

**Rocky Flats Environmental Technology Site**

# **Phase II - Choices for Rocky Flats**

**ACCELERATED SITE ACTION PROJECT**

**Draft Revision 1**

**(February 1996)**

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**"REVIEWED FOR CLASSIFICATION/UCNI"**

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Date: *2-29-96*

## FOREWORD

*Choices for Rocky Flats* describes the concepts and technical logic used to address the major issues affecting selection of the future activities at the Rocky Flats Environmental Technology Site (Rocky Flats or Site). A product of the Accelerated Site Action Project (ASAP) Phase II, this document describes eight alternatives which begin to bracket what may be possible at Rocky Flats, given various assumptions and constraints. Within that context, the alternatives are designed to move the Site to a condition of increased protection of human health and the environment.

By providing comparisons between similar activities for each alternative, *Choices for Rocky Flats* is intended to support the decisionmaking process of the Rocky Flats community. No alternative has been chosen yet, and every effort has been made to avoid leading the reader toward any one alternative.

Discussion of the costs, schedules, and risks of achieving an end state, as well as the required degrees of institutional control, constitutes a large portion of this document. Cost and schedule profiles are planning estimates with an accuracy range of -50% to +100%. Uncertainties, both internal and external, that impact cost, schedule, and risk profiles are identified, and as with any long-range forecast, it is important to understand that the uncertainties associated with these cost estimates and schedules increase as the forecast horizon is extended.

Qualitative risk profiles compare only the relative risk of the alternatives to each other because the information needed for quantitative risk profiles is still under development and subject to a broad range of accuracy and interpretation.

*Choices for Rocky Flats* should be used to review the range of conceptual Site alternatives presented, with their cost, schedule and risk profiles, in order to evaluate their respective differences and potential impacts on future Site planning activities.

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# EXECUTIVE SUMMARY

## "CHOICES FOR ROCKY FLATS"

### INTRODUCTION

*Choices for Rocky Flats*, reports the results of the second phase of the Accelerated Site Action Project (ASAP) planning effort. The goal of the ASAP is to identify and implement a path forward for the Rocky Flats Environmental Technology Site (Rocky Flats or Site) to radically reduce the risks and costs at the Site in a way that represents the consensus values of the extended Rocky Flats community.

This document presents an array of alternatives to manage the cleanup of the Site including cost, schedule, and qualitative risk information. The alternatives described in this document were selected to bound the possible outcomes of the *Draft Site Conceptual Vision* (Vision) currently under development. The Vision will define a single, integrated course of action for Rocky Flats. The Vision will describe what will happen with materials, wastes, buildings, and land including what Rocky Flats will eventually look like. The ASAP is the implementation strategy to accomplish the Vision. The final selected ASAP alternative will be consistent with the final Vision for the Site.

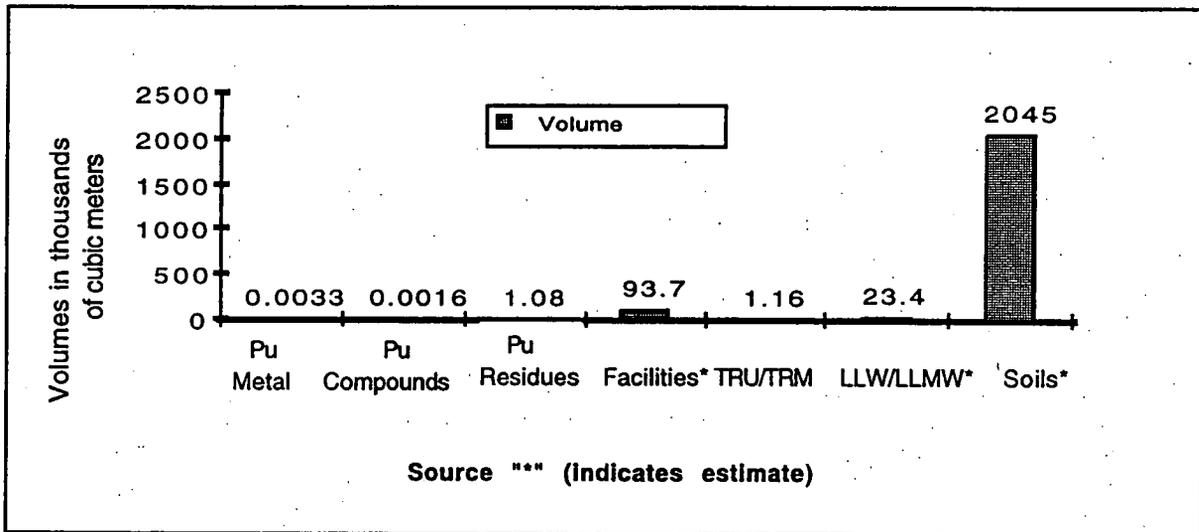
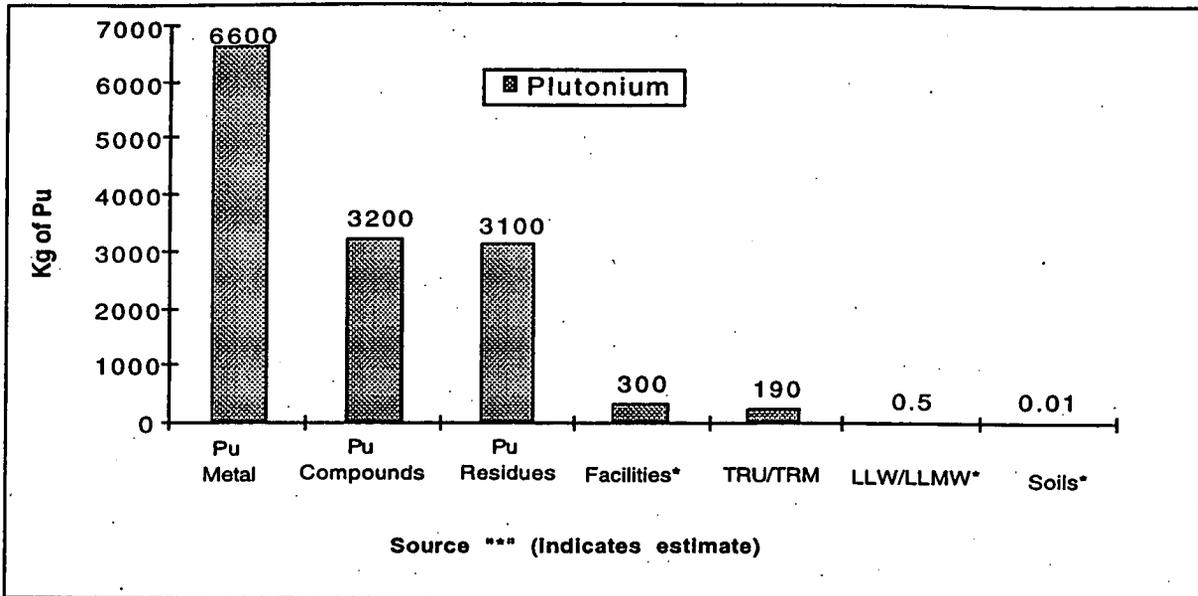
The draft Vision was first published on November 8, 1995 by the Department of Energy (DOE), the Office of the Governor of Colorado, the Colorado Department of Public Health and the Environment, and the United States Environmental Protection Agency. Revisions to the Vision document are still occurring. Some alternatives contained herein are no longer fully consistent with the Vision. It is expected that alternatives inconsistent with the final Vision will be deleted from further consideration.

### PROBLEM DEFINITION AND PROJECT STRATEGY

From its construction in the early 1950's, Rocky Flats was engaged in the production of nuclear and nonnuclear components for nuclear weapons. Plutonium production operations ceased in 1989. All other weapons component production activities ceased in 1994. The Site mission changed to one of cleanup activities, and DOE and its new contractor, Kaiser-Hill, are now faced with the task of accelerating risk reduction, cleaning up the Site, and bringing it to closure. (Risk, as used here, is defined as a measure of potential adverse impacts to the public and Site workers.)

Rocky Flats still contains materials which, if not managed properly, present significant short-term and long-term risks to its workers, the public, and the environment. The principal health and safety risks stem from the presence of significant quantities of radioactive materials (primarily plutonium) stored at the Site in a variety of forms. Currently, it is estimated that there are more than 14 tons of plutonium at Rocky Flats. Figure ES-1 provides information as to the sources of the plutonium at the Site and the volumes of materials containing the plutonium, respectively.

The vast majority of plutonium (over 95%) at Rocky Flats is present in metal, compounds, and residues, and is located in the smallest concentrated volume. The remaining 5% is found in contaminated facilities, wastes, and soil. Conversely, the amount of contaminated soil and other contaminated waste materials represents about 95% of the material volume, but is considered the least contaminated of the material, (containing less than 0.01% of the plutonium).



**Figure ES-1 Plutonium Source Term by Material Type and Matrix Volumes**

In addition to the risks posed by the large quantities of stored radioactive materials, hundreds of acres of land are contaminated with radioactive materials and hazardous chemicals as a result of past disposal practices and releases. These contaminated areas present additional, albeit smaller, risks. In 1989 Rocky Flats was placed on the Superfund National Priorities List because of this environmental contamination. Currently, 167 Individual Hazardous Substance Sites exist at the Site.

Compounding these problems is that, even with the higher funding levels of the past, the Site has had difficulty in making progress in cleanup and risk reductions. In July 1995, DOE hired Kaiser-Hill under a new performance-based contract with the express intention of greatly accelerating the cleanup and closure of the Site. Now as the Site is poised to make progress, Site budgets are rapidly falling to levels that will allow for little expenditure on risk reduction in the face of high nuclear facility baseline costs and an entrenched infrastructure (often referred to as mortgage). The projected outyear funding profile cannot adequately address DOE's prior commitments for Special Nuclear Material (SNM) stabilization and consolidation, environmental cleanup and waste management.

The fundamental strategy for the Site, described in the ASAP, is based on the following elements:

- Establish a unifying implementation strategy for the Site that will simultaneously reduce risks and budget outlays and that can be achieved within the professional lifetime of the people currently working at the Site
- Enable the extended Rocky Flats community to guide the Site to a safe, stable, near-term closure at the earliest possible date. Additional cleanup actions could follow later with greater efficiency and lower risk
- Transform the Site from an operations-based culture to a project-based culture
- Continue to seek ways to achieve early removal of plutonium, enriched uranium, and transuranic waste from the Site
- Aggressively challenge existing facility baseline activities and infrastructure costs
- Challenge current strategies for environmental restoration, waste management, and special nuclear material (SNM) stabilization and consolidation to achieve breakthroughs in accelerating risk reduction activities for much lower costs

## THE ASAP PLANNING AND TRANSFORMATION PROCESS

The ASAP is divided into four major planning and implementation phases as described in Table ES-1.

Table ES-1  
ASAP Path Forward

Phase	Description	Time Period	Status
Phase I	Feasibility Study for Accelerated, Safe, Cost-Effective Closure	9/95 to 10/95	Completed
Phase II	Alternative Study for Accelerated, Safe, Cost-Effective Closure	11/95 to 2/96	Completed
Phase III	Selection of Recommended Approach	1/96 to 9/96	Initiated
Phase IV	Transformation to Recommended Approach	8/96 to 12/96	

ASAP Phase I, conducted from August 1995 through September 1995, was a proof-of-concept effort. It investigated whether a safe, accelerated, and cost-effective closure of the Site was possible compared to the existing extended closure plan published by DOE in the March 1995 *Baseline Environmental Management Report* (BEMR I). The ASAP Phase I draft report described a Feasible Alternative that achieved a safe, accelerated closure of the Site for billions of dollars less and decades before the closure of the Site described in BEMR I.

ASAP Phase II, conducted from October 1995 to February 1996, evaluated four major and several derivative alternatives. The goal of all of the alternatives is the accelerated reduction of risk and safe closure of the Site. The alternatives were expressly selected to bound the possible outcome of the Vision discussions for the Site. *Choices for Rocky Flats* evaluates the alternatives from a cost, schedule, and risk perspective. The purpose of this effort was to aid decision-makers and stakeholders in evaluating the alternatives.

ASAP Phase III, initiated in January 1996 and scheduled to be completed by September 1996, will further explore a number of technical, funding, cost, schedule, and risk assumptions that were made in the Phase I and II reports. These assumptions must be further analyzed in order to improve

technical understanding, while at the same time maximizing risk reduction, schedule compression and cost efficiency. It is expected that a preferred alternative will be recommended at the conclusion of Phase III.

ASAP Phase IV, scheduled for August through December 1996, will focus on aligning the recommended alternative with major Site activities. Some of the activities where alignment will be needed include: (1) the *Site Conceptual Vision*, (2) the Sitewide Environmental Impact Statement, (3) the Site Integrated Baseline, and (4) the recommendations of the Defense Nuclear Facilities Safety Board. It is expected that at the conclusion of Phase IV, the Site will fully implement the recommended alternative.

## ASAP PHASE I

The ASAP Phase I report was published on September 30, 1995. The report described the development of a Feasible Alternative that represented a breakthrough in the approach to risk reduction and closure of the Site. Key attributes of the Feasible Alternative are described below:

*Plutonium and Transuranic Waste:* The Site's recoverable plutonium and transuranic waste would be stabilized and consolidated in new, interim storage facilities awaiting offsite shipment.

*Low-Level and Low-Level Mixed Wastes:* The Site's low-level and low-level mixed wastes would be treated to meet safe, long-term standards and disposed onsite in new RCRA Subtitle C-type landfills.

*Facilities:* All site facilities would be demolished with some low-level waste from decontamination activities entombed in the basements of some facilities.

*Environmental Restoration:* The contaminated areas of highest risk at the Site (approximately 40) would be remediated. New groundwater diversion and passive treatment systems would be installed.

*Land-Use Availability:* Of the Site's approximate 6,200 acres, about 5,000 acres would be clean enough for unrestricted use, including open space. About 1,000 acres would be suitable for use as unoccupied open space. Of the remaining acres, 300 acres would be remediated to allow future industrial or commercial use, if desired. The 200 most contaminated acres, including the current plutonium area (called the Protected Area), and past and future landfills would be safely closed with a long-term landfill cap with long-term monitoring to ensure cap performance and integrity.

Phase I study determined that it was possible to achieve the Feasible Alternative for a total cost of approximately \$6 billion (constant 1995 dollars) by the end of 2003. In contrast, the March 1995 BEMR I reported an estimate of approximately \$22.5 billion and 60 years.

The ASAP Phase I report stimulated a wide ranging debate in the DOE and the Rocky Flats community regarding the various attributes of the Feasible Alternative. Many reviewers praised the initiative, particularly the innovative goal of accelerating risk reduction and cleanup of the Site while attempting to save a significant amount of money. Others expressed concern over the prospect that an interim cleanup might become permanent. Many stakeholders preferred long-term storage instead of disposal, while others wanted the Site to be cleaned to background levels with all waste to be disposed offsite.

During the preparation of the ASAP Phase I report, a number of key technical conclusions were reached by the authors of the report:

- One key cost variable is the timing for exiting the nuclear facilities. This schedule is driven by the time necessary to stabilize and consolidate the SNM. Since SNM activities reduce risk the

most, a clear bias emerges toward allocating funding to those activities and making every effort to safely accomplish them in the minimum possible time.

- Another significant cost variable is the demolition strategy for the nuclear facilities, particularly the five large plutonium facilities (i.e., Buildings 371, 707, 771, 776 and 779). For the buildings to be demolished in a cost effective manner, it appears that demolition would have to be done with some residual low level contamination left in place (i.e., the cost to remove all radioactive contamination from facility surfaces is prohibitive).
- Waste management is a key activity that will impede progress elsewhere unless effective increases in capacity (storage, treatment, and disposal) occur.
- Benefits can be achieved by managing the Site with an overall project scope, schedule, and budget rather than continuing the current practice of managing the Site as an ongoing operation that is funded annually.

Following completion of the ASAP Phase I report, the decision was made to look at a series of possible alternatives that could achieve closure of the Site as the focus of the ASAP Phase II planning process. This decision was based, in large part, on the ongoing discussions on a Site Vision as well as on comments received from the Rocky Flats community on the Phase I report. This approach enables greater stakeholder participation in the decision-making process and hence a greater degree of consensus within the Rocky Flats extended community and greater probability of success.

## **ASAP PHASE II**

### The Approach

The ASAP Phase II planning process selected and evaluated a series of closure alternatives. An alternative is an integrated series of activities that addresses the entire inventory of materials, wastes, and facilities.

Each alternative was developed by teams of subject matter experts in five specialized areas: SNM Stabilization, Consolidation and Storage; Waste Management; Facility Decommissioning; Environmental Restoration; and Infrastructure. Additionally, three other teams were established to assist in the analysis of the alternatives: Cost and Schedule, Implementation, and Risk. Early in the planning process, meetings were held with a number of stakeholders and general agreement was reached that the alternatives selected for evaluation would bound not only the possible outcomes of the ongoing discussion of a Site Vision, but also many of the stakeholders' own personal beliefs about the future of Rocky Flats.

