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Volume I

The 1996 Baseline Environmental Management Report

June 1996

U.S. Department of Energy
Office of Environmental Management

1.0 INTRODUCTION

During World War II and the Cold War, the United States developed a massive industrial complex to research, produce, and test nuclear weapons. This nuclear weapons complex included uranium mining, nuclear reactors, chemical processing buildings, metal machining plants, laboratories, and maintenance facilities that manufactured tens of thousands of nuclear warheads, and conducted more than one thousand nuclear explosion tests.

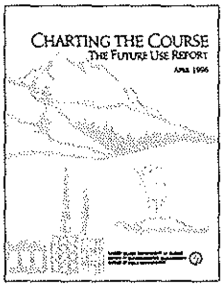
Weapons production stopped in the late 1980s, initially to correct widespread environmental and safety problems, and was later ended indefinitely because of the end of Cold War. The work remaining, and the subject of this analysis, is the legacy of thousands of contaminated areas and buildings, and large volumes of "backlog" waste and special nuclear materials requiring treatment, stabilization, and disposal. (See Appendix B for a further discussion of the causes of the environmental legacy being addressed by the Environmental Management program.) Approximately one-half million cubic meters of radioactive high-level, mixed, and low-level waste must be stabilized, safeguarded, and dispositioned, including a quantity of plutonium sufficient to fabricate thousands of nuclear weapons. Therefore, the security as well as the safety of this material is of paramount importance. Moreover, because plutonium can spontaneously ignite in certain circumstances when in contact with moist air, careful attention must be paid to handling and storage safety.

In 1989, the Department of Energy established the Environmental Restoration and Waste Management program, now called the Environmental Management program, to consolidate ongoing activities and accelerate efforts to address the inactive production facilities and sites and the accumulated waste, contamination, and materials. Six years later, this program is responsible for the maintenance and stabilization as well as the environmental restoration and waste management work at virtually the entire nuclear weapons complex not being used for continued weapons activities. The Environmental Management program is the largest environmental stewardship program in the world, with 150 sites in approximately 30 states and Puerto Rico.

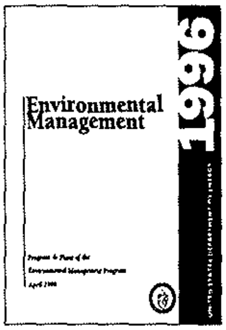
1.1 THE 1996 BASELINE ENVIRONMENTAL MANAGEMENT REPORT

The primary mission of the Department of Energy's Environmental Management program is to reduce health and safety risks from radioactive waste and environmental contamination resulting from developing, producing, and testing nuclear material for weapons. The 1996 Baseline Environmental Management Report provides a total life-cycle cost estimate and anticipated schedule of the projects and activities necessary to carry out the Environmental Management program's missions for environmental remediation, waste management, basic science, technology development, the transition of operational facilities to safe shutdown status, and the safeguarding and security of special nuclear materials.

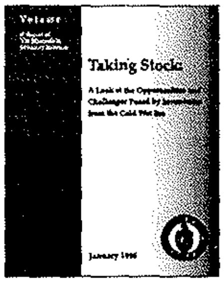
For more comprehensive information about the Environmental Management program and a description of program accomplishments and other related initiatives, see the following published reports:



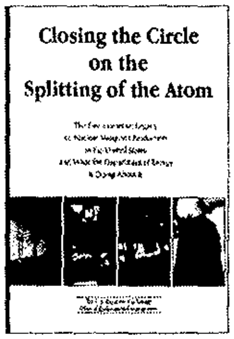
Charting the Course: The Future Use Report (April 1996) provides results of the Department-wide Future Use Project and discusses the future-use planning efforts under way at 20 Department research and former nuclear weapons production sites. Sixteen of the 20 participating sites, in collaboration with Tribal and local governments and stakeholders, developed recommendations regarding the future use of site land and facilities.



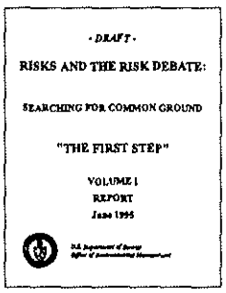
Environmental Management 1996 (April 1996) is the Office of Environmental Management's annual report on the program's progress. It assesses the program's performance in 1995 compared with 1994.



Taking Stock: A Look at the Opportunities and Challenges Posed by Inventories from the Cold War Era (January 1996) reports on a Department-wide effort to improve management and disposition and to reduce costs for materials that no longer have clearly defined or immediate uses.



Closing the Circle on the Splitting of the Atom (January 1996, second printing) describes existing environmental, safety, and health problems throughout the nuclear weapons complex, and what the Department of Energy is doing to remedy the problems.



Risks and the Risk Debate: Searching for Common Ground, "The First Step" (June 1995) details the findings of the Department's first effort to develop a consistent approach to evaluating risks throughout the nuclear weapons complex. This draft risk report provides a qualitative risk evaluation of 1,199 environmental management activities planned for FY 1996. This report will be finalized in Summer 1996.

To obtain copies of these reports, or for more information on the Environmental Management program, please contact the Center for Environmental Management Information at 1-800-7-EM-DATA.

The Department of Energy prepared this report as an analytical tool to help guide Departmental decisions and to provide an accounting of the Department's progress, spending, and plans. In addition, federal law requires the Secretary of Energy to regularly submit a Baseline Environmental Management Report. The 1996 Baseline Environmental Management Report (Baseline Report) is the second of these reports. In addition, the report serves as a benchmark - or starting point - in the development of new "Ten-Year Plans" that are being prepared to define new, near-term cleanup objectives and greatly accelerate the pace and reduce the costs of cleanup over current plans.

