation and decommissioning. However, the Department is considering transferring additional surplus facilities to the EM program beginning in 2002 with limited exceptions occurring before that date. If and when such transfers occur, the EM program will develop projects and adjust current assumptions to account for the cleanup of these facilities and include these costs in future updates to *Paths to Closure*.

### 2.3.4 Cost by Category of Project Completion Date

For the FY 1999 budget request, the EM program developed a new categorization structure based upon the projects included in *Paths to Closure*. The new structure includes three program budget accounts:

- **Closure** includes all projects at sites closed by 2006 without a continuing DOE mission.
- **Project Completion** includes sites completed by 2006 with an ongoing DOE mission, and projects completed by 2006 at sites with cleanup work continuing after 2006.
- **Post-2006 Completion** includes projects that are expected to require work beyond FY 2006.

The new structure also identifies three additional accounts: Technology Development, Program Direction (i.e., federal salaries), and Privatization projects. Exhibit 2-6 shows the baseline cost of the EM program broken out over time into the Closure, Project Completion, and Post-2006 Completion accounts. Most of the projects in the Closure and the Project Completion accounts are scheduled for completion by 2006. Other projects and/or sites could move into project completion or closure as they achieve additional enhanced performance.