### The Alternatives

Eight alternatives were evaluated. For comparison purposes, the current Site planning vehicle, BEMR I, was included as one of the eight alternatives. The alternatives describe, among other things, different levels of Site cleanup. The extent to which cleanup would be performed under each alternative is often described from a possible future land-use perspective to aid the reader in understanding the differences in the cleanup levels achieved in each alternative. Residential use requires the most extensive cleanup. Open space use requires less stringent cleanup than residential use, and more extensive cleanup than industrial use. Future land-use descriptions are helpful in defining proposed cleanup levels, but it is important to note that future land-use decisions would be made by local governments. At the end of this Executive Summary there is a series of photographs that represent the various end states of each alternative. A brief summary of the major attributes of each alternative follows:

### *Alternative 1, Unrestricted*

All SNM and transuranic wastes would be prepared for safe transport and then shipped offsite. All low-level and low-level mixed waste would be treated as required, and then shipped offsite. Site facilities, foundations, and all utilities would be demolished and excavated. Extensive environmental cleanup would be performed to cleanup levels that, from a risk perspective, could allow residential development, if others so desired.

### *Alternative 2, BEMR I*

This alternative is similar to Alternative 1 except the Site would be remediated to less stringent cleanup standards. All SNM and waste would be shipped offsite. Site facilities and utilities would be demolished and excavated except for water lines and roads. Environmental cleanup would be performed to allow for open space and recreational use of the Buffer Zone with industrial use everywhere else.

### *Alternative 3, Retrieval and Monitored Storage/Disposal*

There are five variations of Alternative 3. Each variation differs in the manner in which waste would be handled but they share the same future-use availability of the Site. In all variations, significant environmental cleanup would be performed to allow open space use in the Buffer Zone, and some future industrial use availability, with capped or restricted areas elsewhere. The caps are generally used to cover contaminated soils following remediation, building foundations, retrievable and monitored storage or disposal facilities, or closed landfills depending on the alternative. The primary purpose of the caps is to protect the materials underneath the caps from precipitation and burrowing animals which might spread contamination. It is important to note that significantly less waste is handled than in Alternatives 1 and 2 because environmental cleanup focuses on the medium and high risk areas only.

#### *Alternative 3a, Phased Shipment*

All radioactive waste (low-level, low-level mixed, transuranic, and transuranic mixed waste) would be treated, if required, and shipped offsite for disposal *after* SNM stabilization, consolidation, and shipment offsite. Site facilities, facility foundations, and utilities would be demolished and excavated.

#### *Alternative 3b, Priority Shipment*

All radioactive waste would be *preferentially* treated and shipped offsite for disposal, therefore delaying all but the most important SNM risk reduction activities and environmental cleanup. Compared to the other Alternative 3 variations, SNM stabilization and consolidation and environmental cleanup are delayed. Site facilities and utilities would be demolished and excavated.

#### *Alternative 3c, Excavation*

Low-level and low-level mixed waste would be placed in onsite retrievable, monitored storage/disposal facilities to provide safe, long-term protection. SNM and transuranic waste would be consolidated and then shipped offsite. Site facilities, facility foundations, and utilities would be demolished and excavated.

#### *Alternative 3d, Leveled Buildings*

Low-level and low-level mixed waste that must be moved (e.g., from facility decontamination or environmental cleanup) would be placed in onsite retrievable, monitored storage/disposal facilities.

SNM and transuranic wastes would be consolidated and then shipped offsite. Site facilities would be demolished *except* for foundations and some underlying utilities, which would be placed under a protective cap.

*Alternative 3e, Entombment and Landfill*

Low-level waste would be either entombed in building basements or placed in a landfill. Low-level mixed waste would be placed in an onsite RCRA Subtitle C-type landfill after treatment to provide long-term protection. SNM and transuranic waste would be consolidated and then shipped offsite. Site facilities would be demolished except for foundations and underlying utilities, which would be placed under a protective cap.

*Alternative 4, Mothball*

Low-level waste and low-level mixed waste would be placed in onsite retrievable, monitored storage/disposal facilities. SNM and transuranic waste would be consolidated and shipped offsite. Site facilities would be decontaminated to levels sufficient to eliminate all active safety systems and then would be left standing vacant. Some facilities would be demolished, where cost effective.

**ALTERNATIVE COMPARISON**

The alternatives were compared based on a number of factors including cost, major cost drivers, schedule, and comparative risk. Table ES-2 presents a summary of each alternative's project costs, completion dates, and operations and maintenance (O&M) costs remaining after the project is completed.

**Table ES-2  
Estimated Total Alternative Cost**

Alternative	Interim End State <sup>1</sup>		Final End State <sup>2</sup>		Annual O&M Cost <sup>3</sup>
	Date	Cost	Date	Cost	
1, Unrestricted	N/A	N/A	2029	\$22.5B	\$5M
2, BEMR I <sup>4</sup>	N/A	N/A	2060	\$21.1B	\$10M
3a, Phased Shipment	2009	\$9.2B	2023	\$14.6B	\$14M
3b, Priority Shipment	2010	\$10.0B	2018	\$12.8B	\$14M
3c, Excavation	2010	\$8.9B	2015	\$9.7B	\$14M
3d, Leveled Buildings	2010	\$8.8B	2015	\$9.6B	\$14M
3e, Entombment and Landfill	2010	\$9.0B	2015	\$9.9B	\$14M
4, Mothball	2007	\$6.1B	2015	\$7.5B	\$35M

1. All work complete except offsite shipment of waste and SNM, D&D of new temporary facilities (if required), and final ER activities.
2. All work complete except long-term monitoring. Deferred liability costs for Alternatives 3c, 3d, 3e, and 4 not included (i.e., in 3c, 3d, 3e, and 4, waste remains onsite).
3. Annual O&M cost for Alternatives 1, 3a, 3c, 3d, and 3e are essentially the same when escalation is factored out. Alternative 4 annual O&M cost is approximately four times that of the other alternatives. Annual O&M costs begin on the date specified on the Final End State.
4. BEMR I was costed earlier and differently than the other alternatives.

Alternative 1 and Alternative 2 take the longest time to complete and have the highest total project costs. At the opposite end of the spectrum, Alternative 4 takes the shortest time to complete and has the lowest project costs, but a deferred liability remains because the facilities are left standing. As expected, Alternative 4 has the highest long-term O&M costs because Site facilities are left standing. Each alternative presents risk as a function of two time periods: during implementation and after implementation. The relative risks of the alternatives were compared on a qualitative basis for three areas: Occupational Safety and Health (OSHA), Radiological Exposure, and Transportation.

OSHA risks, which are those associated with workplace activities, are highest for Alternatives 1 and 2 because those alternatives involve the greatest amount of material and waste handling. Risks from radiological exposure (those associated with the handling of nuclear materials and radiological emissions) are highest for Alternatives 1 and 2 also, because of the significant amount of nuclear material and waste handling. Risks associated with the transportation of radioactive materials, wastes, and other cargo (expressed as the number of transportation accidents which could be expected) are highest for Alternatives 1 and 2, because of the large number of offsite shipments of radioactive waste.

In general, the overall risk during implementation is qualitatively considered to be highest for Alternative 1, high for Alternatives 2 and 3b, moderately high for Alternative 3a, moderate for Alternatives 3c, 3d, and 3e, and lowest for Alternative 4. Upon completion of activities, the remaining hazards for the projected end state for all alternatives, although significantly lower than the risks the Site currently poses, are highest for Alternative 4, low for Alternatives 2, 3a, 3b, 3c, 3d, and 3e, and lowest for Alternative 1. It is important to note that the risk to the workers and the public at the end state for all alternatives is considered low in comparison to the current risk at Rocky Flats because of the lower levels of hazards remaining after each alternative is completed.

## Key Findings

The key findings of the ASAP Phase II report are as follows:

- Implementation costs (construction and placement of waste) for retrievable, monitored storage/disposal facilities (e.g., concrete-lined facilities) and landfills are not appreciably different.
- It costs 50 percent more to treat and dispose of low-level mixed waste offsite as compared to onsite because of different regulatory requirements.
- The Alternative 1, Unrestricted end state costs more than twice as much to achieve, when compared to the 3 series alternatives, even with favorable assumptions about projected waste volumes and treatment costs.
- All alternatives except Alternative 3b, Priority Shipment, follow the same logic of stabilizing and consolidating SNM first. Alternative 3b represents a significant shift in risk reduction strategy and would have the most significant impact on the next few years of Site operations.
- The construction of a new transuranic waste storage facility is cost-effective if the opening of the Waste Isolation Pilot Plant is delayed.
- Key cost drivers for waste management are specifically related to the degree of cleanup and facility decommissioning required.
- It is more cost-effective to construct a new SNM storage facility because full-scale offsite SNM shipment probably cannot begin until after 2007, and the annual storage cost in a retrofitted Building 371 grows significantly more expensive with each year beyond 2007 due to high annual operating costs.

- All the alternatives start with the same relative risk, progress to a higher risk as the Site is cleaned up, and then decrease to a similar, lower end-state risk except for Alternative 4, Mothball, which defers facility disposition. There are significant differences in cleanup risk because of differences in the magnitude of the waste volumes managed and the varied waste treatment and disposal options.

## **NEXT STEPS**

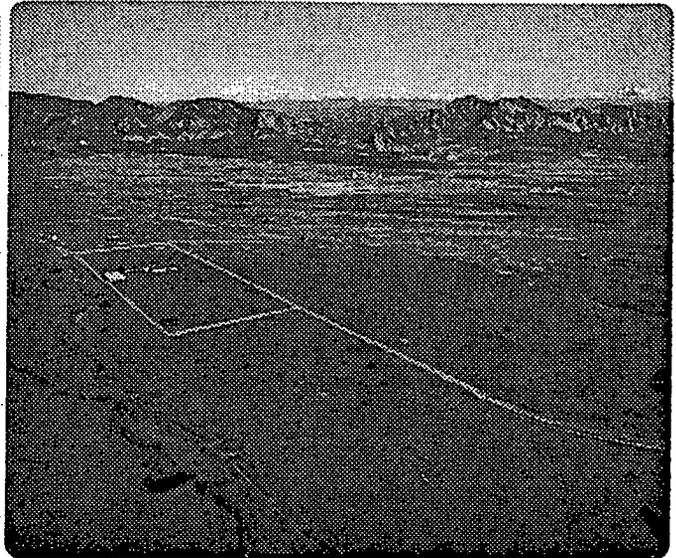
The next phase of the ASAP project will further explore a number of technical, funding, cost, schedule, and risk assumptions that were made in the Phase I and II reports. These assumptions require further analysis to clarify technical uncertainties and maximize the cost and schedule efficiencies.

Several key activities will occur during Phase III of the project:

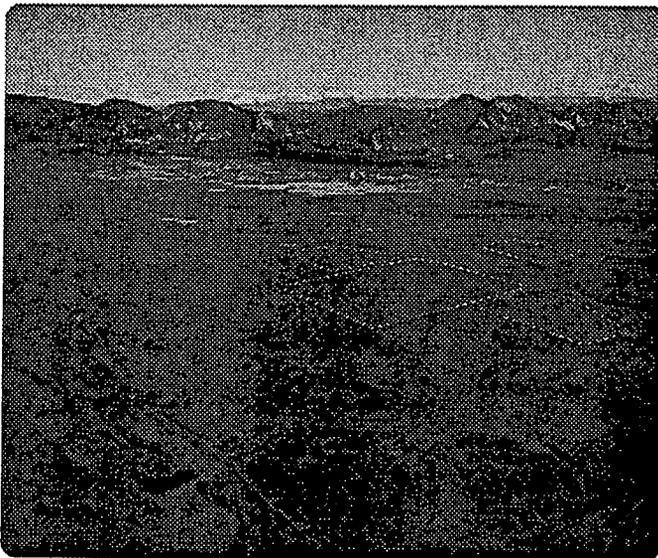
- After the Site Vision is finalized during the Phase III timeframe (i.e., January through September 1996), a decision on the recommended alternative is expected, pursuant to a decision-making process currently under development.
- Communication between the ASAP team and the DOE team preparing the Sitewide Environmental Impact Statement (SWEIS) will continue to ensure that Site planning efforts are integrated. The selected ASAP alternative will be consistent with the preferred alternative in the SWEIS.
- Preparation of some outyear budgeting documents will incorporate basic concepts of the ASAP that are common to all alternatives (e.g., near-term SNM risk-reduction activities).
- Continued internal and external stakeholder briefings and discussions will be held on the Phase II report.



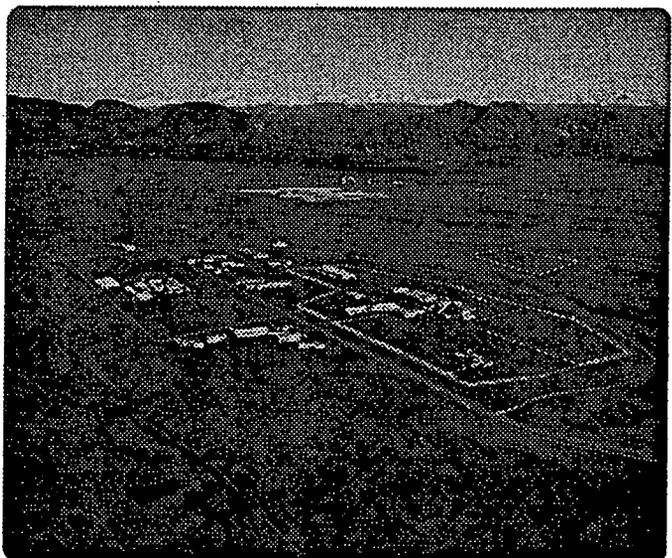
Alternative 1



Alternative 2



All Alternative 3s



Alternative 4

## 1.0 INTRODUCTION

### 1.1 Accelerated Site Action Project (ASAP)

The Rocky Flats Environmental Technology Site (Rocky Flats or Site) Accelerated Site Action Project (ASAP) is a planning and integration project with the goal of radically reducing the risks associated with the presence of nuclear and nonnuclear materials at Rocky Flats. This risk reduction would be accomplished at an accelerated pace and at a significantly reduced cost compared with the Site's previously planned course of action. On September 30, 1995, a Phase I report was published which demonstrated that the Site could achieve rapid risk reduction within eight years at a cost of \$6 billion. The Phase I report contained several policy assumptions, including unconstrained annual funding and significant regulatory flexibility.

*Choices for Rocky Flats*, the document resulting from the ASAP Phase II activities, presents the results of continuing ASAP planning and integration. Specifically, the document presents several Site-closure alternatives that bound the draft Conceptual Vision of the Site promulgated on November 8, 1995 by the Department of Energy (DOE), the Colorado Department of Public Health and Environment (CDPHE), the Environmental Protection Agency (EPA), and the Colorado Governor's Office. Revisions to the Vision document are still occurring. At publication time of this document, the alternatives described here still bound the latest revision of the Vision document, although some alternatives are no longer completely consistent with all parts of the Vision.

ASAP seeks to address the fundamental problem at Rocky Flats: current plans for the stabilization of nuclear material and environmental activities to clean up the Site are uncertain in outcome, costly, and too slow.

### 1.2 Historical Perspective

Rocky Flats is part of the Nuclear Weapons Complex of DOE. The DOE complex consists of 13 interrelated major facilities that have (or have had) as their main mission the design, manufacturing, testing, production, and maintenance of nuclear weapons for the U.S. arsenal.

By the end of the Cold War, numerous DOE facilities were radioactively contaminated. Many of the sites contain large and intricate production facilities contaminated with hazardous chemical and radiological substances. Contamination of soil, surface water, and groundwater is extensive. DOE has estimated that it will cost nearly a total of \$300 billion to clean up the entire DOE weapons complex, and this cleanup will be the single largest environmental program in history.

Rocky Flats, one of the 13 major DOE weapons facilities, occupies approximately 6,200 acres in northern Jefferson County, Colorado, about 16 miles northwest of Denver. From its first construction in the early 1950's, the original site has developed into an industrial complex consisting of more than 500 facilities that were used for manufacturing, chemical processing, laboratory, support, research and development, and administrative activities. The main production and support facilities were located near the center of the Site, commonly referred to as the Industrial Area, and occupy about 385 acres. In 1972, a surrounding 3,930-acre parcel was acquired to function as a security and safety Buffer Zone to minimize problems arising from the growing proximity of residential communities.

Land adjacent to the Buffer Zone is used primarily for agricultural and residential purposes. In the 40 years since Rocky Flats was constructed, surrounding multi-use development has steadily approached the Site. The population of the Denver metropolitan area has increased to nearly 2.2 million people within a 50-mile radius of the Site.

From 1952 to 1989, the primary mission of the Site (then called the Rocky Flats Plant) was the production of nuclear and nonnuclear components for nuclear weapons. During this period, activities generally consisted of radioactive (e.g., plutonium and uranium) and nonradioactive (e.g., stainless steel and beryllium) metal working, fabrication and component assembly, and plutonium recovery and purification. Research and development in the fields of chemistry, physics, metallurgy, materials technology, nuclear safety, and mechanical engineering were conducted to advance the Site's mission.

In 1989, almost all of the radioactive-material production activities at Rocky Flats were suspended due to safety and environmental concerns related to operations, and the Site was placed on the Superfund National Priorities List. In 1992, the nuclear weapons component role of Rocky Flats ended with the cancellation of production of the W-88 Trident Warhead. Although production has ceased, nuclear weapons components, other nuclear materials, and wastes are still stored in many buildings. Extensive effort and human resources are required to maintain these buildings and other facilities in a safe and secure condition.

In the process of fulfilling the earlier national security mission, the use of the above mentioned materials and processes contaminated facilities, soil, groundwater and surface water at Rocky Flats with chemical and radioactive substances. Additionally, the Site has significant quantities of nuclear material; radioactive and hazardous waste; contaminated facilities, land, and water; and surplus equipment and materials. As a consequence, the Site has numerous potential health and safety risks, high baseline operating costs, significant legal requirements, and other infrastructure burdens.