The first report, prepared in 1995, estimated that the total cost of the Environmental Management program's mission will be between $200 and $350 billion over a 75-year period. Significant decisions made over the past 12 months have changed the projected scope of the Environmental Management program presented in the 1995 report. For example, new technical approaches at the Hanford Site in Washington, the Idaho National Engineering Laboratory, and the Rocky Flats Environmental Technology Site in Colorado have affected the cost and schedule estimates for these sites. The 1996 Baseline Report highlights these changes, both at the site level and at the national level. Guided by a new ten-year planning process, we are confident that we can further reduce the costs and accelerate the pace of cleanup through better coordination between sites, use of "breakthrough management" and use of new technologies.

Because the program is only seven years into a life cycle that spans over 75 years, many decisions will be made that can dramatically change the direction of the program. In addition to illustrating the assumed path forward, the 1996 Baseline Report presents policy analyses that examine the consequences of modifying key program assumptions. The analyses presented include answers to the following questions:

- **Land Use –** What effect will future land-use decisions have on the overall scope, cost, and schedule of cleanup for Environmental Management sites?

- **Program and Project Scheduling –** What are the cost consequences of delaying or accelerating programs and projects? What is the relationship between program pace, schedule, and waste volumes?

- **A "Minimal Action" Scenario –** What is the minimum funding necessary to prevent risks to human health or the environment from increasing for 75 years in the absence of the constraints of current legal requirements?

> ***THE 1996 BASELINE REPORT IS:***
>
> - A life-cycle cost estimate for the entire Environmental Management Program
> - A policy analysis tool that explores the potential consequences of several policy alternatives
> - A description of environmental management activities expected to be necessary to address the Department's legacy and projected future activities
>
> ***THE 1996 BASELINE REPORT IS NOT:***
>
> - A definitive basis for planning specific projects
> - A budget document
> - A funding request
> - A description of long-term priorities

The 1996 Baseline Report is based on current (as of late 1995) national and site-level assumptions regarding the actions or activities that are most likely to occur in the future. It is expected that these projected activities will change in the future. In fact, one of the principal purposes of this report is to inform a national debate on what the best future course should be.

BASELINE REPORT BACKGROUND

The Department prepared the 1995 Baseline Report in response to a Congressional mandate made in the 1994 National Defense Authorization Act (Appendix A.1). Congress directed the Department to:

- estimate the total cost of the Environmental Management program,
- describe each project or activity at each site,
- describe the environmental problem addressed by each project or activity,
- specify the proposed remedy or solution to the problem, if known,
- estimate the cost for completing each project or activity (in five-year increments where appropriate), and
- estimate the schedule for completing each project or activity (with five-year milestones).

Congress included additional requirements in the 1995 National Defense Authorization Act (Appendix A.2), which directed the Department to:

- describe personnel and facilities required to complete each project or activity,
- increase stakeholder involvement,
- expand the pollution prevention discussion, and
- describe the research and development necessary to develop the technologies for environmental restoration and waste management projects or activities.

1.2 OVERVIEW OF THE 1996 BASELINE REPORT

The 1996 Baseline Report consists of an executive summary and three volumes: Volume I, the *1996 Baseline Environmental Management Report*, and Volumes II and III, *Site Summaries for the 1996 Baseline Environment Management Report.*

Volume I contains eight chapters:

Chapter 1 introduces and provides an overview of the 1996 Baseline Report.

Chapter 2 describes how the Environmental Management program is organized to provide remedies to the environmental legacy of the nuclear weapons complex. Six functional areas are described: environmental restoration, waste management, nuclear material and facility stabilization, science and technology development, landlord, and national program planning and management.

Chapter 3 defines the "Base Case," which is a long-range projection of costs, schedules and activities that describe the Environmental Management program from its current state to completion. This chapter describes the challenges involved in developing a life-cycle cost estimate for the Environmental Management program and outlines the general methodology and key assumptions used to develop the Base Case. The key Base Case assumptions are divided into four main categories: funding, scheduling/site completion, land use, and functional area.

Chapter 4 summarizes the Base Case results. These results represent a new baseline for the Environmental Management program and depict the most likely scenario for the program based on current assumptions. This chapter also includes summary results of two Base Case analyses: science and technology development and pollution prevention.

Chapter 5 compares the 1995 and 1996 Base Case results and describes how the Base Case changed since last year.

Chapter 6 examines alternative scenarios that are built on the Base Case. These alternative scenarios examine the impacts to cost and schedule estimates that result from varying program assumptions. Included are three scenarios: land use, program and project scheduling, and minimal action.

Chapter 7 compares the results of the Base Case and the alternative scenarios in three areas: life-cycle cost estimates, program end states, and overall benefits and losses. This chapter provides side-by-side comparisons of the results that are presented separately in Chapters 4 and 6.

Chapter 8 discusses the various conclusions of this year's report and how baseline planning exercises will continue in the Environmental Management program.

Volume I also contains several appendices:

Appendix A contains the Baseline Environmental Management Report requirements in the National Defense Authorization Acts for FY 1994 and FY 1995.

Appendix B describes the sources of the environmental legacy being addressed by the Environmental Management program, such as the steps in the nuclear weapons production process and the resulting contamination.

Appendix C describes the Baseline Report methodology and presents a detailed discussion of the following areas: setting assumptions; defining activities and projects for major program elements; developing categories for personnel requirements; gathering and assembling data; conducting integration analyses; estimating program improvements; developing documentation; and involving stakeholders.

Appendix D provides supporting information for the land-use scenario analysis.

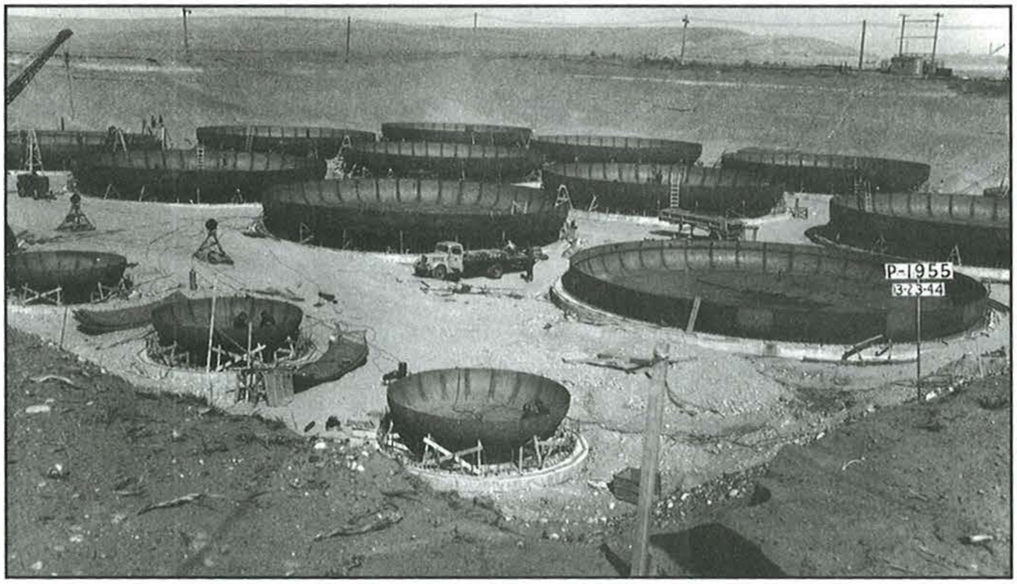
Appendix E discusses the effects of productivity and discounting on the Base Case estimate.

Appendix F describes the methodology for the analysis of the effects of technology development on the Base Case Estimate.

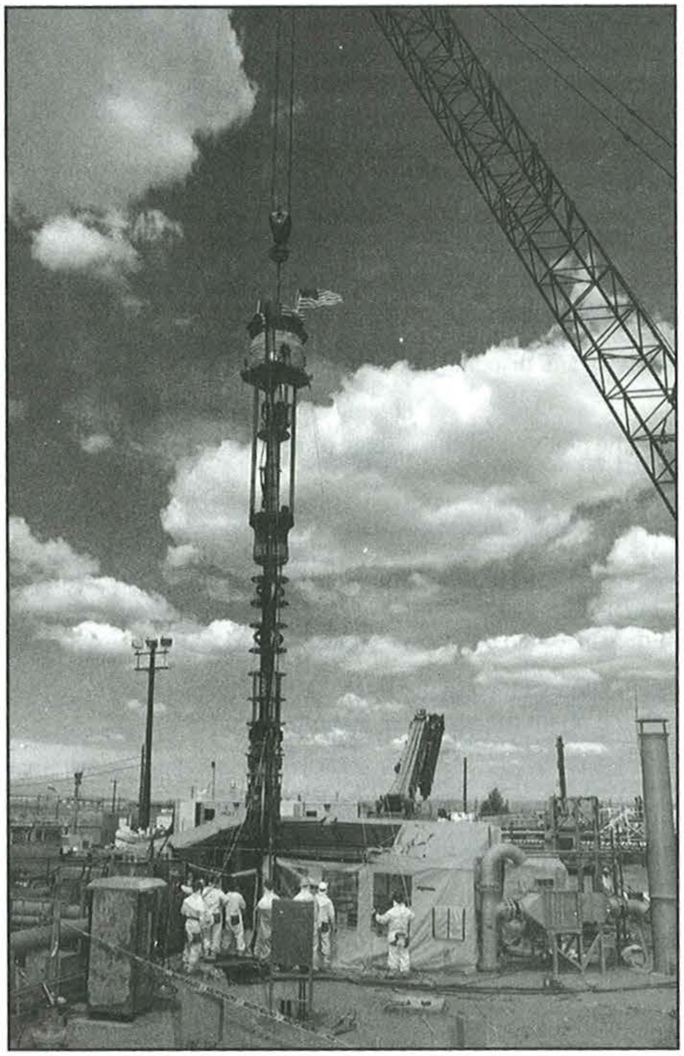
Appendix G describes the methodology for the analysis of the effects of pollution prevention efforts on the Base Case estimate.

Appendix H lists the various Department of Energy reading rooms where copies of this report and other Departmental information may be obtained.

Volumes II and III contain summaries for each site included in the Base Case estimate. The site summaries provide specific information about the activities and projected costs at each site as requested by the National Defense Authorization Act. The site summaries are organized by state. Each summary provides a brief discussion of the site's current and future missions, followed by discussions of the projects and activities necessary to remediate the site. The summaries also provide more detail about the site-specific assumptions used to develop the Base Case.



Construction of the first high-level waste tanks at Hanford Site, Washington, 1944. *Designed for a useful life of 25 years, these tanks contain intensely radioactive acids and solvents resulting from reprocessing spent nuclear reactor fuel elements to extract plutonium and uranium. Approximately half of the 177 tanks were a "single shell", such as these, while others were "double shell" tanks. Because workers during the Cold War typically filled the tanks without sampling the waste and without recordkeeping that would meet today's standards, the Department is now undertaking a complex and hazardous effort to characterize the waste already in the tanks.*



Installing a mixing pump in tank 101-SY at Hanford Site, Washington, 1993. *This custom-built pump was critical in controlling the buildup of explosive gases in the tank, which was identified as one of the most urgent safety risks in the former nuclear weapons complex at the time. The ongoing cost for simply averting serious safety problems in these tanks is approximately $300 million per year. Beyond this routine safety operation, the Department is planning to remove the waste from the tank, which is the focus of a top-priority multibillion dollar, multidecade effort. The cost and complexity of dealing with these tanks provides excellent examples of the benefits of life-cycle planning and cost estimation. Characterizing the waste and treating it for disposal, after many years of storage, is significantly more expensive, complex, and hazardous than if the work was done as part of the production process.*

7.0 COMPARISON OF ALTERNATIVE CASES

Previous chapters of the Baseline Report present ten scenarios and life-cycle cost estimates for performing the Environmental Management program. The Base Case is presented in Chapter 4. Nine alternative cases are presented in Chapter 6: five land-use cases (Section 6.1); three scheduling cases (Section 6.2); and one minimal action case (Section 6.3). These cases provide a basis for comparing the effect of varying assumptions underlying the Environmental Management program.