Figure 1-1 shows that the vast majority of the Site plutonium (over 95 percent) is found in metal, compounds, and residues. About 5 percent of Site plutonium is found in contaminated facilities, containerized wastes and soils. Figure 1-2 shows that of the total volume of materials containing plutonium, about 95 percent is contaminated soils (over 2,000,000 cubic meters).

In 1991, the DOE entered into a tri-party Rocky Flats cleanup agreement (referred to as the Interagency Agreement or IAG) with the State of Colorado and the EPA. The IAG specified a legally enforceable framework for assessing the nature and extent of contamination, determining the associated risks, and accomplishing remediation. Under the IAG, 173 Individual Hazardous Substances Sites (IHSSs) were identified at the Site and grouped into 16 Operable Units (OUs).

With the cancellation of the Site's national security mission, the first major attempt to realign Site activities to cleanup was reflected in the 1992 Mission Transition Report. Later attempts to define the Site's future mission activities included the Congressionally mandated Baseline Environmental Management Report (BEMR I) published in March 1995, and the Site Strategic Plan published in September 1995.

In July 1995, Kaiser-Hill (K-H) assumed responsibility for Site operations and was faced with declining budgets, and costly and inefficient work processes. K-H initiated ASAP as a means to challenge many of the current Site work processes and to greatly accelerate the cleanup and closure of the Site.

In October of 1995, representatives of DOE, the State of Colorado, EPA, K-H, and the Defense Nuclear Facilities Safety Board (DNFSB) met to discuss a path forward for the cleanup of Rocky Flats. On November 8, 1995, DOE, EPA, and the State issued a Draft Conceptual Vision of the Site to help guide the future direction of Rocky Flats. The idea behind the Vision was to decide what the Site would look like in its final state to enable the representatives to draft a subsequent regulatory agreement in early 1996 addressing the means to achieve that end.

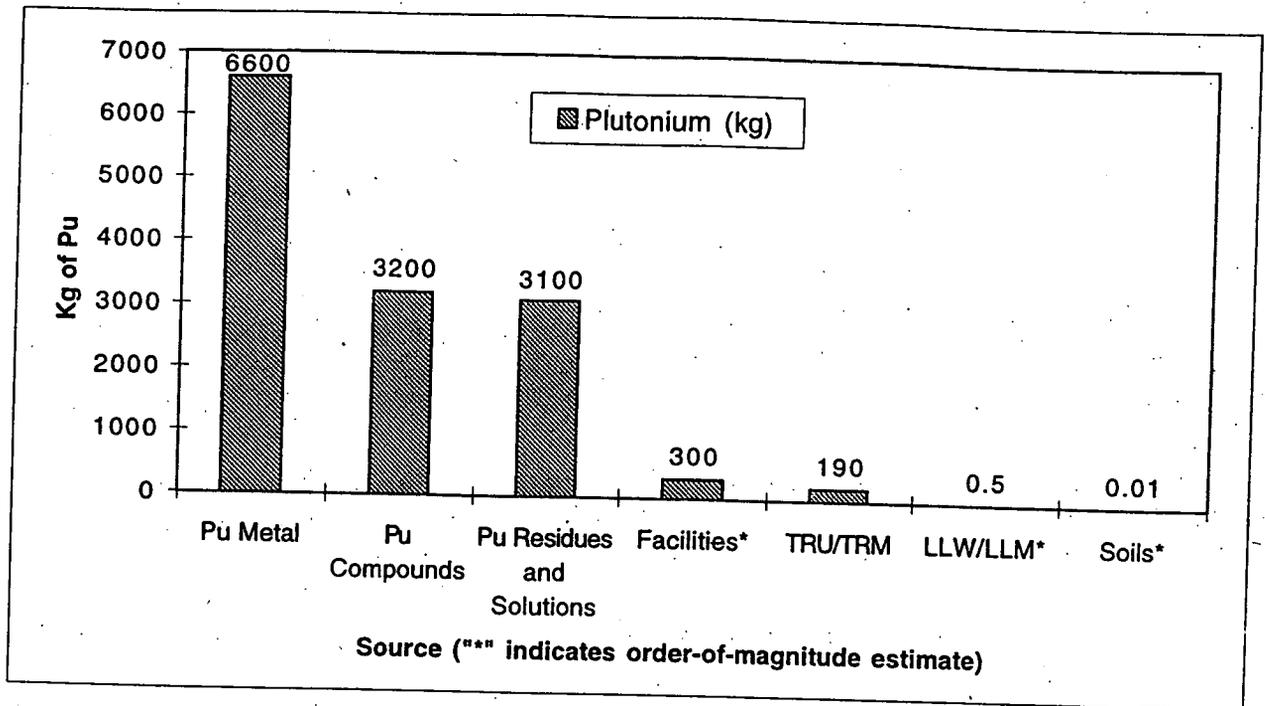


Figure 1-1 Mass Distribution of Plutonium

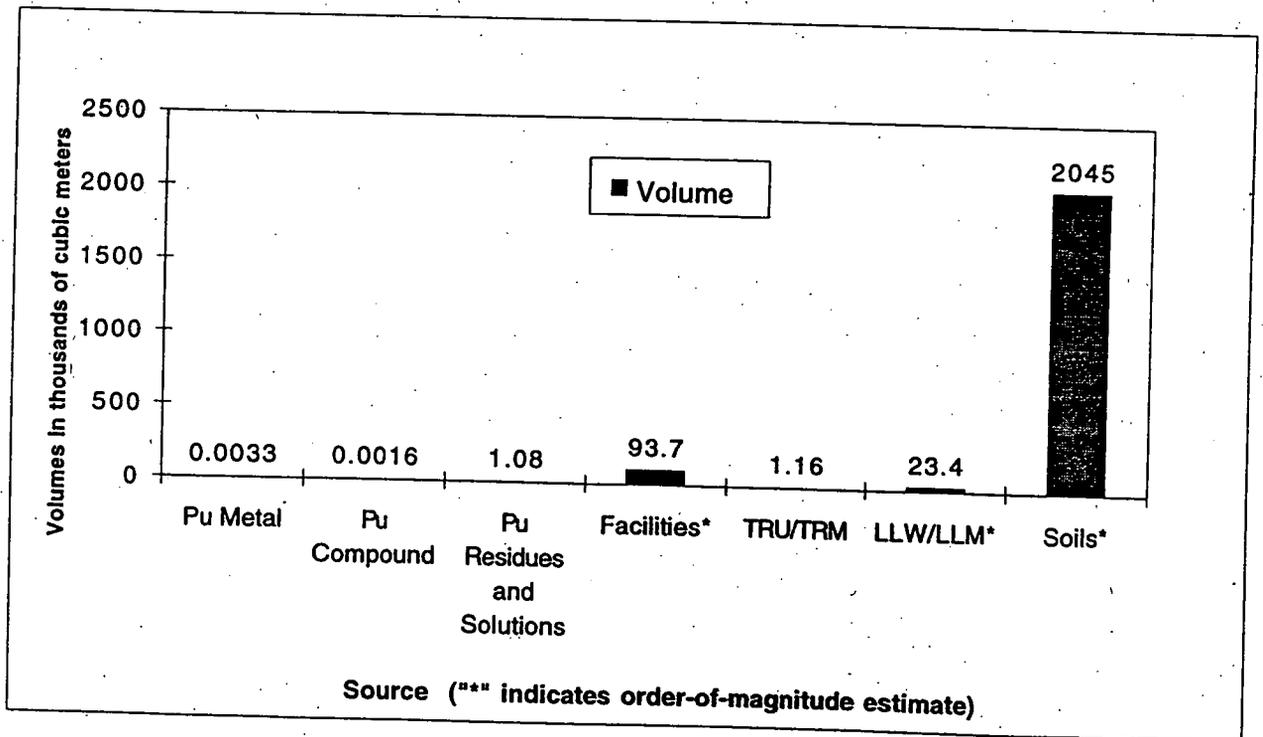


Figure I-2 Volume Distribution of Plutonium

### 1.3 ASAP Planning Phases

ASAP is divided into four major planning phases, as described in Table 1-1, ASAP Path Forward, and in Figure 1-3, ASAP Planning Strategy.

**Table 1-1  
ASAP Path Forward**

Phase	Description	Time Period	Status
Phase I	Feasibility Study for Accelerated, Safe, Cost-Effective Closure	9/95 to 10/95	Completed
Phase II	Alternative Study for Accelerated, Safe, Cost-Effective Closure	11/95 to 2/96	Completed
Phase III	Selection of Recommended Approach	1/96 to 9/96	Initiated
Phase IV	Transformation to Recommended Approach	8/96 to 12/96	

#### 1.3.1 ASAP Phase I Scope of Feasibility Study

Phase I of the ASAP effort, conducted from August through September 1995, was a proof-of-concept effort that investigated whether a safe, accelerated, and cost-effective closure of the Site was possible compared to the existing extended closure plan presented by the DOE in the BEMR I. ASAP Phase I described a feasible alternative that greatly accelerated risk reduction and interim closure of the Site. The Phase I alternative addressed onsite disposal of low-level and low-level mixed waste (LLW/LLMW); environmental cleanup of high risk areas; contaminated groundwater management; building demolition; and interim storage of Special Nuclear Material (SNM) and transuranic waste.

ASAP Phase I explored one specific route to accelerated Site closure that used onsite disposal of primary and secondary wastes, where appropriate. During the subsequent analysis of Phase I, two key observations were made: (1) there were many accelerated safe-closure alternatives that appeared to be superior in cost and schedule compared with the path forward described in the BEMR I (the existing planning vehicle); and (2) each alternative had a different success probability based on risk, safety, technical, regulatory, social, political, and financial issues.

#### 1.3.2 ASAP Phase II Scope of Alternative Development

An immediate decision had to be made regarding the scope of ASAP Phase II. Two paths were available: (1) Phase II could be a deeper vertical treatment of the feasible alternatives of the Phase I study; or (2) Phase II could be expanded horizontally to assess the various alternatives in order to identify the most promising Site alternative for in-depth exploration in Phase III.

The decision to develop information about various routes to accelerated safe closure at Rocky Flats was driven by stakeholder and regulator input, and the desire to assist decision-makers in their deliberations over the future Vision for Rocky Flats.

Four major alternatives, along with several derivative variations, were developed and are described in Section 2, Presentation of Alternatives. The differences among the alternatives are outlined to permit the reader to evaluate impacts, and to either select a preferred

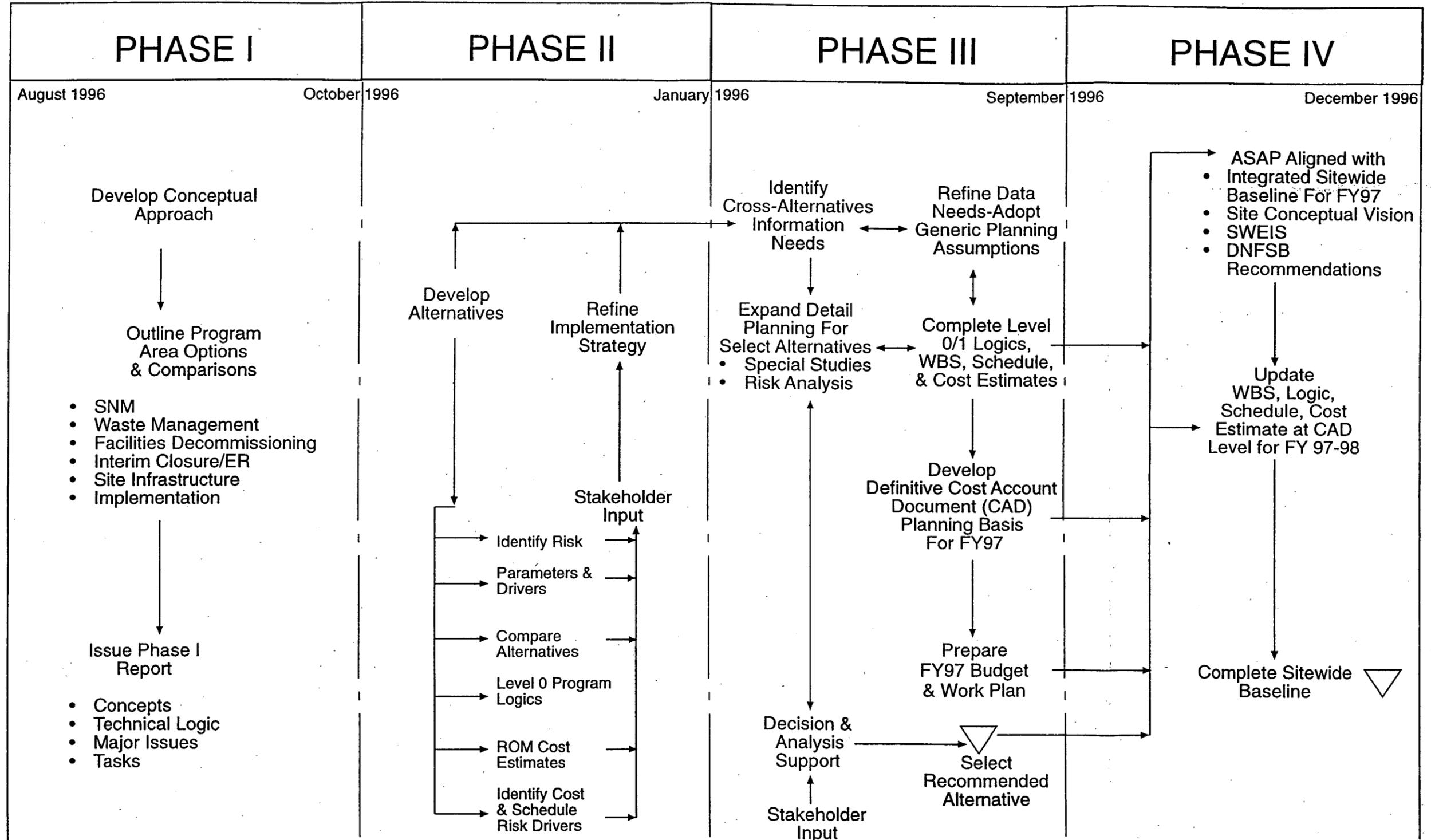
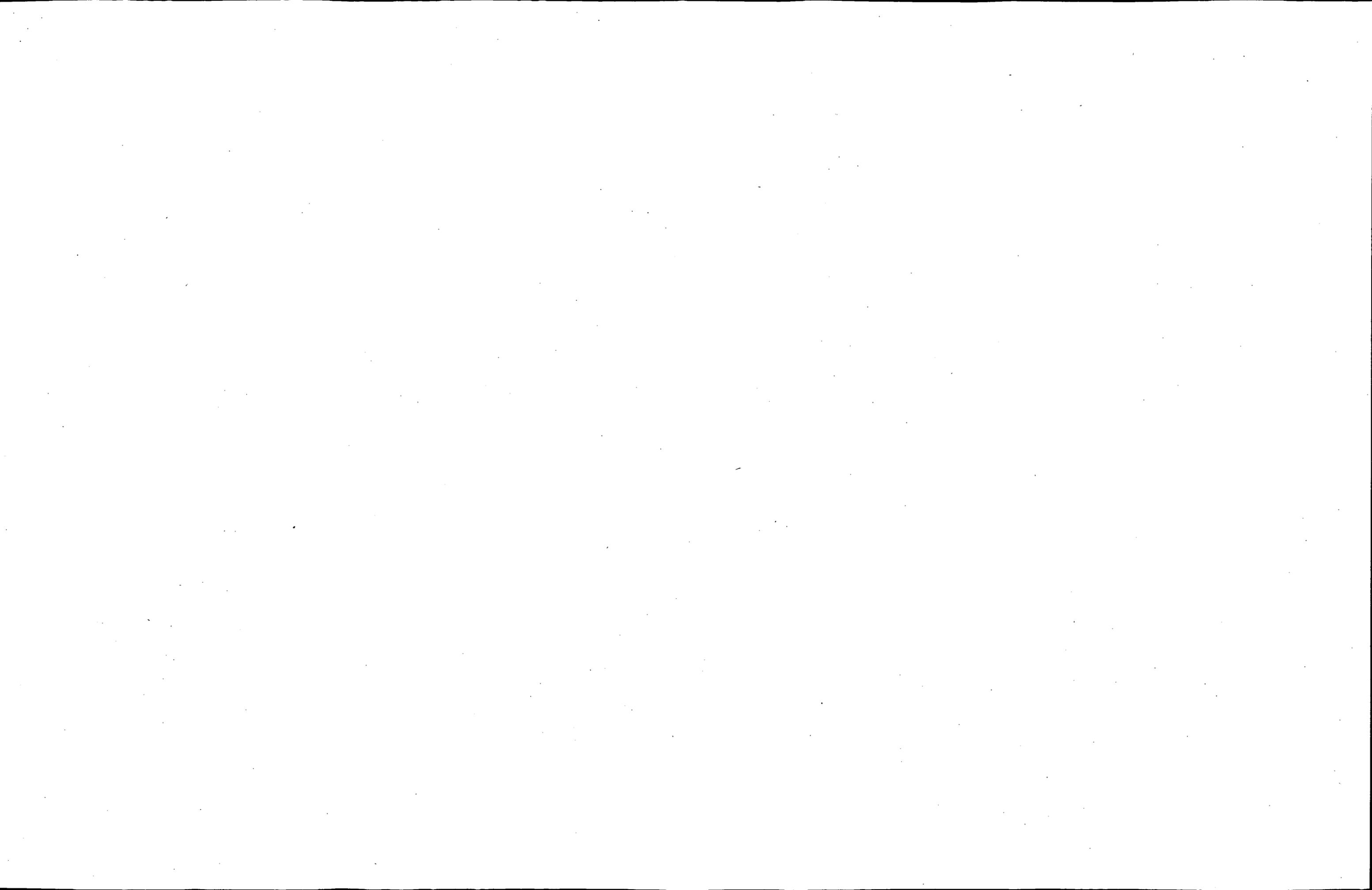


Figure 1-3 ASAP Planning Strategy - Choices for Rocky Flats



alternative or form a hybrid for future evaluation. The information is presented in a manner that encourages the reader to formulate an individual decision matrix to select a path forward from the various closure alternatives, satisfying individual concerns.