The analysis of these alternative cases (also referred to as "scenario analysis"), provides a tool for understanding possible long-term consequences of particular policy options. The goal of scenario analysis is to produce a set of possible outcomes from which a future path can be developed. By developing and evaluating different scenarios, organizations can be more comprehensive in their planning process. For the Environmental Management program, these scenario analyses serve as analytical tools to evaluate the influence of different funding and activity decisions on costs, program scope and end states. By using scenario analyses, overall planning can be improved and the long-term cost of the program can potentially be reduced.

Each of the nine alternative cases presented in Chapter 6 was developed using case-specific methodologies and assumptions. The alternative cases, however, do have common elements that can be used to compare across cases. This chapter looks at the specific elements of 75-year cost and end states found in each alternative case and provides a comparison of these cases to each other and to the Base Case.

7.1 FRAMEWORK FOR COMPARING ALTERNATIVES

The Base Case is compared to the alternative cases using the following measures:

- **75-Year Cost Estimate** - All cost estimates are presented for the 75-year Base Case life-cycle period unless otherwise stated. All costs are evaluated and compared in constant 1996 dollars. (For a discussion of discounting and its effect on the cost estimate for each alternative see Appendix E.2.)

- **Program End State** - This measure evaluates the state of the program at the end of the Base Case life-cycle period (2070). End states are described in several ways: program completion date, type of waste stored onsite, amount of land potentially available for alternate uses, and whether compliance with existing agreements and regulatory requirements is assumed in reaching the end state.

Using these measures, a summary is presented of the nine alternative cases as compared to the Base Case. The implications of these results also are discussed.

75-YEAR COSTS ARE NOT LIFE-CYCLE COSTS

To accurately compare costs for all the cases, the cost estimates presented are *only* for the 75-year Base Case life-cycle period (1996-2070). In three of the alternative cases (Maximum Feasible Green Fields, Funding Reduction, Minimal Action), the change in scope and schedule require the program to extend beyond 2070. Both the Maximum Feasible Green Fields and the Funding Reduction cases estimate the program to complete around 2080. In the Minimal Action case, the length of time required to complete the program is not determined. The Minimal Action case assumes that the program will continue past 2070.

Each of the nine alternative cases was developed using different assumptions for scope and schedule that deviate from the Base Case and from each other. (For more detail on these assumptions, refer to Chapter 6.) Upon completion of each of the alternative case analyses, the life-cycle period for some cases extends beyond that of the Base Case, while other cases do not fully address the effects of scope changes on activity scheduling. Because of differences, there are limitations in comparing the alternative cases. Through the use of the measures discussed above, however, this chapter attempts to provide a general understanding of how these nine alternative cases compare to each other and to the Base Case.

To be consistent with information presented in Chapter 6, the comparison of alternative cases focuses on the five highest-cost Environmental Management sites: Hanford Site, Idaho National Engineering Laboratory, Oak Ridge Reservation, Rocky Flats Environmental Technology Site, and Savannah River Site.

7.2 75-YEAR COST ESTIMATE

The total Base Case cost for the five highest-cost sites is estimated at $160 billion for the 75-year life-cycle period. The alternative cases present 75-year cost estimates that range from less than $90 billion (Minimal Action) to more than $270 billion (Maximum Feasible Green Fields). Figure 7.1 presents the 75-year costs for the Base Case and each alternative case.

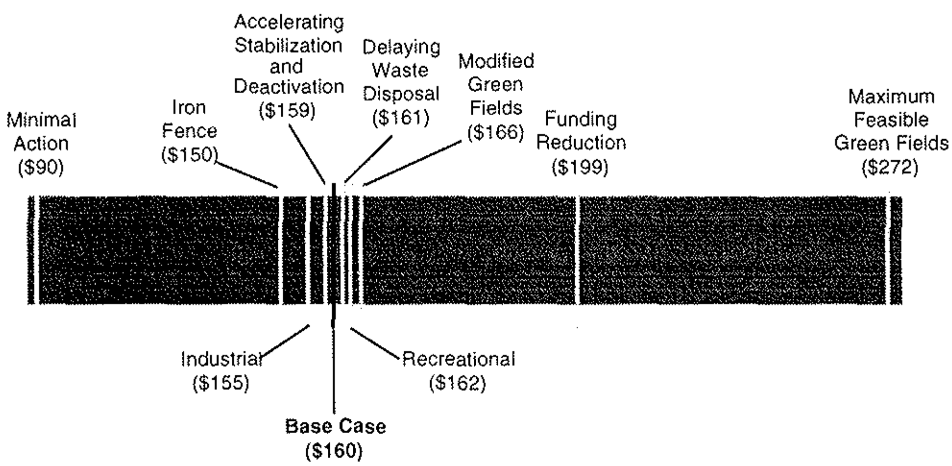


Figure 7.1. 75-Year Cost Estimates for the Five Highest-Cost Sites (Constant 1996 Dollars in Billions)

Although each of the alternative cases differs from the Base Case in its assumptions for scope and/or schedule, the 75-year costs for six of the alterative cases fall near the Base Case. Cost deviations from the Base Case are apparent, however, with the Maximum Feasible Green Fields, Funding Reduction, and Minimal Action cases.

In the 75-year time period, the highest cost alternative is the Maximum Feasible Green Fields case. In this land-use case, an aggressive cleanup strategy is pursued, requiring extensive removal of contaminated media and/or material. The change in scope increases the overall cost of the Maximum Feasible Green Fields case by 70 percent over the Base Case. The activities for this case, however, are not completed by 2070. Ten additional years are required to complete the program, leading to a total life-cycle cost of $284 billion.

The second most expensive alternative is the Funding Reduction scheduling case - $39 billion greater than the Base Case for the 75-year period. In this case, the scope performed in the first 20 years is limited, leading to higher costs further in the future (see Figure 7.2). As with the Maximum Feasible Green Fields case, the Funding Reduction case is not complete at the end of the 75-year period. By 2082, the life-cycle cost for the Funding Reduction case is $209 billion, $49 billion more than the Base Case.

The Minimal Action case is, by far, the least costly alternative (approximately 47 percent less expensive than the Base Case). The Minimal Action case is less expensive than the other case because the case specifically assumes noncompliance with agreements and regulatory requirements. The Minimal Action case cost estimate also reflects the elimination of offsite waste disposal activities and the limitation of remediation activities to address only urgent human health and environmental risks during the 75-year period (1996-2070). In the minimal action case, activities are not completed, however, by 2070. Although there are no projections of the additional program costs, they are assumed to be substantial.

7.2.1 Distribution of Cost Across Functional Areas

Figure 7.2 presents the distribution of costs across functional areas for the alternative cases. When the nine alternative cases are compared to the Base Case it is apparent that the distribution of costs across functional areas is fairly consistent with the Base Case. A major exception is found, however, in the cost difference of waste management activities for the Maximum Feasible Green Fields and Minimal Action cases.

The changes in waste management costs reflect changes to waste storage, treatment, and disposal activities. In the Maximum Feasible Green Fields case, all waste (including waste from demolished buildings) is treated and shipped to offsite disposal facilities, thus increasing the 75-year cost of the Waste Management program. In the Minimal Action case, waste management cost estimates are reduced as sites do not incur the cost of shipping waste to offsite disposal facilities or the costs for managing waste from building demolition activities.

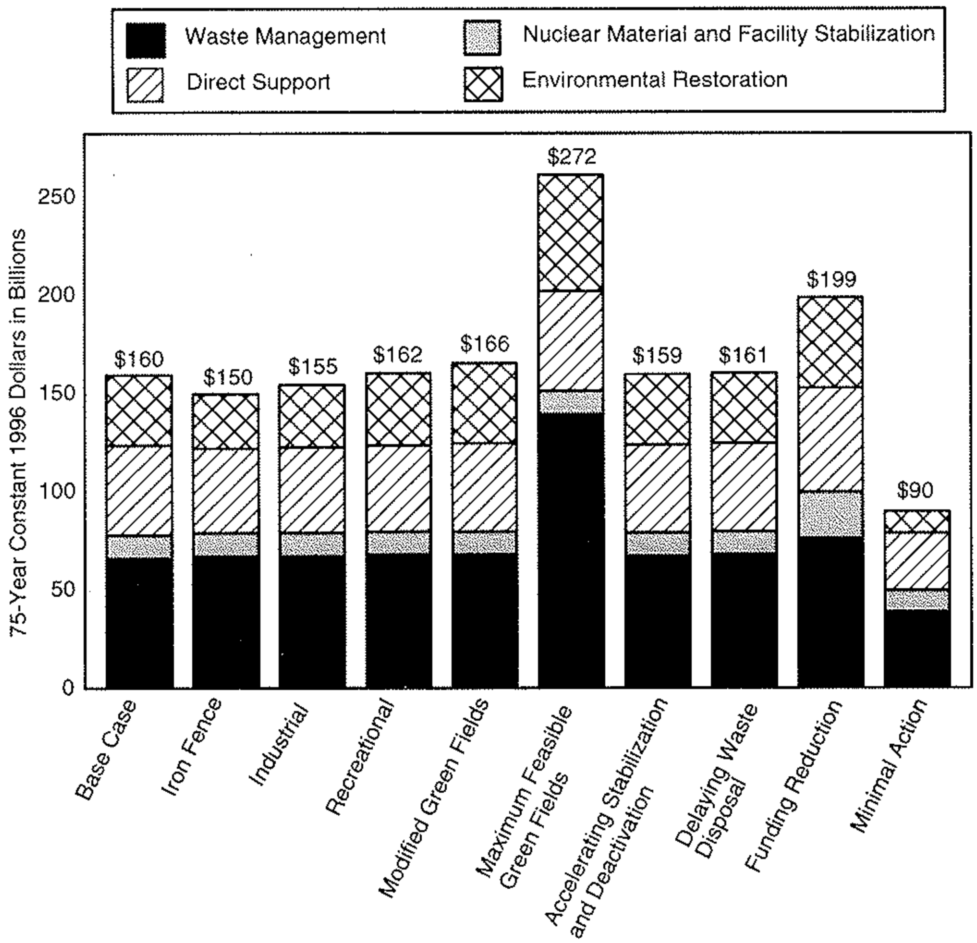


Figure 7.2. Distribution of Costs Over Functional Areas for the Five Highest-Cost Sites

There is some difference in environmental restoration activities across the alternative cases reflecting changes in assumptions for remediation and decommissioning activities. The Maximum Feasible Green Fields case remediates over 95 percent of contaminated acreage to Residential or Agricultural uses and demolishes almost all buildings. This case exceeds the level of Base Case environmental restoration activities and surpasses most environmental regulation and compliance agreement requirements. In this case, two of the five sites (Rocky Flats Environmental Technology Site and Oak Ridge Reservation) are completely remediated to a level that would safely support Residential and Agricultural uses.