The ASAP Phase II family of alternatives was based on two key objectives: (1) provide upper and lower bounds for the available alternatives representing the current Draft Conceptual Vision of November 8, 1995; and (2) address the issues raised by stakeholders and regulators. Each alternative encompasses a set of integrated choices relating to the five specialty task areas: (1) SNM Stabilization and Consolidation and Storage; (2) Waste Management; (3) Facility Decommissioning; (4) Environmental Restoration; and (5) Infrastructure. These specialty task areas are discussed in further detail in Appendices A through E.

A comparative analysis of the alternatives is included in Section 3 of this document. A more detailed analysis will be completed during ASAP Phase III, during which time stakeholders, regulators, and decision makers will work to select the alternative most compatible with the final vision for the Site.

### 1.3.3 ASAP Phase III Special Studies and Alignment of FY97 Work Scope

Each alternative identified during Phase II contains assumptions and activities common to most, if not all, of the other alternatives. If maximum technical and schedule improvement, and cost-efficiency are to be realized by ASAP, then further analysis of these common assumptions and activities during Phase III is necessary. Special studies, cost-benefit analysis, and risk analysis will be performed to maximize risk reduction and reduce uncertainties while improving productivity and efficiency. Also, as stakeholder and regulator groups from the general public, state, and federal sectors work toward selection of an alternative to recommend, special study topics may be identified.

Recommendation of the preferred alternative will occur during Phase III. Following this decision, the results of earlier special studies, risk analysis, cost-benefit analysis, and systems engineering studies will be integrated during the development of a single ASAP description and proposed baseline.

By July 1996, the baseline description will be sufficiently detailed to provide the basis for preparation of the FY97 site budget request with outyear descriptions fully developed at the summary level. Complete network logic diagrams, work breakdown structure, schedules, and cost estimates will be assembled for outyear planning.

### 1.3.4 ASAP Phase IV Implementation

By the end of Phase III, the major plans and work activities at the Site will have been aligned for implementation with the recommended alternative. Phase IV implementation of ASAP will focus on aligning the recommended alternative with three major Site planning efforts: (1) the Conceptual Vision for the Site developed during the Workout II session in March 1996; (2) the Integrated Sitewide Baseline (ISB); and (3) SNM stabilization and consolidation plans encompassed by the Site Integrated Stabilization Management Plan (SISMP), and DNFSB Recommendations 94-1 and 94-3. ASAP's anticipated alignment with each of these three program areas is discussed below.

*ASAP, the Conceptual Vision, and the National Environmental Policy Act (NEPA)* – The Rocky Flats Draft Conceptual Vision and the ASAP are closely related. The draft Conceptual Vision, currently under development, will help guide all actions at the Site including cleanup, SNM consolidation, safety, physical plant conversion and land use. The Vision forms the planning target for Site closure. ASAP will define the implementation strategy to reach the

Vision. The data generated during the ASAP process will aid decision makers in the finalization of the Vision and development of the cleanup agreements.

Rocky Flats NEPA activities will bound the alternative recommended for the Site. The Site-Wide Environmental Impact Statement (SWEIS), publication of which is expected in 1997, will incorporate major elements of the various ASAP alternatives. The Conceptual Vision focuses the direction that the Site will pursue and is consistent with the SWEIS analyses for end state scenarios. The record of decision (ROD) will define the preferred action(s). Actions that need to take place prior to the ROD can be treated as interim actions to the SWEIS if they meet the criteria of 40 CFR 1506.1c which requires that the actions are justified independently of the program, are accompanied by an adequate NEPA document, and will not prejudice the ultimate decision on the program.

*ASAP, the SNM Storage Stabilization and Consolidation Programs 94-1, 94-3, and SISMP* – The expectation is that ASAP will not introduce new activities in the stabilization, consolidation, and storage of SNM. ASAP plans for SNM stabilization and consolidation will conform to existing commitments described in the SISMP, and DNFSB Recommendations 94-1 and 94-3. SNM strategy in ASAP is expected to align with the existing SNM programs, and the Site intends to honor DNFSB and DOE commitments.

*ASAP and the Integrated Sitewide Baseline (ISB)* – Alignment of the ISB, once the recommended alternative is approved for planning purposes, is expected. During the first half of FY96, work is being aligned to a set of DOE-approved performance measures and corresponding work packages that do not preclude the implementation of any of the alternatives identified in Section 2 and discussed further in Appendix I.

ASAP will become the basis for sitewide integrated planning and program execution. The emphasis through Phase III will be on detailed studies and selection of a recommended alternative. From September 1996 through December 1996, ASAP Phase IV will concentrate on refinement of planning for FY98 and beyond.

#### **1.4 Barriers and Uncertainties**

There are both internal and external uncertainties associated with this document. Internal factors, such as wage rates, resource costs, consumable quantities, uncertain technology utilization, and timing uncertainties for key activities, can alter planned activities and cost. In addition, external influences such as regulatory changes, regional and socioeconomic impacts, and offsite disposal and treatment facility availability also have the potential to modify planned events at the Site significantly. As with any long-range forecast, the uncertainties associated with the cost estimates provided in this report grow as the forecast horizon increases. Therefore, near-term activities and their associated cost projections have a much higher degree of certainty than the outyear activities and costs.

#### **1.5 Organization of Choices for Rocky Flats**

This document, *Choices for Rocky Flats*, is the product of the ASAP Phase II planning effort and is divided into two major parts. The first part includes Sections 1 through 4. The second part includes Appendices A through K. This document was divided into two parts to allow the reader flexibility as to depth of detail desired.

Sections 1 through 4 contain basic information and the conclusions that were developed as part of this planning effort. These sections also include a brief history of Rocky Flats and the ASAP planning phases (Section 1); a brief discussion of the alternatives selected for evaluation (Section 2); a comparison of the major attributes (i.e., cost, schedule, and risk) of

the alternatives (Section 3); and a discussion of ASAP activities planned for the future (Section 4).

Appendices A through E contain the technical details for the major task areas that were evaluated in order to arrive at the four major integrated Alternatives. These task areas are SNM Stabilization, Consolidation, and Storage; Waste Management; Facility Decommissioning; Environmental Restoration, and Infrastructure. Appendices F through I contain information on topical areas related to the implementation of the ASAP, methodology for calculating and evaluating cost and risk, and additional comparative details for each of the alternatives. Appendix J includes proposals that were submitted by stakeholders.

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## 2.0 PRESENTATION OF ALTERNATIVES

An alternative is a possible vision of Rocky Flats that addresses the Site inventory of materials, systems, structures, and components. Each alternative integrates aspects of work performed within five specialized areas: Special Nuclear Materials, Waste Management, Facility Decommissioning, Environmental Restoration, and Infrastructure. These five areas, as well as the integrating activities related to cost, schedule, implementation, and risk, were analyzed to identify how they would change under a series of possible alternatives. Table 2-1 describes the activity areas that were analyzed.

**Table 2-1**  
**Integrated Activity Analysis**

Area	Description
Special Nuclear Material	Stabilization, consolidation, and disposition of plutonium and enriched uranium (e.g., metal, oxides, and solutions)
Waste Management	Characterization, treatment, storage, and disposal of radioactive and nonradioactive waste
Facility Decommissioning	Disposition of excess Site facilities (e.g., deactivation, decontamination, dismantlement or demolition)
Environmental Restoration	Characterization and cleanup of environmental contamination including soil and groundwater
Infrastructure	Management of utilities and services to support the Site during all phases of implementation of each alternative
Cost and Schedule	Development, evaluation, and comparison of costs and schedules inherent to in each alternative
Implementation	Activities necessary to implement the planning process and to support the process of choosing a recommended alternative
Risk	Evaluation and comparison of the relative risks inherent in each alternative

### 2.1 Alternative Overview

One key to understanding each alternative is to focus on the attributes of the Site remaining at the completion of that alternative, and the date by which the inventory of material, systems, structures, and components have been addressed and a significantly reduced staff and mortgage have been achieved.

The four major alternatives were developed and analyzed to bound the potential interim and/or end states for the Site. One of the alternatives, Alternative 3, had 5 derivatives which were developed and analyzed. Tables 2-2 through 2-9, which summarize the key attributes of each alternative, and Table 2-10, which provides an overall summary of the attributes, are found at the end of this section. Each of the alternatives is discussed below.

#### 2.1.1 Alternatives

*Alternative 1, Unrestricted* – Reclaims the land encompassing the entire Site to a level that would support residential housing development anywhere on the Site (generally one-in-a-million risk or less of excess lifetime cancer). Alternative 1 is the most extensive of the land reclamation alternatives and represents an upper boundary of land reclamation. All Special Nuclear Material (SNM) would be repackaged for interim storage and await shipment offsite,

stored safely onsite in a new state-of-the-art facility. All waste would be dispositioned offsite. All buildings eventually would be removed, and their foundations dug up.

*Alternative 2, BEMR I* – Represents DOE's early Site planning as published in the 1995 Congressionally mandated Baseline Environmental Management Report (BEMR I). BEMR I was predicated on a less extensive level of cleanup consistent with open space or recreational use of the buffer zone (approximately one-in-one-hundred-thousand or less risk of excess lifetime cancer) and restricted or industrial use of the current industrial area (approximately one-in-ten-thousand or less risk of excess lifetime cancer). In BEMR I, buildings would be demolished soil and foundations would be removed down to 12 inches below floor level. Building 371 (modified as required) would be used for consolidation and storage of SNM until all SNM is dispositioned offsite.

*Alternative 3, Retrievable, Monitored Storage and Disposal* – There are five variations of Alternative 3. Each of the variations differs in the manner in which waste is handled, but they share the same future use of the Site. In all variations, significant environmental cleanup would be performed to allow open space and unoccupied open space in the Buffer Zone, some future industrial use, and capped and restricted areas elsewhere. Fifty-to-fifty-five Individual Hazardous Substance Sites (IHSSs) would be remediated. The differences among the five variations are discussed below.

Final covers (or caps) are placed over portions of the Site after completion of cleanup and decommissioning covering approximately 87 acres:

- (1) 10 acre cap over the 371/374 area
- (2) 43 acre cap over the 700 area
- (3) 13 acre cap over the Solar Pond (OU4) area
- (4) 21 acre cap over the Landfill (OU7)

Each cap may cover: (1) contaminated soil remaining after remediation, (2) foundations, (3) retrievable and monitored low-level waste, (4) closed landfill, and (5) dismantled building structures with entombed low-level waste, depending upon the alternative.

- *Alternative 3a, Phased Shipment* – Places all radioactive waste, including building debris and foundations, in retrievable, monitored interim storage facilities with the assumption that offsite shipment would occur at a later date. The design of these facilities would be optimized to facilitate removal and offsite shipment at a later date. Removal of waste from storage and subsequent treatment and packaging to meet Land Disposal Restriction (LDR) requirements would occur just prior to shipment to take advantage of any technological breakthroughs and potential regulatory changes. Caps cover only contaminated soil remaining after remediation.
- *Alternative 3b, Priority Shipment* – Evaluates accelerated shipment of radioactive waste offsite for disposal. Shipment as soon as possible would be funded preferentially over all but the most urgent SNM and environmental restoration risk reduction activities. SNM would be consolidated into a refurbished Building 371 instead of a new storage facility. Solid residues and SNM solutions would be processed to meet Waste Insolation Pilot Plant Waste Acceptance Criteria (WIPP WAC). There would be no new building for storing transuranic (TRU) waste. Instead, all waste would be stored in existing facilities. All appropriate low-level mixed waste (LLMW) would be treated to LDR requirements before storage and shipment offsite for disposal. Site facilities would be demolished and building foundations dug up. Caps cover only contaminated soil remaining after remediation.

- *Alternative 3c, Excavation* – Places all low-level waste (LLW) and LLMW, including building demolition waste and foundations, in retrievable, monitored onsite storage and disposal facilities. The special design of these facilities would preserve the option for later removal if a receiving site becomes available and the decision is made to remove waste stored in the retrievable waste facility. RCRA LDR noncompliant LLMW would be treated as necessary to ensure the long-term safety and health of the workers, the public and the environment. TRU waste would be consolidated into a new interim storage building until it could be transported to WIPP. Foundations would be excavated. Caps cover retrievable, monitored storage and disposal, and contaminated soil remaining after remediation.
- *Alternative 3d, Leveled Buildings* – Places all LLW/LLMW which must be transported or moved (i.e., container and bulk) including dismantlement buildings into retrievable, monitored onsite storage/disposal facilities. RCRA LDR noncompliant LLMW would be treated as necessary to ensure the long-term safety and health of the workers, the public and the environment. TRU waste would be consolidated into a new interim storage building until it could be transported to WIPP. Building foundations would remain in place, but no waste would be placed in the foundations for entombment. Caps cover retrievable, monitored storage and disposal, foundations remaining, and contaminated soil remaining after remediation.
- *Alternative 3e, Entombment and Landfill* – Disposes LLW onsite in entombed basements and LLW/LLMW onsite in RCRA Subtitle C-type landfills. LLMW would be treated to provide safe long-term protection of workers, the public and the environment. Demolition waste from radioactively contaminated buildings would be safely entombed onsite within those building foundations remaining in place. TRU waste would be consolidated into a new interim storage building until it could be transported to WIPP. Caps cover the entombed waste, OU7 landfill, and contaminated soil remaining after remediation.
- *Alternative 4, Mothball* – Cleans up the Site to a degree that allows facilities to remain standing but essentially in a shutdown mode with only those safety systems (passive) operating as required to ensure necessary and sufficient safety. LLW and LLMW would be placed in retrievable, monitored storage and disposal facilities. RCRA LDR noncompliant LLMW would be treated as necessary to ensure long-term safety and health of the workers, the public, and the environment. TRU waste would be consolidated into a new storage building until it could be transported to WIPP. A 13-acre cap covers retrievable and monitored storage and disposal and contaminated soil remaining after remediation in OU4 (the Solar Pond Area). Caps totaling 53 acres cover OU5 and OU7.

Facilities would remain vacant unless it made economic sense to demolish them. Increased levels of maintenance, fire protection, security, and radiation protection would be necessary compared to the other alternatives because the facilities would be left standing. This alternative would incur a significant deferred liability involving maintenance, upkeep (long-term operations and maintenance costs), and the costs of future demolition (uncosted in this document).

**Table 2-2  
Alternative 1, Unrestricted \***

Tasks	Attributes
SNM	<ul style="list-style-type: none"> <li>• HEUN bottled and then shipped offsite</li> <li>• Metal &amp; Oxides (SNM) consolidated and packaged for safe interim storage until shipment</li> <li>• Solid residues processed to meet WIPP WAC and shipped offsite</li> <li>• SNM solutions solidified to meet WIPP WAC and shipped offsite</li> <li>• SNM and selected high SNM content residues in a new interim SNM storage facility until removed to an offsite facility by 2015</li> </ul>
Waste	<ul style="list-style-type: none"> <li>• All radioactive waste disposed offsite</li> <li>• Treat all LLMW to meet RCRA LDR standards</li> <li>• New interim TRU storage facility</li> <li>• New interim LLW/LLM storage facility</li> <li>• Sanitary and hazardous waste disposed offsite</li> <li>• Construction debris disposed offsite if cost-effective</li> </ul>
Facility Decommissioning	<ul style="list-style-type: none"> <li>• Nonradiological contaminated buildings demolished and disposed offsite</li> <li>• Pu and U buildings decontaminated, demolished, and disposed offsite; no buildings remain standing</li> <li>• Building foundations and under-building contamination dug up and disposed offsite</li> <li>• New interim SNM, TRU and LLW/LLMW facilities demolished after material is shipped offsite for disposal</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>• All (onsite/offsite) IHSSs cleaned to 10<sup>-6</sup> residential standards</li> <li>• All remediation waste disposed offsite</li> <li>• Groundwater management systems in place until groundwater remediated to residential standards</li> <li>• No caps</li> </ul>
Infrastructure	<ul style="list-style-type: none"> <li>• No infrastructure remains at final closure</li> <li>• Underlying infrastructure removed and disposed (streets, above and below ground utilities) except when needed to support economic development</li> </ul>
<b>Assumptions for ASAP Phase II</b>	<ul style="list-style-type: none"> <li>• Assume unconstrained annual cash flow for only this alternative because an annual cash flow of \$700 million is inadequate for completion of the alternative as described</li> <li>• At final closure, all land is deemed surplus and is available to be developed as land use authorities see fit</li> <li>• Assume no new construction except new interim storage to facilitate offsite shipment and safe storage of SNM and radioactive waste</li> </ul>

\* This alternative describes the cleanup of the entire Site to standards which would support residential use if the community should decide to pursue alternative land use.