The Minimal Action case performs only remediation activities that do not increase risk to offsite populations over 75 years. Cleanup activities are undertaken only in these circumstances and, therefore, many compliance or regulatory agreements are not met. Decommissioning activities, in the Minimal Action case, leave vacant buildings standing, which require continual surveillance and maintenance.

The functional area least influenced by the various alternative cases is nuclear material and facility stabilization. The only major difference is found in the Funding Reduction case. Nuclear material and facility stabilization cost increases in the Funding Reduction case due to the postponing of future activities. The delay in deactivation and stabilization activities increases the need for long-term pre-stabilization surveillance and maintenance activities.

7.2.2 Distribution of Cost Over Time

Another approach to examining the differences in the alternative cases is to present a time profile of cost estimates (Figure 7.3). The analysis reveals that changes in scope presented by the Maximum Feasible Green Fields and Funding Reduction cases as well as in the Minimal Action case have a substantial effect on the time profile of costs.

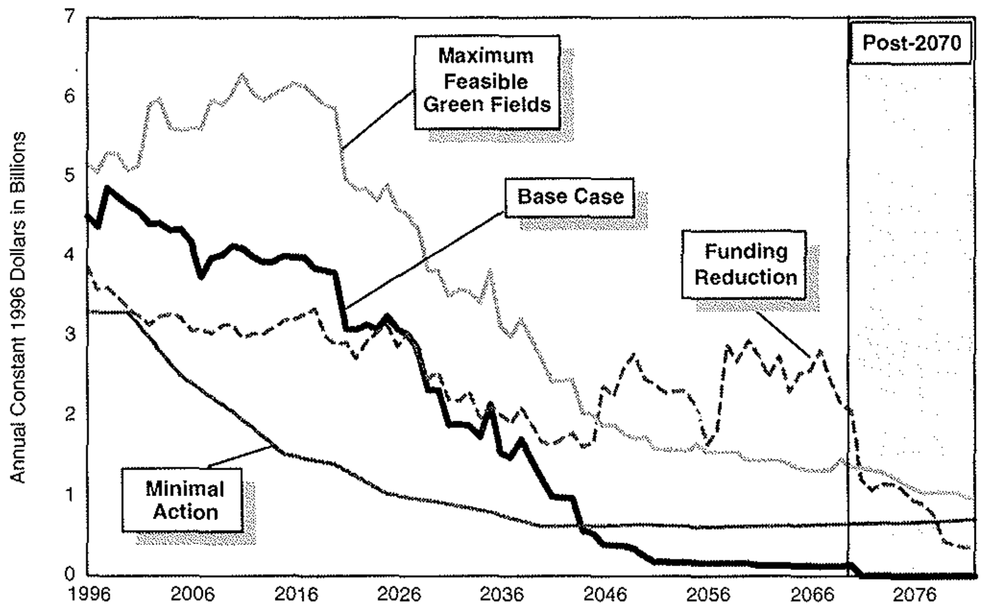


Figure 7.3. Time Profile of Life-Cycle Cost Estimates for the Five Highest-Cost Sites

The increase in scope found in the Maximum Feasible Green Fields dramatically affects the life-cycle time profile. This case requires funding for extensive remediation and waste management activities during the early life-cycle period. These costs drop dramatically after 2020, however, reflecting a shift to long-term surveillance and monitoring activities.

The Funding Reduction and Minimal Action cases also show deviations from the Base Case time profile. In both cases, cost estimates are well below the Base Case early in the analysis period, driven by reduced remediation and waste management activities. However, over time, annual costs for both cases surpass the Base Case cost estimate.

When presented over time, the 75-year cost estimate for the Iron Fence, Industrial, and Recreational land-use cases and the Accelerating Stabilization and Deactivation scheduling case are relatively similar to the Base Case life-cycle profile. The Delaying Waste Disposal scheduling case follows the Base Case time profile for most of the 75-

year period. The delay in disposal activities, however, does increase the cost estimate in the later years.

7.3 PROGRAM END STATE

The Maximum Feasible Green Fields and the Minimal Action cases result in program end states that are dramatically different from those in the Base Case. In 2070, with the Maximum Feasible Green Fields case, all waste is expected to be in offsite storage or disposal facilities, almost all contaminated areas are projected to be removed, and over 99 percent of the land is clean enough for Residential or Agricultural use. In sharp contrast, the Minimal Action case has an end state with high-level waste, spent nuclear fuel and transuranic waste stored in onsite facilities, nonurgent contaminated areas left without remediation, and vacant buildings remaining standing. Table 7.1 presents each end state in four areas: program completion date, type of waste stored onsite, amount of land potentially available for alternate uses, and whether compliance with existing agreements and regulatory requirements is assumed in reaching the end state.

Table 7.1. Description of Program End State in 2070

		Land Use					Scheduling			
	Base Case	Iron Fence	Industrial	Recreational	Modified Green Fields	Maximum Feasible Green Fields	Accelerating Stabilization and Deactivation	Delaying Waste Disposal	Funding Reduction	Minimal Action
Program Completion Date	2070	2070	2070	2070	2070	2080	2070	2070	2082	> 2070
Waste Onsite										
High-Level Waste	No	No	No	No	No	No	No	No	Yes	Yes
Spent Nuclear Fuel	No	No	No	No	No	No	No	No	Yes	Yes
Transuranic Waste	No	No	No	No	No	No	No	No	No	Yes
Land Potentially Available for Alternate Uses	480,000 acres	315,000 acres	460,000 acres	485,000 acres	630,000 acres	980,000 acres	480,000 acres	480,000 acres	480,000 acres	<315,000 acres
Sites Meet Existing Compliance and Regulatory Requirements	Yes	Yes	Yes	Yes	Exceed	Exceed	Yes	No	No	No

The program completion date reflects when all cleanup activities have concluded except for long-term surveillance and monitoring activities and ongoing waste management of non-Environmental Management mission waste streams. By 2070, the Environmental Management program is complete for six alternative cases. In the Maximum Feasible Green Fields case, the program must continue for 10 years beyond the Base Case in order to complete all waste management and remediation activities. In the Funding Reduction and Minimal Action cases, the program end date is also extended due to the delay of cleanup and waste disposal activities.