**Table 2-3  
Alternative 2, BEMR I \***

Tasks	Attributes
SNM	<ul style="list-style-type: none"> <li>• HEUN stabilized and then shipped offsite</li> <li>• Metals and oxides (SNM) consolidated and repacked for long-term storage in Bldg. 371 until shipment</li> <li>• Solid residues processed to meet WIPP WAC and shipped offsite</li> <li>• SNM solutions solidified to meet WIPP WAC and shipped offsite</li> <li>• SNM and selected high SNM content residues stored on an interim basis in Bldg. 371 and then removed to an offsite facility by 2020</li> </ul>
Waste	<ul style="list-style-type: none"> <li>• All radioactive waste disposed offsite</li> <li>• LLMW treated to meet LDR</li> <li>• Existing site facilities are used for TRU/TRM and LLW/LLMW storage</li> <li>• Construction debris, and hazardous and sanitary waste disposed offsite</li> </ul>
Facility Decommissioning	<p>Same as Alternative 1 except:</p> <ul style="list-style-type: none"> <li>• Facilities decontaminated, decommissioned and demolished; 12 inches below floor level removed</li> <li>• No new facilities constructed</li> <li>• Interim economic conversion of facilities considered</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>• Buffer Zone remediated to 10<sup>-5</sup> open space/recreational standards</li> <li>• Industrial area remediated to 10<sup>-4</sup> industrial clean-up standards</li> <li>• Groundwater management systems maintained until completion of remediation (2040)</li> <li>• Accelerated cleanup complete in 2012</li> </ul>
Infrastructure	<ul style="list-style-type: none"> <li>• Onsite infrastructure maintained until support functions completed</li> <li>• Majority of utility infrastructure removed except road network and water distribution</li> </ul>
Assumptions for ASAP Phase II	<ul style="list-style-type: none"> <li>• Assumes variable (generally \$750-850) annual million cash flow per 1995 DOE/M&amp;O projection per HQ direction</li> <li>• At final closure, Site is retained in a state that restricts use of core area to industrial use, and the Buffer Zone to open space, an ecological preserve, or recreational use</li> </ul>

This alternative represents early site planning that was published in the 1995 Baseline Environmental Management Report (BEMR), a Congressionally mandated report, dated March 1995.

Note: Entire Site cleanup complete by 2060 at an unescalated cost ranging between \$22 billion (with productivity improvements) and \$38 billion (without productivity improvements)

**Table 2-4  
Alternative 3a, Phased Shipment\***

Tasks	Attributes
SNM	<ul style="list-style-type: none"> <li>• HEUN bottled and then shipped offsite</li> <li>• SNM consolidated and packaged for safe interim storage until shipped</li> <li>• Solid residues processed to meet WIPP WAC and then shipped offsite</li> <li>• SNM solutions solidified to meet WIPP WAC and then shipped offsite</li> <li>• SNM and selected high SNM content residues in a new interim SNM storage facility until removed to an offsite facility by 2015</li> </ul>
Waste	<ul style="list-style-type: none"> <li>• All radioactive waste stored in above-ground storage facilities until disposal offsite</li> <li>• All LLMW treated to meet RCRA LDR standards just prior to shipment</li> <li>• New interim TRU storage facility until disposal at WIPP</li> <li>• Sanitary and hazardous waste disposed offsite</li> <li>• Construction debris disposed offsite if cost effective</li> <li>• Retrieval of waste occurs just prior to treatment and shipment</li> </ul>
Facility Decommissioning	<ul style="list-style-type: none"> <li>• Nonradiological contaminated buildings demolished</li> <li>• Pu and U buildings demolished and put in capped retrievable or above-ground storage depending upon cost analysis until shipment</li> <li>• Contaminated foundations dug up and put in interim storage facilities until shipment</li> <li>• New interim SNM and waste facilities demolished after material is shipped offsite for disposal</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>• 55 out of 167 IHSSs remediated</li> <li>• 5158 acres meet standards for open space (recreational use)</li> <li>• 842 acres meet standards for unoccupied open space (limited access use such as ecological studies)</li> <li>• 97 acres meet standards for industrial use</li> <li>• 66-acre cap over contaminated soil remaining after remediation</li> <li>• 53 acres as a closed landfill with a RCRA cap on OU 7</li> <li>• Groundwater management systems maintained indefinitely</li> </ul>
Infrastructure	<ul style="list-style-type: none"> <li>• Most infrastructure located offsite</li> <li>• Small onsite septic system to support remaining, interim SNM and TRU storage facilities</li> <li>• Site capabilities replaced by public and commercial utilities</li> </ul>
<b>Assumptions for ASAP Phase II</b>	<ul style="list-style-type: none"> <li>• Assume maximum \$700 million/year annual cash flow</li> <li>• At final closure, Site is retained in a state that controls access to the capped areas of the site and restricts use of the inner Buffer Zone</li> <li>• The new interim SNM storage facility is planned to be robust enough to allow the public within close proximity to the facility to facilitate land use options</li> <li>• Assume approximately 50 or more TRU/TRM and LLW/LLMW shipments per year once risk reduction activities are complete</li> </ul>

\* This alternative describes eventual offsite shipment of radioactive waste placed in interim storage facilities. LDR treatment and packaging for WIPP WAC will occur just prior to shipment to take advantage of any new technologies or to respond to any subsequent regulatory changes.

**Table 2-5  
Alternative 3b, Priority Shipment\***

Tasks	Attributes
SNM	<ul style="list-style-type: none"> <li>• HEUN bottled and then shipped offsite</li> <li>• No new SNM facility</li> <li>• SNM is consolidated into an upgraded Bldg. 371 facility until shipment, due to delays in SNM stabilization and consolidation which may make the Bldg. 371 retrofit more cost-effective than a new interim facility</li> <li>• SNM solutions solidified to meet WIPP WAC and then shipped offsite</li> <li>• Solid residues processed to meet WIPP WAC and then shipped offsite</li> <li>• Delayed consolidation and risk reduction from accelerated waste shipping compared to others</li> <li>• Funding of SNM and residue stabilization and consolidation based on risk with priority given to waste shipment</li> <li>• SNM and selected high SNM content residues in a new interim SNM storage facility until removed to an offsite facility by 2015</li> </ul>
Waste	<ul style="list-style-type: none"> <li>• All radioactive waste disposed offsite</li> <li>• LLMW treated to RCRA LDR standards before storage</li> <li>• TRU/TRM waste stored in existing facilities until shipment</li> <li>• Limited new interim LLW/LLMW storage to facilitate maximum shipment only</li> <li>• Sanitary and hazardous waste disposed offsite</li> <li>• Construction debris disposed offsite if cost effective</li> </ul>
Facility Decommissioning	<ul style="list-style-type: none"> <li>• Nonradiological contaminated buildings demolished</li> <li>• Pu and U buildings demolished and put in storage prior to shipment</li> <li>• Contaminated foundations dug up and put in interim storage prior to shipment</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>• 55 out of 167 IHSSs remediated</li> <li>• 5158 acres meet standards for open space (recreational use)</li> <li>• 842 acres meet standards for unoccupied open space (limited access use such as ecological studies)</li> <li>• 97 acres meet standards for industrial use</li> <li>• 66-acre cap over contaminated soil remaining after remediation</li> <li>• 53 acres as a closed landfill with a RCRA cap on OU 7</li> <li>• Groundwater management systems maintained indefinitely</li> <li>• Environmental Restoration schedule delayed due to preferential funding of waste shipment and Pu risk reduction</li> </ul>
Infrastructure	<ul style="list-style-type: none"> <li>• Most infrastructure located offsite</li> <li>• Small onsite septic system to support remaining SNM and TRU storage facilities</li> <li>• Site capabilities replaced by public and commercial utilities</li> <li>• Road upgrades will likely be needed to handle transport of large shipping volumes</li> <li>• Some infrastructure upgrades may be needed to handle building deactivation delays</li> </ul>
<b>Assumptions for ASAP Phase II</b>	<ul style="list-style-type: none"> <li>• Assume maximum \$700 million/year annual cash flow</li> <li>• At final closure, Site is retained in a state that controls access to the capped areas of the Site and restricts use of the inner Buffer Zone</li> <li>• Due to schedule delays, Bldg. 371 upgrades required by DNFSB, making construction of a new SNM storage facility much less cost-effective</li> <li>• Assume at least 200 TRU/TRM and LLW/LLMW shipments per year</li> <li>• When WIPP opens, assume TRU/TRM waste shipped first, followed by LLW/LLMW</li> <li>• Assume adequate disposal facilities available</li> </ul>

\* This alternative evaluates accelerated shipment of radioactive waste offsite for disposal. Shipment is preferentially funded over SNM and ER risk reduction. This is similar to Alternative 3a, Phased Shipment, but the priority of activities is different.

**Table 2-6  
Alternative 3c, Excavation\***

Tasks	Attributes
SNM	<ul style="list-style-type: none"> <li>• HEUN bottled and then shipped offsite</li> <li>• SNM consolidated and packaged for safe interim storage until shipment</li> <li>• Solid residue processed to meet interim storage criteria (not necessarily WIPP WAC initially) and then to meet WIPP WAC just prior to shipment</li> <li>• SNM solutions solidified for interim storage and then to meet WIPP WAC just prior to shipment</li> <li>• SNM and selected high SNM content residues in a new interim SNM storage facility until removed to an offsite facility by 2015</li> </ul>
Waste	<ul style="list-style-type: none"> <li>• LLW and LLMW stored in capped, retrievable and monitored storage/disposal facilities (not landfill)</li> <li>• Waste treated to the degree where it can be stored/disposed safely (may not meet prescriptive LDR regulatory standards)</li> <li>• New interim TRU storage facility until disposal at WIPP</li> <li>• Sanitary and hazardous waste disposed offsite</li> <li>• Construction debris disposed offsite if cost-effective</li> </ul>
Facility Decommissioning	<p>Same as 3b except:</p> <ul style="list-style-type: none"> <li>• Pu and U buildings demolished and put in capped retrievable or above-ground storage, depending upon cost factors</li> <li>• Contaminated foundations dug up and put in capped, retrievable and monitored storage/disposal facilities</li> <li>• New interim SNM and waste facilities demolished after material is shipped offsite for disposal</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>• 55 out of 167 IHSSs remediated</li> <li>• 5158 acres meet standards for open space (recreational use)</li> <li>• 842 acres meet standards for unoccupied open space (limited access use such as ecological studies)</li> <li>• 97 acres meet standards for industrial use</li> <li>• 66-acre cap over contaminated soil remaining after remediation, and retrievable and monitored LLW/LLMW storage/disposal</li> <li>• 53 acres as a closed landfill with a RCRA cap on OU 7</li> <li>• Groundwater management systems maintained indefinitely</li> <li>• Environmental Restoration schedule delayed due to preferential funding of waste shipment and PU risk reduction</li> </ul>
Infrastructure	<ul style="list-style-type: none"> <li>• Same as 3b, and 3d, and 3e except: upgraded roads</li> </ul>
<b>Assumptions for ASAP Phase II</b>	<ul style="list-style-type: none"> <li>• Assume maximum \$700 million/year annual cash flow</li> <li>• At final closure, Site retained in a state that controls access to the capped areas of the Site and restricts use of the inner Buffer Zone</li> <li>• The new interim SNM storage facility is planned to be robust enough to allow the public within close proximity to the facility to facilitate land use options</li> </ul>

\* This alternative places all LLW/LLMW waste in monitored, retrievable storage/disposal facilities preserving the option for later removal. This alternative allows for potential retrieval, but does not plan or cost out these activities.

**Table 2-7  
Alternative 3d, Leveled Buildings\***

<b>Tasks</b>	<b>Attributes</b>
SNM	<ul style="list-style-type: none"> <li>• Same as 3c, 3e, and 4</li> </ul>
Waste	Same as 3c except: <ul style="list-style-type: none"> <li>• Remediation and D&amp;D waste generated which <u>must be moved</u> (handled or put in containers), will be placed in capped, retrievable and monitored storage/disposal facilities</li> <li>• Waste within the cap footprint which does not need to be moved for operating purposes, will be capped in place (e.g., foundations)</li> </ul>
Facility Decommissioning	Same as 3c except: <ul style="list-style-type: none"> <li>• Some contaminated building foundations remain entombed but no waste is placed in the foundations for entombment</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>• Same as 3a, 3c, and 3e except caps over contaminated soil remaining after remediation, and LLW/LLMW retrievable storage/disposal</li> </ul>
Infrastructure	<ul style="list-style-type: none"> <li>• Same as 3b, 3c, and 3e except upgraded roads</li> </ul>
<b>Assumptions for ASAP Phase II</b>	<ul style="list-style-type: none"> <li>• Same as 3c and 3e</li> </ul>

\* This alternative evaluates the placement of all low-level and low-level mixed waste that must be transported or moved (container and bulk) into onsite monitored, retrievable storage/disposal facilities. Waste which must be moved includes the bulk remediation and containerized waste which requires handling during planned activities. These wastes will be placed in capped, retrievable and monitored storage and disposal.

**Table 2-8  
Alternative 3e, Entombment and Landfill\***

<b>Tasks</b>	<b>Attributes</b>
SNM	Same as 3c, 3d and 4
Waste	Same as 3c except: <ul style="list-style-type: none"> <li>• Most LLW and LLMW disposed onsite in entombed basements or RCRA Subtitle C landfill(s) rather than capped, retrievable and monitored storage/disposal facilities</li> </ul>
Facility Decommissioning	<ul style="list-style-type: none"> <li>• Nonradiological contaminated buildings demolished</li> <li>• Pu and U buildings partially dismantled with lower portions entombed</li> <li>• LLW left in entombed facilities &lt;100 nCi/gm</li> <li>• New interim SNM and TRU facilities demolished after material is shipped offsite for disposal</li> </ul>
Environmental Restoration	<ul style="list-style-type: none"> <li>• Same as 3a, 3c, and 3d except: 760 acres at standards for unoccupied open space (limited access use such as ecological studies); 66-acre cap over entombed basements, RCRA landfill, 13-acre cap over the Solar Pond area; and 232 acres with indefinite controlled access and physical security</li> </ul>
Infrastructure	<ul style="list-style-type: none"> <li>• Same as 3b, 3c, and 3d except upgraded roads</li> </ul>
<b>Assumptions for ASAP Phase II</b>	<ul style="list-style-type: none"> <li>• Same as 3c and 3d</li> </ul>

\* This alternative evaluates the disposal of most low-level and low-level mixed waste onsite in entombed basements or in buildings in RCRA Subtitle C-type landfill(s). Future retrieval of waste is more difficult than 3c, Excavation, or 3d, Leveled Buildings.

**Table 2-9  
Alternative 4, Mothball\***

<b>Tasks</b>	<b>Attributes</b>
SNM	<ul style="list-style-type: none"> <li>• Same as 3c, 3d, and 3e</li> </ul>
Waste	<ul style="list-style-type: none"> <li>• Same as 3c</li> </ul>
Facility Decommissioning	<ul style="list-style-type: none"> <li>• Facilities remain standing but vacant unless it makes economic sense to demolish them</li> <li>• Some or all nonradiological contaminated buildings demolished, provided doing so is cost-effective</li> <li>• Pu and U buildings minimally decontaminated and left standing</li> <li>• Decontamination achieves the standards necessary to terminate operation of all active safety equipment (e.g., SAAMs) and to shut off utilities</li> <li>• New SNM and TRU facilities are not demolished</li> </ul>
Environmental Restoration	<p>Same as 3c, 3d, and 3e except:</p> <ul style="list-style-type: none"> <li>• 5158 acres meet standards for unrestricted open space</li> <li>• 760 acres meet unoccupied open space standards (limited access use such as ecological studies)</li> <li>• 97 acres meet standards for potential industrial conversion</li> <li>• 53 acres of closed landfills</li> <li>• 13-acre cap over contaminated soil remaining after remediation (Solar Pond Area) and LLW/LLMW retrievable storage/disposal, and 21-acre cap over the closed OU7 landfill</li> <li>• Some controlled access with long-term physical security</li> <li>• No physical removal of under-building contamination</li> <li>• Groundwater management systems (e.g., pump and treat) maintained indefinitely</li> <li>• Additional environmental monitoring will be required</li> </ul>
Infrastructure	<p>Most infrastructure located offsite</p> <ul style="list-style-type: none"> <li>• All facilities left standing after being placed in a safe configuration unless demolition is cost-effective</li> <li>• Increased infrastructure maintained more than all other alternatives to ensure safety and structural integrity of facilities; includes increased levels of maintenance, fire protection, security, and radiation protection</li> <li>• Minimal utilities, passive ventilation, and lights for inspection purposes</li> <li>• Site capabilities replaced by public and commercial utilities</li> </ul>
<b>Assumptions for ASAP Phase II</b>	<p>Same as 3c, 3d, and 3e except:</p> <ul style="list-style-type: none"> <li>• At final closure, Site retained in a state that controls access to core area which remains under indefinite physical security and restricts use of the inner Buffer Zone (and possibly access as well)</li> </ul>

\* This alternative evaluates the cleanup of the Site to necessary and sufficient safety levels. Facilities remain standing but vacant unless it makes economic sense to demolish them. Most LLW/LLMW is disposed in monitored, retrievable storage/disposal facilities. A deferred liability remains.

**Table 2-10  
ASAP II Alternative Summary**

Tasks	Attributes	Alternatives							
		1	2	3a	3b	3c	3d	3e	4
SNM	SNM Consolidation and Storage	New	371	New	371	New	New	New	New
Waste Management	New Interim TRU Storage Facility	X		X		X	X	X	X
	New LLW/LLMW Retrievable and Monitored Storage and Disposal Facility	X		X	X	X	X	X	X
	Land Disposal Restriction (LDR) Treatment	LDR	LDR	LDR	LDR	Safe	Safe	Safe	Safe
	All waste disposal offsite *	X	X	X	X				
	Long-Term Retrievable Monitored Storage (capped)					X	X		X
	Disposal onsite - Entombment and RCRA Landfill							X	
Facility Decommissioning	Non-Rad facilities demolished, and debris disposed offsite (if cost-effective)	X	X	X	X	X	X	X	X
	Pu and U facilities demolished and foundations excavated	X	X	X	X	X			
	Facilities remaining at the end of project	None	None	None	None	None	None	None	Shells
	Foundations left in place						X	X	X
Environmental Restoration	Buffer Zone Open Space/Unoccupied Open Space/PA-Industrial Use		X	X	X	X	X	X	
	Capped Areas			X	X	X	X	X	X
	Groundwater Management System		2040	X	X	X	X	X	X
Infrastructure	Infrastructure upgrades necessary	X	X		X				X
	Utilities remaining at project end	None	Water Roads	Public	Public	Public	Public	Public	Public
Cost	Total Projected Life-Cycle Cost (\$B escalated)	\$22.5**	\$22.1***	\$14.6	\$12.8	\$9.7	\$9.6	\$9.9	\$7.5
Schedule	Projected End-of-Alternative Timeline (year)	2029*	2060	2023	2018	2015	2015	2015	2015

\* Volumes of offsite waste disposal vary by alternative  
 \*\* most probable (assumes unconstrained funding for some years)  
 \*\*\* BEMR is unescalated

Acronyms: PA - Protected Area  
 Safe - Provides safe long-term protection of the workers, the public and the environment  
 Shells - Decontaminated facilities remain standing

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### 3.0 ALTERNATIVE COMPARATIVE ANALYSIS

This section provides a comparative assessment of the ASAP alternatives without imposing any decision criteria. Details on several key aspects of the alternatives are provided for side-by-side comparison. The aspects of cost and schedule, land-use availability, waste disposition, and risk, are considered the most useful by stakeholders, regulators, and decision-makers. Table 3-1 provides a summary of these key aspects as they relate to the alternatives.

#### 3.1 Cost and Schedule

Cost estimates for the alternatives can be used to compare annual cost profiles, total costs, major cost contributors, and schedule durations. In addition, information concerning cost uncertainties and deferred cost liabilities associated with the alternatives is discussed.

##### 3.1.1 Annual Cost Profiles

The estimated annual cost profiles (in escalated dollars) of the alternatives are depicted in Figure 3-1. These profiles show the annual funding that would be required to perform the scope of work of the individual alternatives.

For the Figure 3-1 comparison only, Alternative 1, Unrestricted is flat-funded at \$700 million per year. Over time, this flat profile impacts work scope due to the increasing effects of escalation discussed in Appendix G. At this funding level, the end state of Alternative 1 cannot be reached. Alternative 2 is costed differently than all of the other alternatives since the BEMR was prepared about one year earlier. As a result, BEMR I is not shown in Figure 3-1.

The annual cost profiles for the remaining Alternatives 3a, Phased Shipment; 3b, Priority Shipment; 3c, Excavation; 3d, Leveled Buildings; 3e, Entombment and Landfill; and 4, Mothball show the different cost profiles that would be required to achieve their associated interim end states. After reaching the interim steady state, some level of annual funding would need to be maintained until the final end state is achieved. After the final end state is reached, annual operating and maintenance (O&M) costs will be required. Alternatives 3a through 3e, and 4, absorb the impact of escalation while actual funding needs fall below the \$700 million per year level beyond FY2002.

##### 3.1.2 Total Cost Chart

The estimated total costs (in escalated dollars) of the alternatives are shown in Table 3-2. Alternative 2 is not included here because its cost categories are not easily comparable to the other alternatives. Table 3-2 illustrates the total funding that would be required to achieve an interim steady state for Alternatives 3a through 3e and 4, and the total funding required to achieve a final end state for Alternative 1.

Figure 3-2 graphically depicts three relative differences among the alternatives: (1) the estimated total cost of each alternative, (2) the total costs associated with the major tasks within a given alternative, and (3) the differences in cost of the major tasks within the alternatives. The main variations in the annual and total costs can be attributed to changes in physical scope and/or in duration of scope because each alternative has a unique physical scope and schedule of work to be performed. As the schedule of physical work scope varies from one alternative to another, the duration and level of required baseline (support) activities would also vary.

**Table 3-1  
Alternative Comparison**

	Alternative							
	1	2	3a	3b	3c	3d	3e	4
<b>Cost (\$ M's)</b>								
• Total Cost	\$22,500 (a)	\$22,100 (b)	\$14,600	\$12,800	\$9,700	\$9,600	\$9,900	\$7,500
• Annual longterm O&M Costs (d)	\$5	\$10	\$14	\$14	\$14	\$14	\$14	\$35
<b>Milestone Schedule</b>								
• Interim End State (c)	n/a	n/a	2009	2010	2010	2010	2010	2007
• Project End (e)	2029 (a)	2060	2023	2018	2015	2015	2015	2015
<b>Land Use (acres)</b>								
• Unrestricted Residential	6,216	5,316	0	0	0	0	0	0
• Open Space Unrestricted	0	0	5,158	5,158	5,158	5,158	5,158	5,158
• Open Space Restricted	0	847	842	842	842	842	842	760
• Potential Industrial Conversion	0	0	97	97	97	97	97	97
• Closed Landfill (f)	0	53	53	53	53	53	53	53 (i)
• Capped Area (nonlandfill)	0	0	66	66	66	66	66	13
• Vacant Facilities	0	0	0	0	0	0	0	135
<b>Waste Generated (cubic meters)</b>								
• TRU/TRM	8,900	15,391	4,530	8,990	4,530	4,530	4,530	2,170
• Low-Level Wastes	905,070	105,909	66,570	66,570	66,570	66,570	66,570	36,170
• Low-Level Mixed	1,232,995	524,893	268,995	268,995	268,995	268,995	268,995	116,945
• Hazardous	83,575	36,725	11,075	11,075	11,075	11,075	11,075	8,975
• Uncontaminated (g)	180,450	488,667	180,450	180,450	180,450	180,450	180,450	18,650
• Other	35	0	35	35	35	35	35	35
• Total	2,411,115	1,171,585	531,655	536,115	531,655	500,155	493,155	182,945
<b>Comparative Risk - During (h)</b>								
• OSHA - Worker	higher	higher	higher	higher	higher	comparable	comparable	lower
• Transportation	higher	higher	comparable	comparable	lower	lower	lower	lower
• Radiological - Worker	higher	higher	comparable	higher	comparable	lower	comparable	lower
• Radiological - Public	higher	higher	comparable	comparable	comparable	lower	comparable	lower
<b>Comparative Risk - After (h)</b>								
• OSHA - Worker	lower	lower	comparable	comparable	comparable	comparable	comparable	higher
• Radiological - Worker	lower	lower	comparable	comparable	comparable	comparable	comparable	higher
• Radiological - Public	lower	comparable	comparable	comparable	comparable	comparable	comparable	higher

**Legend**

- Higher - Risks are relatively higher than other alternatives
- Comparable - Risks are comparable to other alternatives
- Lower - Risks are relatively lower than other alternatives
- n/a = Interim end state is undefined due to uncertainty associated with achievement of a steady state
- (a) Most probable with unconstrained funding
- (b) BEMR I uses different cost methodology and assumptions, and earlier data than the other alternative
- (c) Operations & Maintenance (O&M) costs (unescalated)
- (d) Identifies date when steady state costs achieved
- (e) Identifies date when project completed and only long-term operations and monitoring remain
- (f) OU 5 is remediated but not capped in Alternative 4
- (g) Large deviation in uncontaminated wastes volumes due to assumptions on years for surveillance & maintenance
- (h) All risks are comparative only

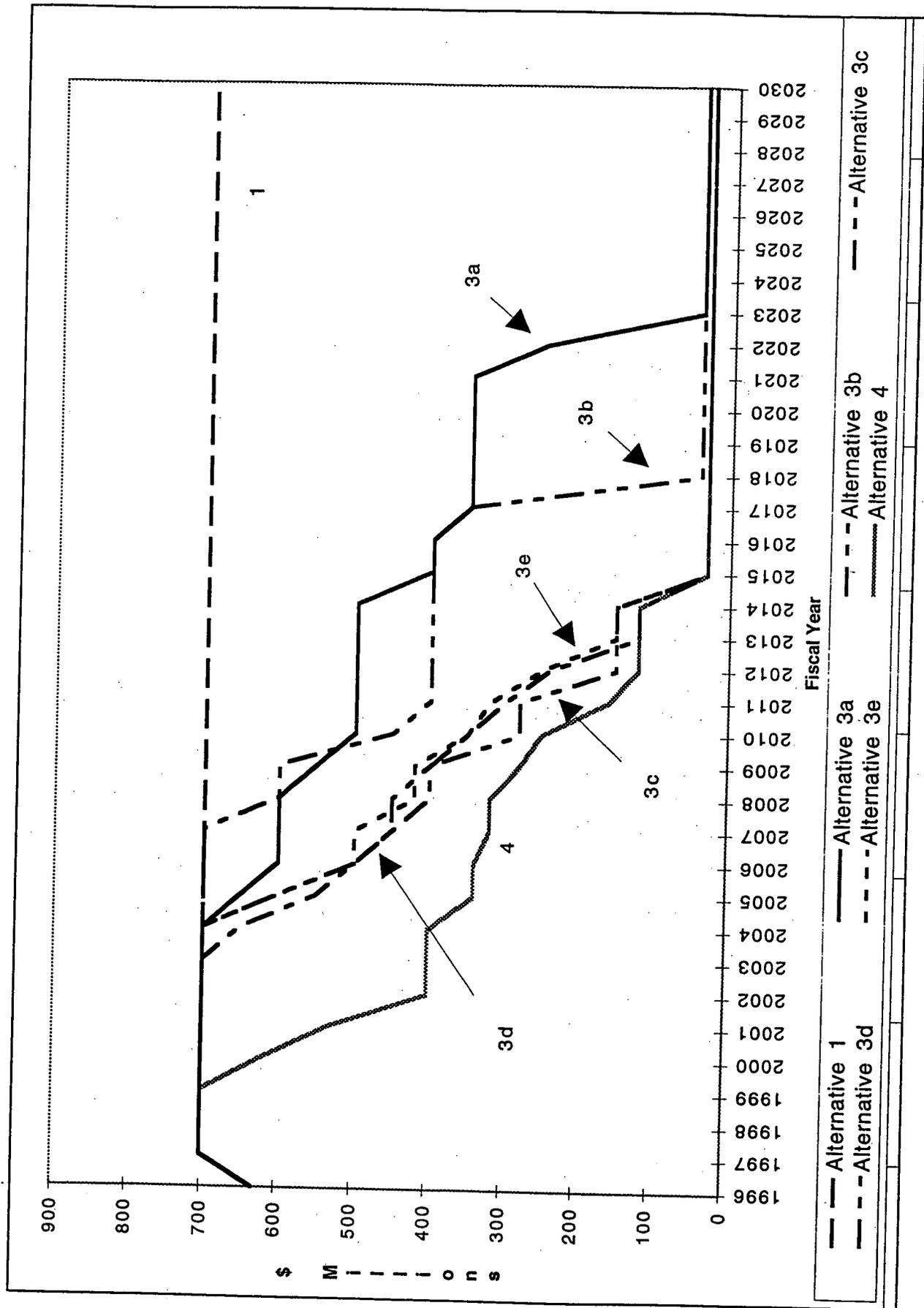


Figure 3-1 ASAP Annual Cost Profiles

**Table 3-2  
Estimated Total Alternative Cost**

Alternative	Interim End State <sup>1</sup>		Final End State <sup>2</sup>		Annual O&M Cost <sup>3</sup> (in millions)
	Date	Cost (in billions)	Date	Cost (in billions)	
1, Unrestricted*	N/A	N/A	2029	\$22.5B	\$5M
2, BEMR I**	N/A	N/A	2060	\$22.1B	\$10M
3a, Phased Shipment***	2009	\$9.2B	2023	\$14.6B	\$14M
3b, Priority Shipment***	2010	\$10.0B	2018	\$12.8B	\$14M
3c, Excavation***	2010	\$8.9B	2015	\$9.7B	\$14M
3d, Leveled Buildings***	2010	\$8.8B	2015	\$9.6B	\$14M
3e, Entombment and Landfill***	2010	\$9.0B	2015	\$9.9B	\$14M
4, Mothball***	2007	\$6.1B	2015	\$7.5B	\$35M

- \* Escalated but not leveled because it is not possible to do so
- \*\* Unescalated and leveled at \$750-850M /yr or less per BEMR guidance; cost estimated by using different methodologies
- \*\*\* Escalated and leveled

1. All work complete except offsite shipment of waste and SNM, D&D of new temporary facilities (if required), and final ER activities
2. All work complete except long-term monitoring. Deferred liability costs for Alternatives 3c, 3d, 3e, and 4 not included (i.e., in 3c, 3d, 3e, and 4, waste remains onsite)
3. 1996 unescalated dollars

N/A = Interim end state is undefined due to uncertainty associated with achievement of a steady state

From Figure 3-2, it is apparent that the waste management costs to achieve the Unrestricted end state in Alternative 1 would be much higher than those costs for the other alternatives.

These high waste management costs in Alternative 1 are driven by the large quantities of wastes requiring differing modes of treatment, storage and disposal. Each of the other alternatives, when compared to Alternatives 1 and 2, would have lower infrastructure costs, primarily as a result of accelerating activities.

Relative cost differences for the Special Nuclear Material area of each alternative would be comparatively small because of the similarity in work scope for handling SNM and solid residues. The cost difference in the Environmental Restoration area for Alternatives 3a through 3e, and 4, would be minimal because of the similarity in assumed cleanup levels associated with these alternatives.

### 3.1.4 Cost Uncertainty

As expected at this stage of the project, uncertainties exist in the cost estimates. Among these uncertainties are (1) availability of funding, (2) regulatory requirements, (3) extent of contaminant concentrations and quantities, (4) cleanup standards, (5) productivity and activity durations, and (6) variations in approaches to waste treatment, storage, and disposal.

As more information becomes available, sensitivity and decision analyses will be used quantitatively to incorporate risk and uncertainty into the cost analyses. This process will identify those critical variables that, if changed, could affect the cost estimates considerably.

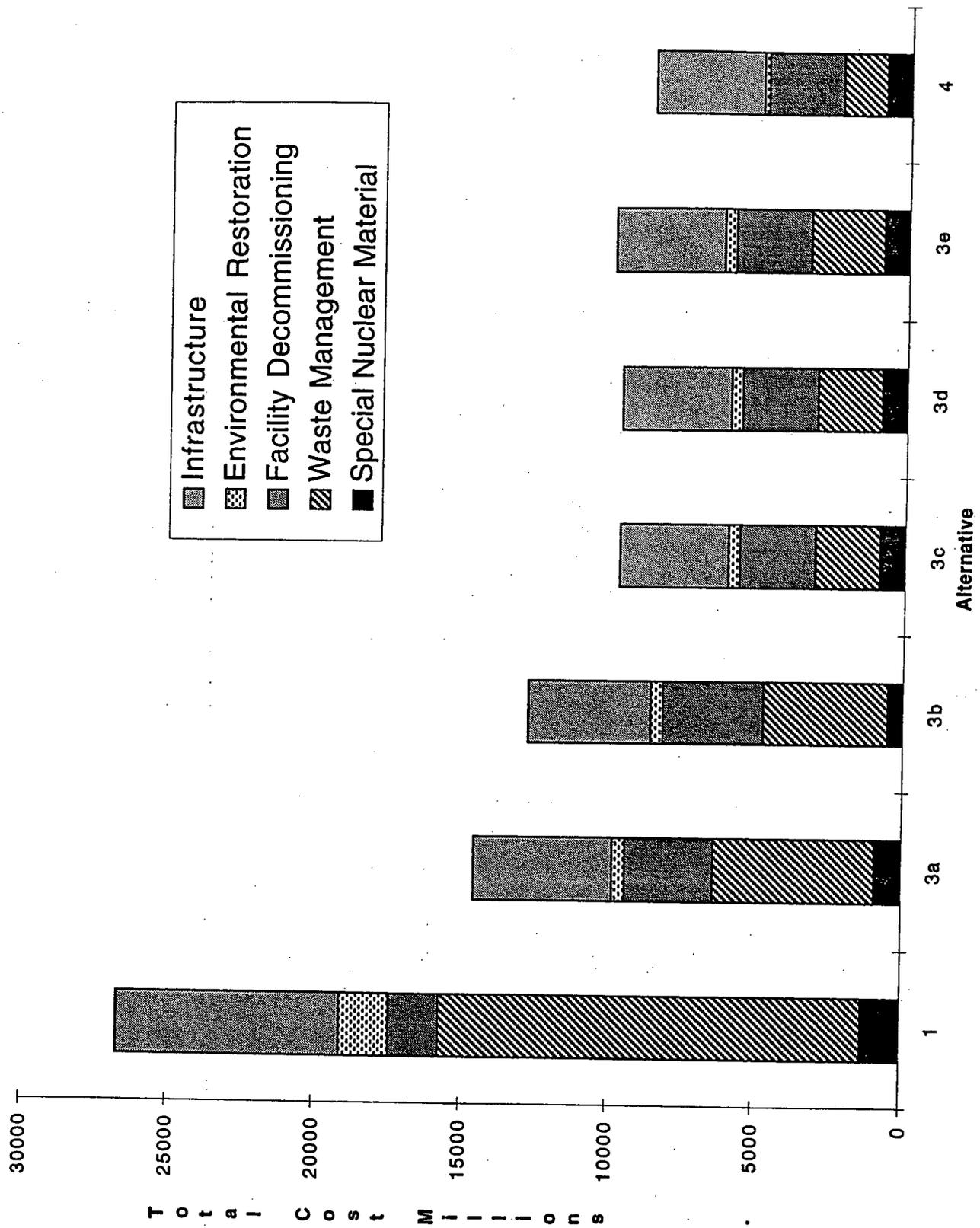


Figure 3-2 Total Costs

### 3.1.5 Deferred Cost Liabilities

Several of the alternatives have the potential for significant deferred cost liabilities. With the exception of Alternatives 1 and 2, the costs provided here are estimates of the funding required to take the Site to an interim steady state. Alternatives 3a through 3e, and 4 may have deferred cost liabilities associated with them in order to achieve a final end state. These deferred liabilities would vary according to the end state and because these end states are presently undefined, the magnitude of the deferred liability remains unknown. In Alternative 4, Mothball, for example, a large number of the facilities would remain standing in a safe condition for the foreseeable future. Should additional deactivation and decontamination be undertaken later, the deferred costs could be substantial.