Another measure of the end-state differences is the amount and type of waste remaining onsite. In the Base Case, all high-level waste, spent nuclear fuel, and transuranic waste is disposed of at offsite geologic repositories. By 2070, two of the cases have waste remaining in onsite storage facilities. In the 75-year cost estimates for both the Funding

Reduction and Minimal Action cases, the sites do not incur the high costs associated with disposing high-level waste and spent nuclear fuel at a geologic repository. Instead, this waste remains in onsite storage facilities, requiring long term surveillance and monitoring activities and eventual offsite disposal. In the Minimal Action case, transuranic waste also remains onsite, eliminating the costs associated with waste characterization and shipment activities.

In assessing land use at the end of 2070, the contrast between the Maximum Feasible Green Fields and the Iron Fence alternatives clearly illustrates the effect of these different cases. In the Maximum Feasible Green Fields case, only a small amount of land at the Savannah River Site, the Hanford Site and the Idaho National Engineering Laboratory must be retained for storage/disposal activities. All other land is clean enough to be released for uses ranging from Industrial to Agricultural. Under the Iron Fence case, the current site boundaries are maintained and the potential for reuse of buffer areas within sites is reduced significantly. In addition, under all land-use scenarios, the amount of land released from federal control can only be determined by individual sites and their stakeholders.

The last measure of end-state difference is whether each case followed existing compliance and regulatory agreements in reaching the end state. For the Modified and Maximum Feasible Green Fields cases, the scope of cleanup activities exceeds current environmental and compliance agreement requirements. In the Delaying Waste Disposal and Funding Reduction cases, however, the postponement of offsite waste disposal violates current compliance agreement requirements. The Minimal Action case does not necessarily meet any compliance or regulatory requirements unless it leads to minimal cost without affecting risk.

7.4 IMPLICATIONS OF ALTERNATIVE CASES

As discussed above, these alternative cases provide a framework of analysis to help regulators, stakeholders, and other interested parties understand the effects of expected programmatic decisions. When these alternative cases were developed, it was hypothesized that each case would most likely result in large variations in cost from the Base Case. As presented in Figure 7.1, the cost estimates for a majority of the alternative cases (Industrial, Recreational, Modified Green Fields, Accelerating Stabilization and Deactivation, and Delaying Waste Disposal) fall in the range of +/-$6 billion from the Base Case estimate. The remainder of the cases, however, provide the bounding cases that help to understand the influences of extreme changes on scope, schedule, and budget.

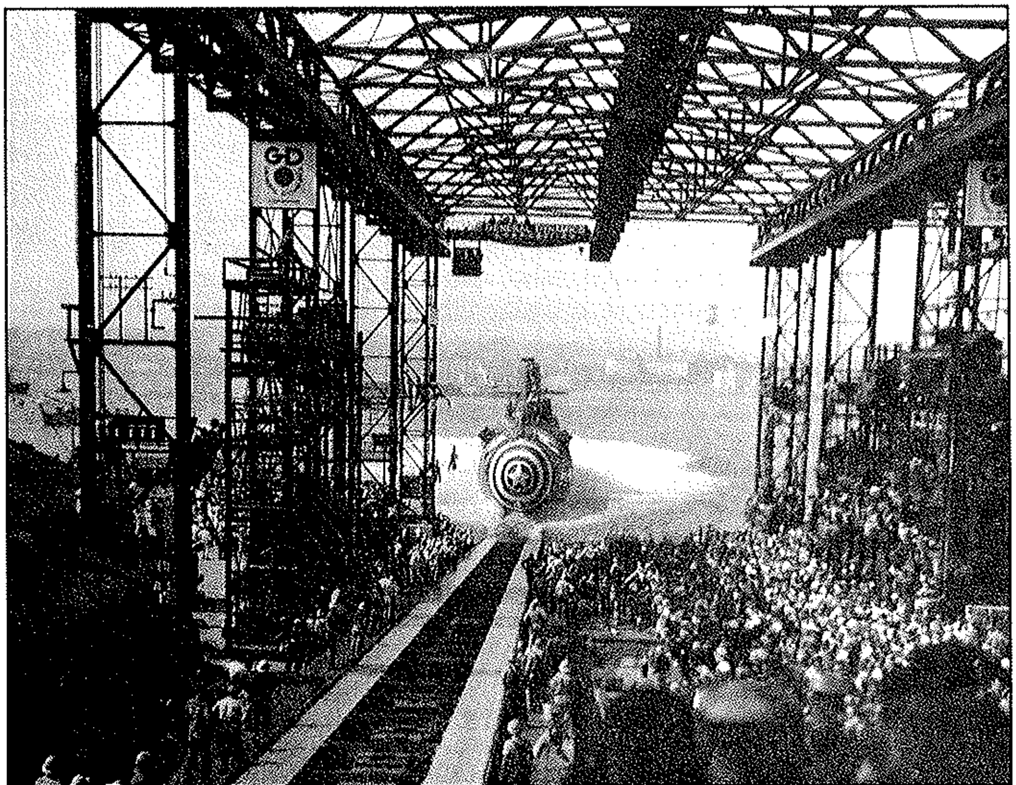
Each of these cases has both positive and negative implications. Table 7.2 provides a summary of the benefits and losses and the 75-year cost estimates associated with each alternative case when compared to the Base Case.

Table 7.2. Benefits and Losses of the Alternative Cases

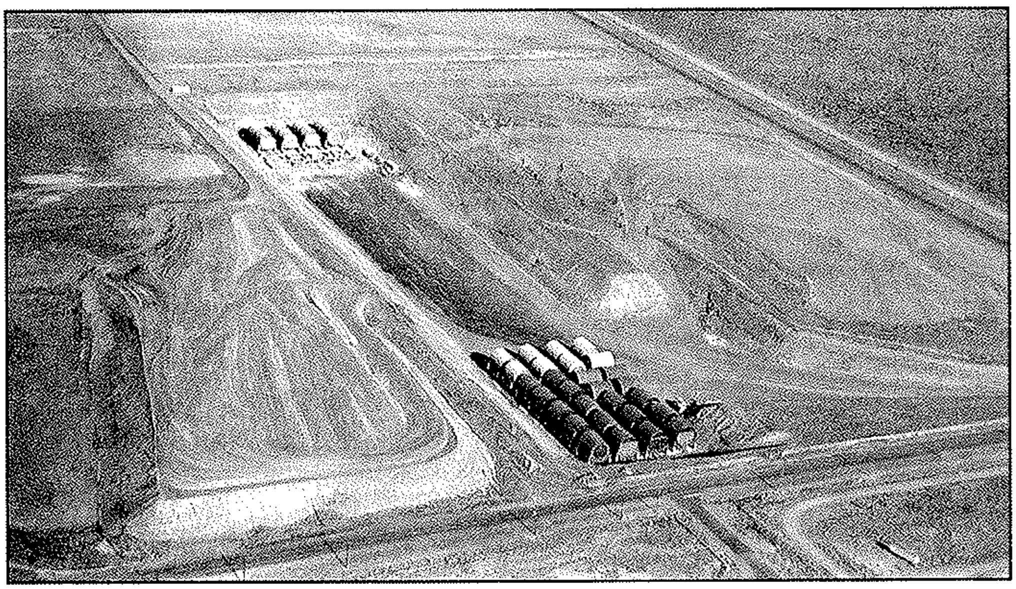
Alternative (75-Year Cost Difference from Base Case)		Benefits	Losses
Land Use	**Iron Fence** (-$10 billion)	• Less cost over period of analysis • Maintains minimum protection of public and site workers	• More land retained as controlled access for waste disposal
	Industrial (-$5 billion)	• Similar cost over period of analysis	• Reduces potential Recreational and Residential use of land outside controlled areas
	Recreational (+$2 billion)	• Similar cost over period of analysis • Increase in land clean enough for Recreational uses	• Reduces potential Residential use of land outside controlled areas
	Modified Green Fields (+$6 billion)	• Small increases in land clean enough to support Residential and Agricultural uses • Maintain potential for continued federal activities with reuse of site facilities	• More expensive over period of analysis
	Maximum Feasible Green Fields (+$112 billion)	• Significant increase in land clean enough to support Residential and Agricultural uses • All land at Rocky Flats and Oak Ridge is cleaned to Residential use standards • Minimal long-term surveillance and monitoring • Activities exceed compliance and regulatory requirements	• Significantly more expensive over period of analysis • Extensive cleanup activities may damage sensitive habitat • Reduces potential for reuse of site facilities • Program duration exceeds Base Case
Scheduling	**Accelerating Stabilization and Deactivation** (-$1 billion)	• Similar cost over period of analysis • Complete high mortgage projects faster	• Requires additional resources for Nuclear Material and Facility Stabilization program in early years
	Delaying Waste Disposal (+$1 billion)	• Similar cost over period of analysis • Little future risk as cleanup is complete	• Additional funding required for Waste Management program • Violates compliance agreements
	Funding Reduction (+$39 billion)	• Less cost in early years	• More expensive over period of analysis • Program duration exceeds Base Case • Violates compliance agreements • Limits flexibility to accomplish efficient scheduling
Minimal Action (-$70 billion)		• Less cost over period of analysis	• Program duration exceeds Base Case • Violates compliance agreements and regulatory requirements • Increase risk after period of analysis • Delays cleanup problems and increases the scope of contamination

The set of alternative cases presented in this scenario analysis provides a broad spectrum of potential outcomes resulting from changes to scope and schedule. Based on the benefits and losses presented above, none of the nine alternative cases should be viewed as "more likely" than another. These alternative cases merely provide boundaries of analysis from which to compare different scope and schedule options.

The Environmental Management program is at the early stages of its life cycle, a point at which many key decisions can dramatically influence the direction of the program. The results of the alternative cases provide an understanding of how changes in scope and schedule can influence program costs and end states — a first step toward assessing program options. By evaluating these alternative cases, Department of Energy personnel, regulators, stakeholders, and other interested parties have the opportunity to expand their understanding of potential outcomes from policy decisions and enhance the policy decisionmaking process.



Launching the nuclear-powered submarine Patrick Henry, SSBN, Connecticut, 1960. *The Department of Energy is responsible for handling spent nuclear fuel and waste resulting from reprocessing fuel from nuclear-powered warships. The U.S. Navy ensures that the submarine hulls, which contain very low levels of relatively short-lived radioactivity, are safely dismantled, sealed, and transported to the Department of Energy's Hanford site for disposal. This process provides an example of effective life-cycle planning and cost consideration.*



Trench 94, Hanford Site, Washington, 1994. *Hull sections containing defueled reactor compartments of decommissioned nuclear-powered submarines are put in disposal trenches. The spent nuclear fuel is removed before dismantlement begins. The radioactively-contaminated hull sections are then transported by barge to Hanford, where they are placed in a trench for burial. In 1986, the Patrick Henry's hull section was the first one placed in Trench 94. Accounting for project beginnings and endings in this manner is the main goal of life-cycle analyses.*