### 3.2 **Land-Use Availability**

Alternatives 1, 2, 3a through 3e, and 4 all address different land-use availabilities. All of the alternatives support a minimum of 5,000 acres meeting cleanup standards for unrestricted open space. For the remaining Site acreage, the alternatives describe potential land uses ranging from unrestricted to long-term controlled access. These attributes are further defined within Appendix D, Environmental Restoration. Figure 3-3 illustrates the land-use availability that would be supported by each alternative. The land-use percentages for Alternatives 3a through 3e are similar and therefore are grouped into one category.

In terms of remediation costs, the Site can be viewed as a collection of acreage. Figure 3-4 shows the estimated additional remediation cost per acre which would be required in order to achieve unrestricted release of land for other uses. The figure illustrates the substantial increase in remediation costs as cleanup efforts move toward unrestricted use standards. Any discussion on land-use availability must be closely linked to impacts on waste quantities from decommissioning and remediation activities. Subsection 3.3 provides a discussion on the waste disposition related to each alternative.

### 3.3 **Waste Disposition**

Waste disposition options range from shipment to DOE and commercial disposal sites to various levels of onsite storage and disposal. Figure 3-5 compares the waste volumes to be managed and the strategies (e.g., onsite versus offsite) specific to each alternative. Alternative 1 for example, represents a maximum waste quantity and offsite disposal strategy. Conversely, Alternative 4 represents the minimum quantity and onsite waste management strategy. The resulting waste volumes differ by approximately an order of magnitude (from one value to ten times that value).

Alternatives 3a through 3e present differing approaches to treatment and disposal. Treatment options range from sufficient treatment permitting safe long-term storage and disposal to more extensive treatment of all appropriate wastes meeting prescriptive regulatory standards. Storage and disposal options for these five Alternatives range from complete offsite disposal to onsite LLW/LLMW disposal in entombed basements and a RCRA landfill.

As shown in Figure 3-5, Alternatives 1 and 2 would represent the highest volume of waste being dispositioned. The actual volume of waste would be determined primarily by: (1) facility demolition strategy; (2) cleanup levels; (3) operational life-time of the facilities; and, (4) onsite versus offsite waste management. Figure 3-6 provides an overview of the major contributors to waste volumes for each of the alternatives. When comparing Figure 3-6, Waste Sources with Figure 3-2, Total Cost, the strong correlation between cost drivers and waste drivers becomes apparent. In many of these situations, waste volumes needing treatment, storage, and disposal are the primary influence on costs. Decisions to achieve

# Acreeage and Percentage of Land Use for Alternatives

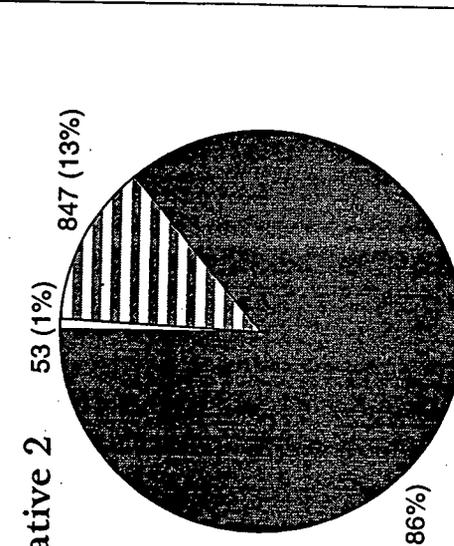
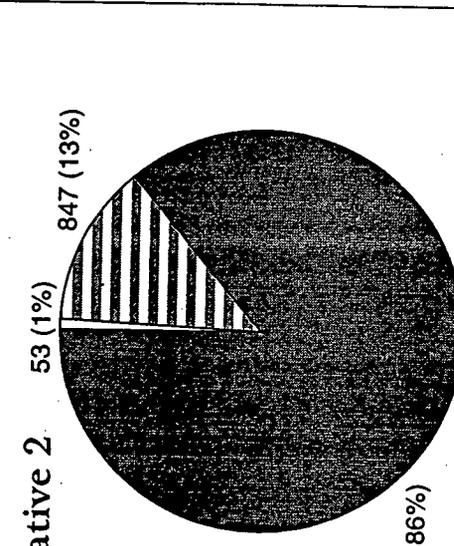
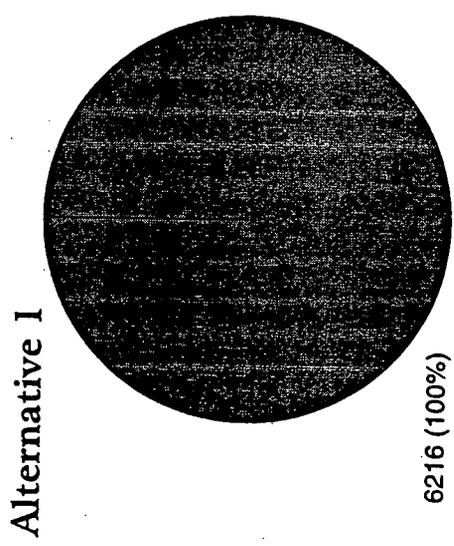
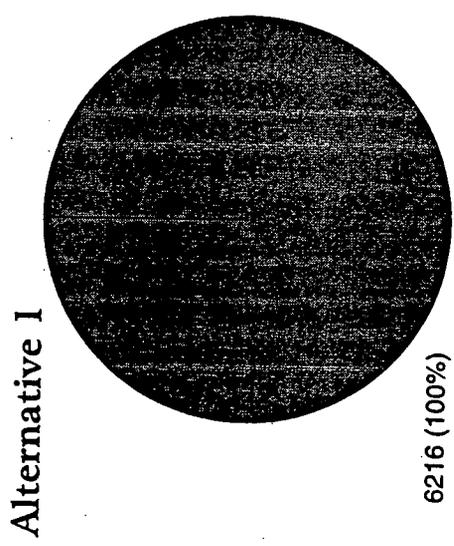
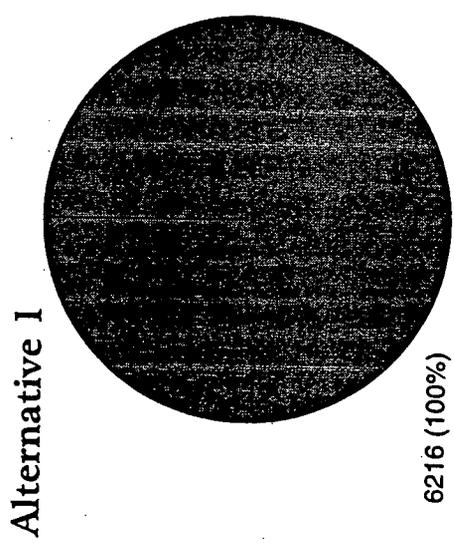
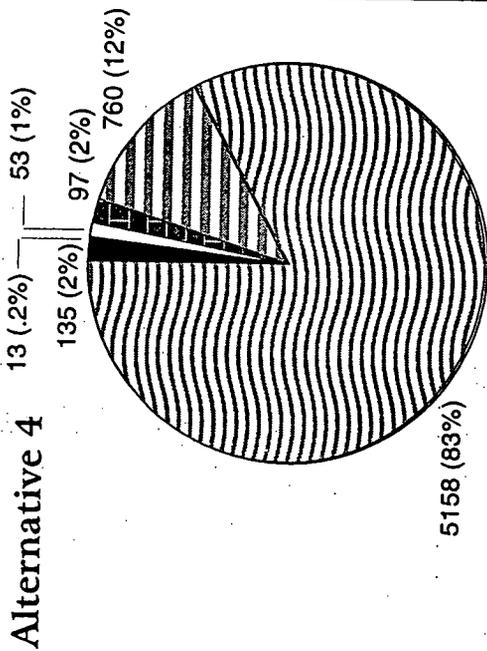
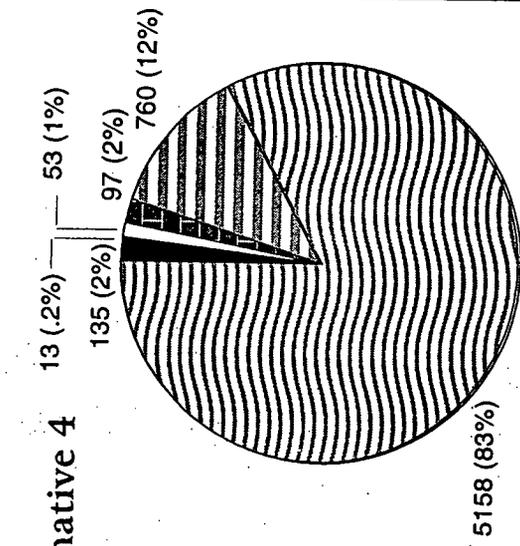
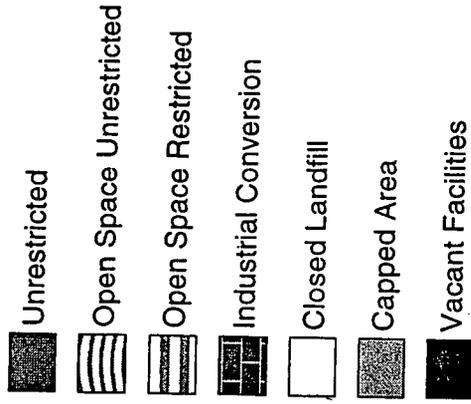


Figure 3-3 Acreages Percentages of Land Use for Alternatives

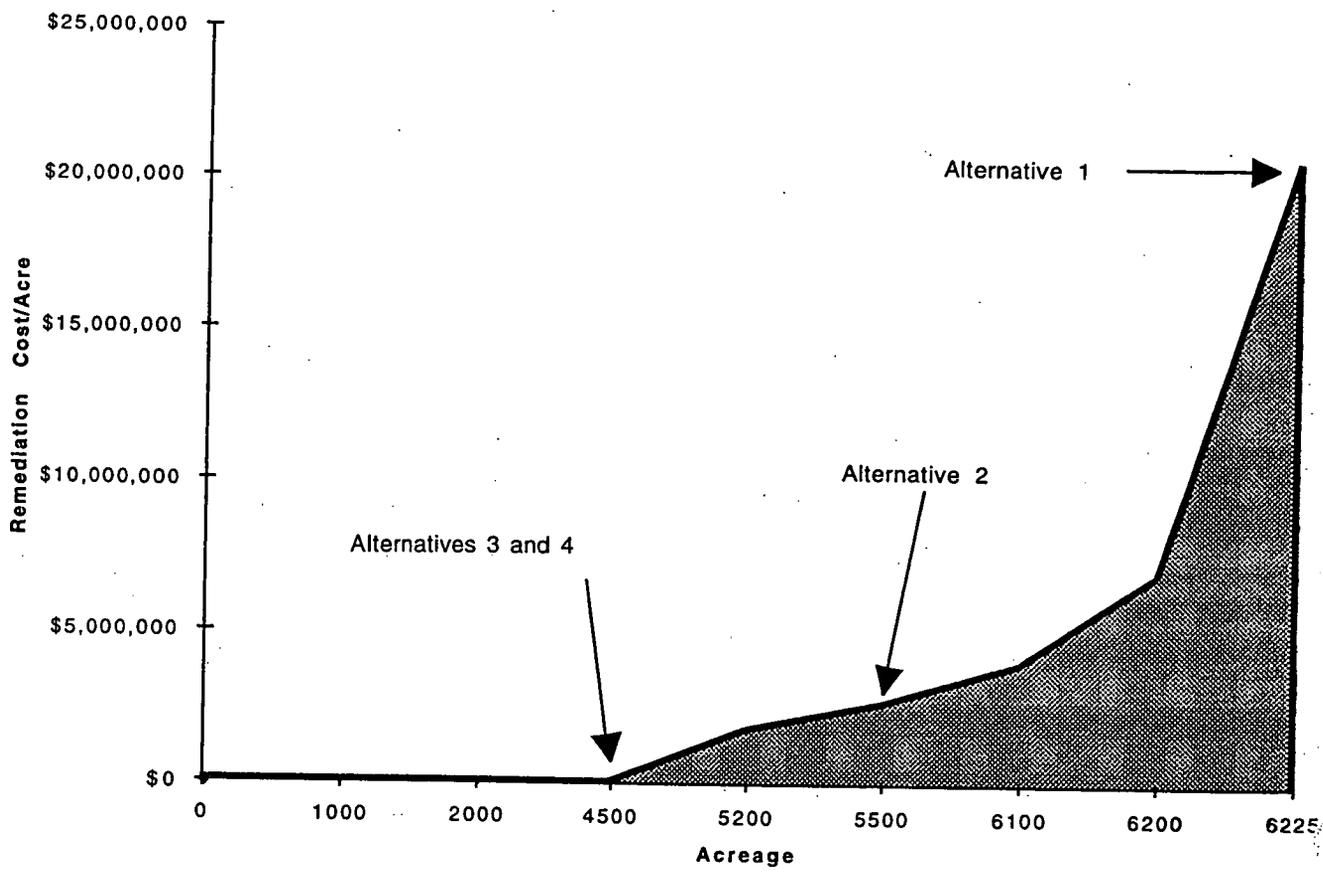


Figure 3-4 Remediation Cost Per Acre

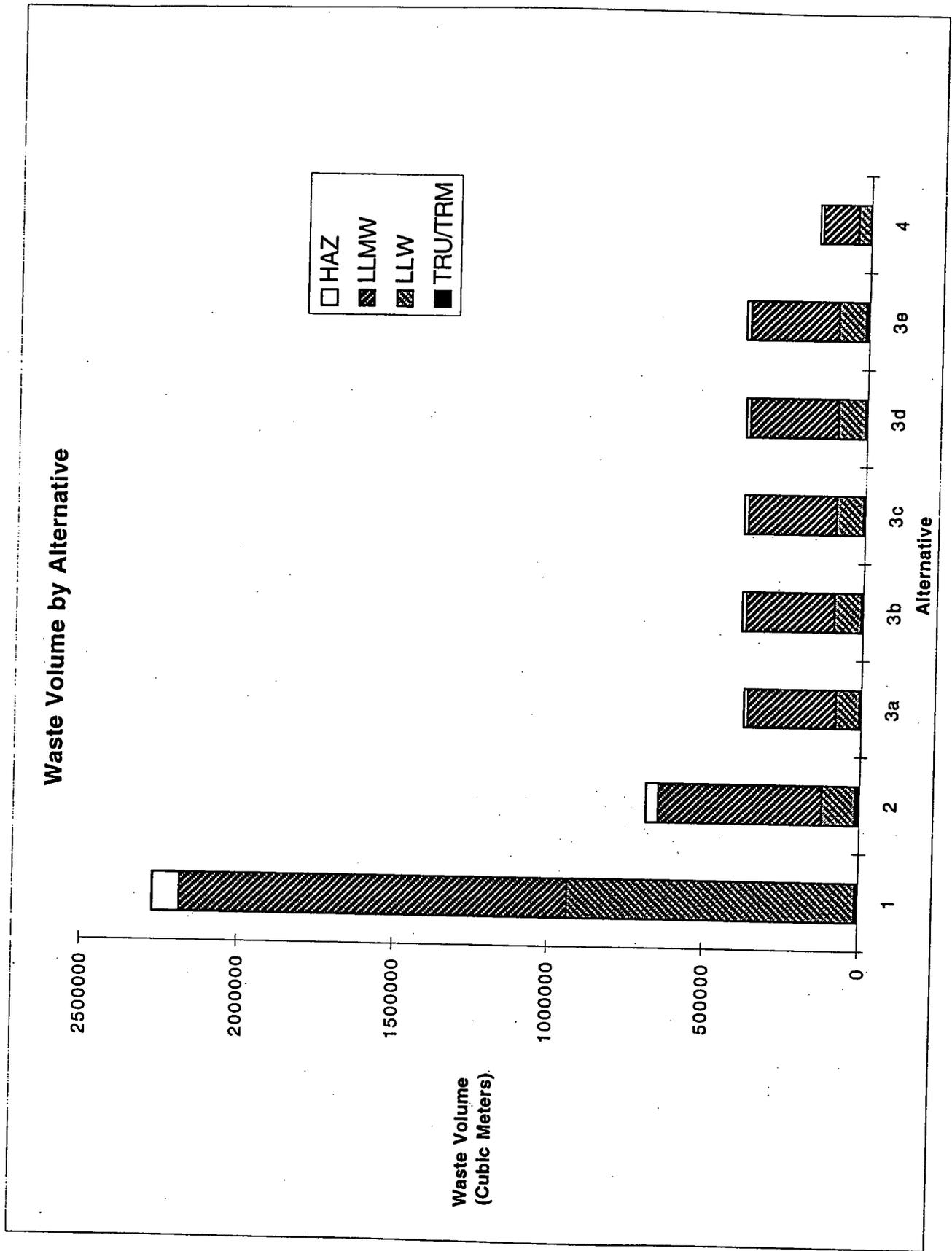


Figure 3-5 Waste Disposition

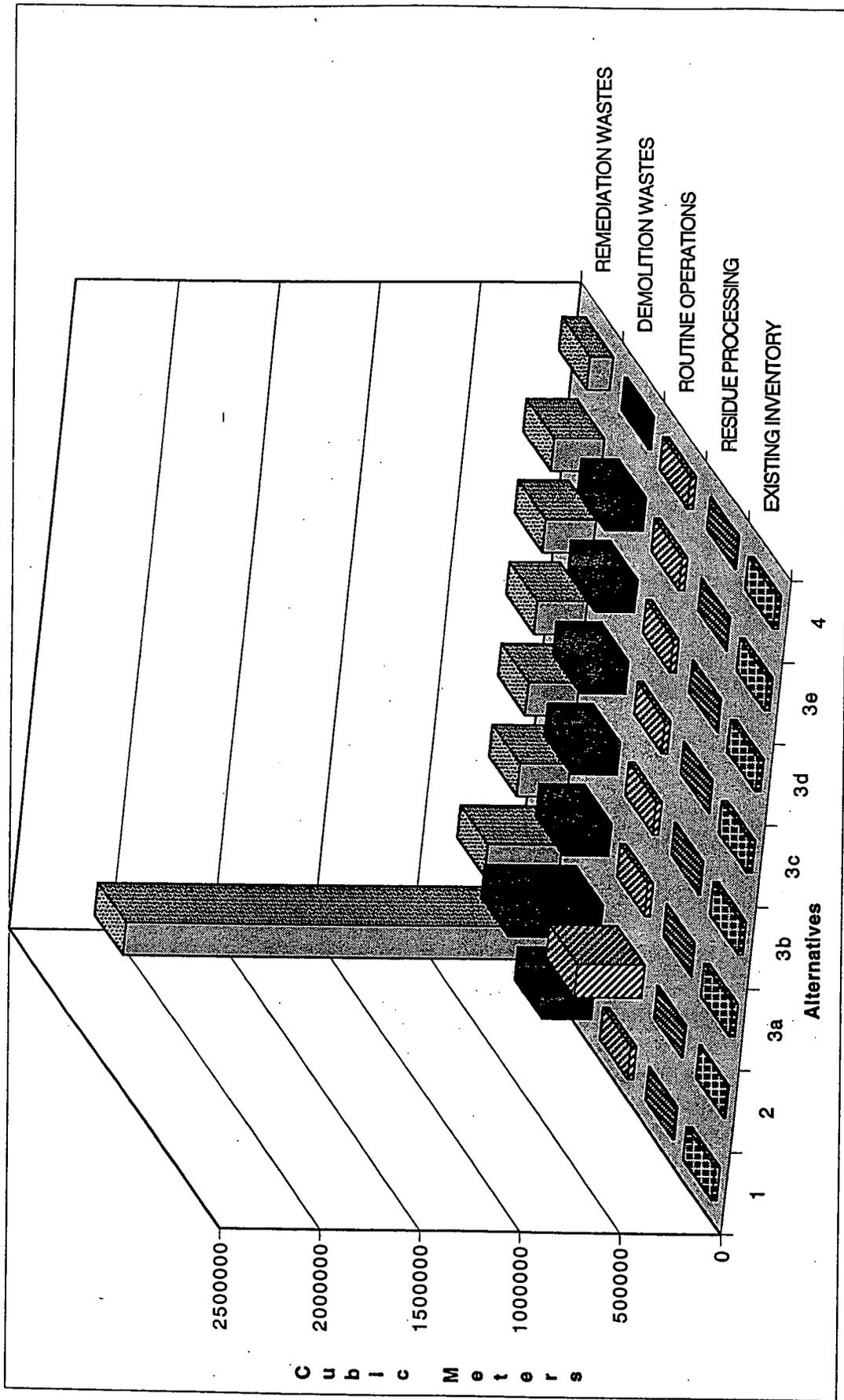


Figure 3-6 Waste Sources

stricter remediation goals will have a direct influence on the waste volumes generated and therefore, on the waste management costs.

### 3.4 Risk

Risk is a measure of the potential for adverse impacts to the public, workers and the environment. Each of the alternatives would produce a different amount of risk. Appendix H discusses in greater detail the methodology used for risk comparisons.

Three types of risk are evaluated: transportation, OSHA, and radiological. Although risk assessments can be qualitative or quantitative, the comparisons presented in this study are *qualitative* and are limited to identifying the types of risk associated with each alternative and to indicate the relative magnitude of the risk elements. Given this limitation, the following risk graphs have to be viewed as providing comparisons (difference/equivalence) between alternatives. The only conclusion that should be drawn from these graphs is that one alternative may have greater risk than another. The actual amount of difference cannot be estimated from only the table or figures. Conversely, alternatives that appear to have equivalent risk cannot be said to have exactly equal risk.

Activity durations are generally not considered. The amount of cumulative risk that resulted from an activity is assumed to be the same regardless of how long the activity took. For example, if drums were being moved into a storage facility, the cumulative OSHA risk is assumed to be the same if the operation took one year or ten years. Simplifying assumptions are also used to assess residual risk. For example, burying waste onsite is assumed to present more long-term risk to the public than shipping the waste to an offsite facility.

#### 3.4.1 Transportation Risks

Transportation risks come from a variety of activities that are generally common to each alternative and are associated with both the onsite and offsite transportation of radioactive materials, wastes, cargo and noncargo shipments. Transportation impacts on human health stem from (1) routine traffic accidents, (2) vehicle emissions, and (3) potential exposures to radioactive and/or hazardous materials from routine and accidental conditions. Figure 3-7 provides a relative comparison among the potential transportation occurrences. As Figure 3-7 illustrates, transportation risks would be dramatically higher in Alternative 1 because of the larger number of offsite waste shipments required to achieve an unrestricted end state.

#### 3.4.2 OSHA Risk

Occupational Safety and Health Administration (OSHA) risks are those risks which occur while performing typical activities associated with common industry and do not include exposures to radiological hazards. OSHA risk is assumed to be limited to workers (i.e., the public could not experience OSHA risk because any public involvement in work activities would be passive). Moreover, there is no residual effect since OSHA risk ceases with cessation of activities. In all the alternatives, OSHA risk would increase with an increase in worker activity.

Figure 3-8 provides a relative comparison of OSHA risks among the alternatives. Alternative 1 would produce the highest OSHA risk during implementation due to the removal of all of the facilities, construction of a new SNM interim storage facility, and offsite disposal of wastes. At the other end of the spectrum, Alternative 4, Mothball, represents minimum work scope and corresponding minimum OSHA risk during implementation. Alternatives 3a through 3e, and 4 contain deferred OSHA risks associated with activities which may be required to deal with disposal facilities and structures that would remain onsite.

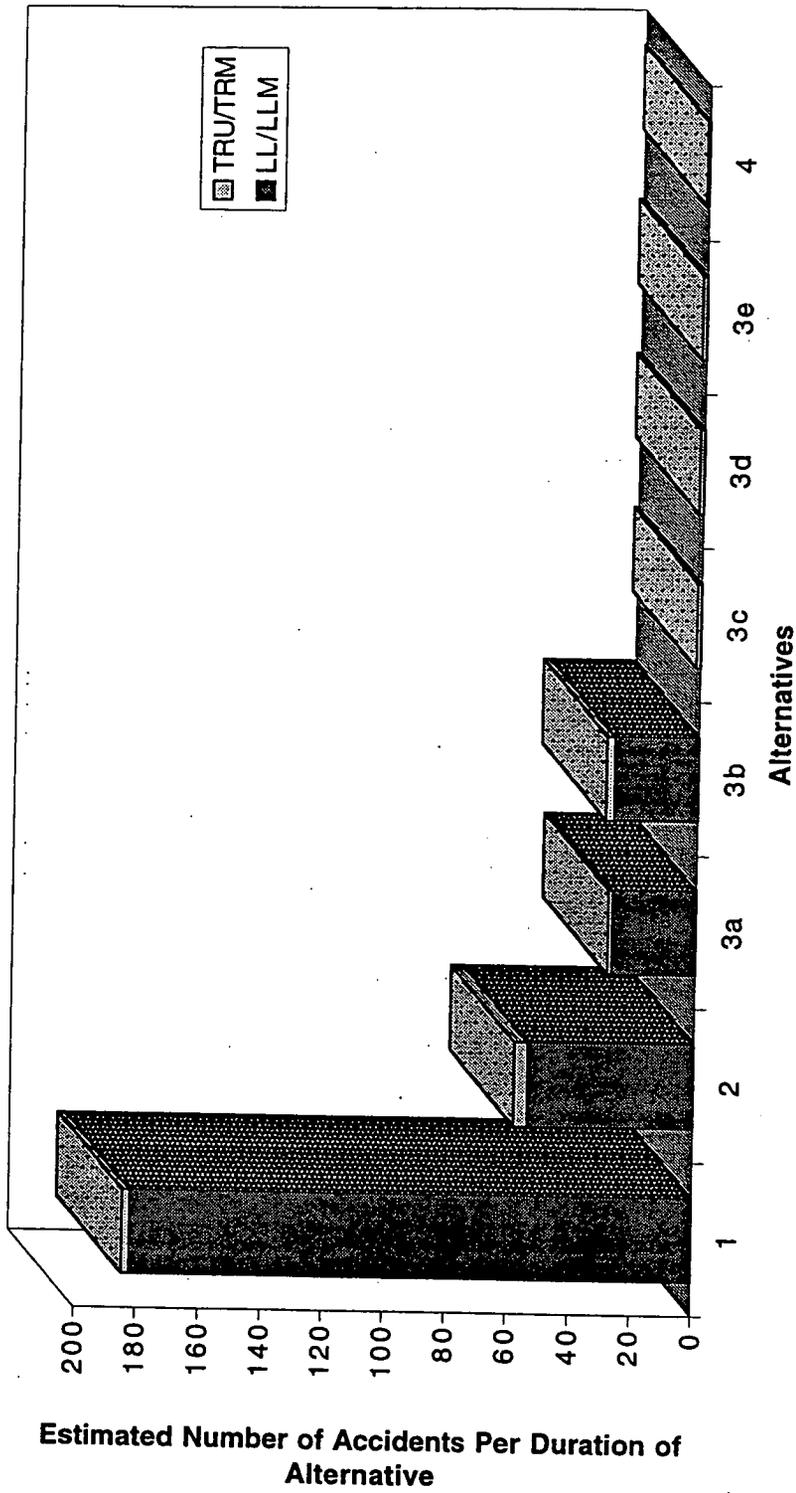


Figure 3-7 Approximate Number of Accidents Projected by Alternative

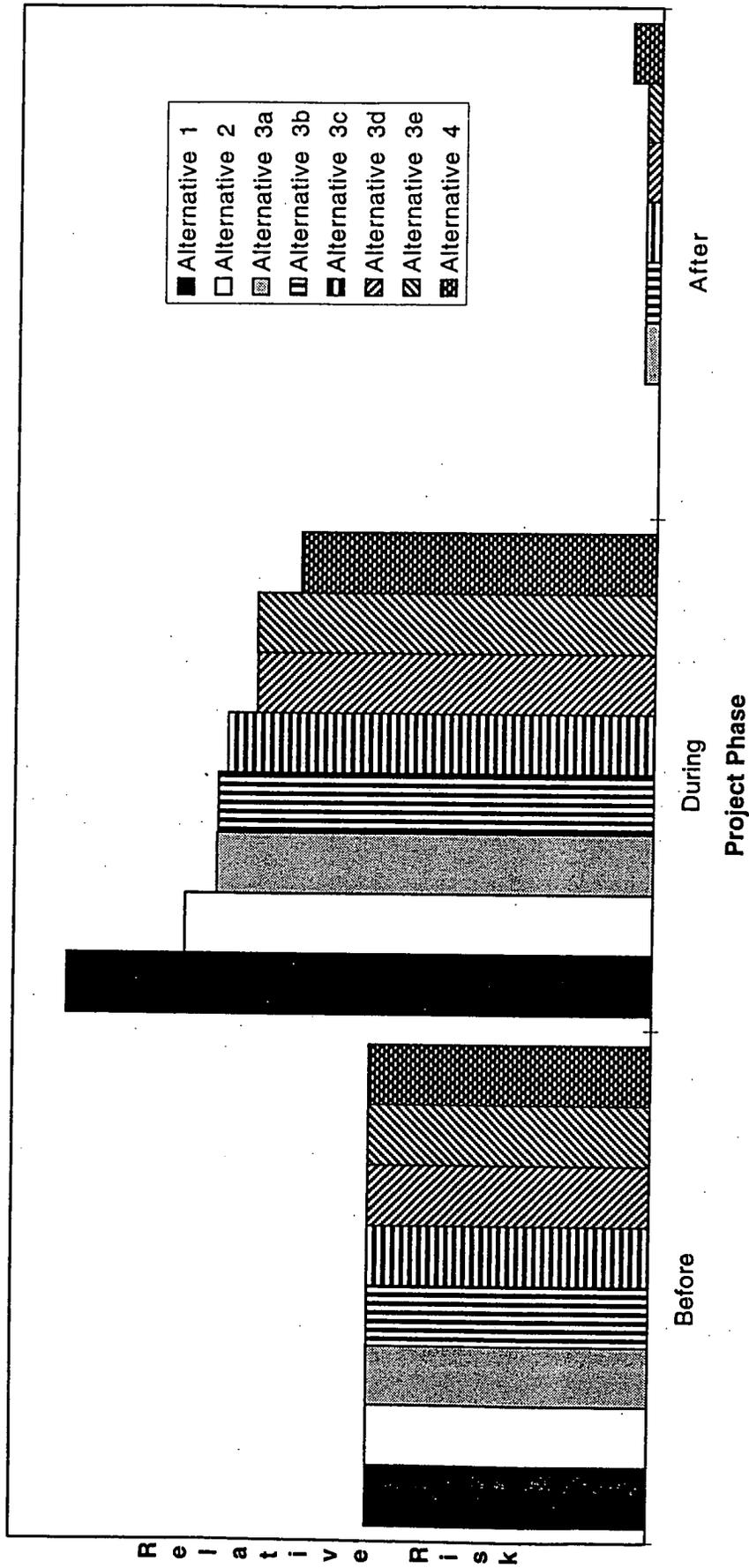


Figure 3-8 Relative Risk Comparisons - Cumulative Worker OSHA Risk

The worker risks for Alternatives 3a through 3e during implementation would be approximately the same, and lower than for Alternatives 1, Unrestricted and 2, BEMR I. Alternatives 3a, and 3b would have slightly higher risks than Alternatives 3c, 3d, and 3e because the workers would be working in existing (older) facilities for longer periods of time until shipments were complete, increasing their vulnerability to accidents. Alternative 4 would have the lowest relative risk during implementation, primarily because fewer buildings are demolished and less material is handled and shipped.

The OSHA risk would be much lower after implementation than during implementation for two reasons: (1) fewer workers remain onsite (if any remain at all), and (2) activities are limited to maintenance, monitoring, and other such activities. The risks for Alternative 3a through 3e, as well as the number of workers and the types of activities in which they would be involved, would be approximately the same. Alternative 4 would have the highest relative OSHA risk after implementation, because of the increased number of workers and activities (compared to Alternatives 3a through 3e).

### 3.4.3 Radiological Risk

Radiological risk to workers and the public is generated by routine emissions, nonroutine emissions (accidents), and residual sources (contamination). The sources of risk include SNM, radioactive wastes, radiologically contaminated buildings (e.g., dust and debris generated during demolition), and contaminated media. Workers may experience exposure during the processing, storing, disposal and/or shipping of radiological material. The public may be exposed to risk from material remaining in onsite storage and/or disposal, and from offsite transportation of the materials. It is assumed that the radiological sources would account for the greatest portion of the risk to both workers and the public. In general terms, radiological risk is assumed to be proportional to the amount of material involved (i.e., storing more radiological materials generates more risk). In addition, worker risk increases as a result of the number of times the material is handled. For those alternatives in which material is moved from one location to a second and then to a third, workers must rehandle the material and therefore, the potential for exposure from handling is increased when compared to alternatives in which the material is sent directly to interim storage.

Figure 3-9 portrays the risk potential for workers in each alternative due to radiological exposure in the different activity periods (before, during, and after). All alternatives start at a common risk level; (i.e., the risk is the same regardless of the alternative). The figure shows that Alternatives 1 and 2 would have the highest relative worker risk during implementation because of the significant volume of radiological material and waste that would be handled by the workers. Increased handling also would occur in Alternative 1 as material was moved into (and out of) new SNM, TRU/TRM waste, and LLW/LLMW storage facilities. Other alternatives would generate less volume of material because cleanup standards would be less stringent and fewer foundations would need to be removed.

Alternative 3b, Priority Shipment, has a relatively higher risk during implementation when compared to Alternatives 3a, Phased Shipment; 3c, Excavation; 3d, Leveled Buildings; 3e, Entombment and Landfill; and 4, Mothball, because workers would work in old plutonium storage facilities for a longer duration to complete SNM shipment, exposing them to the contamination which exists in those buildings.

Alternative 3a has a higher relative risk than 3c, 3d, and 3e for the same reason. However, risk in Alternative 3a would be slightly lower than that of Alternative 3b because the duration of use of the older buildings would be slightly less than in Alternative 3b.

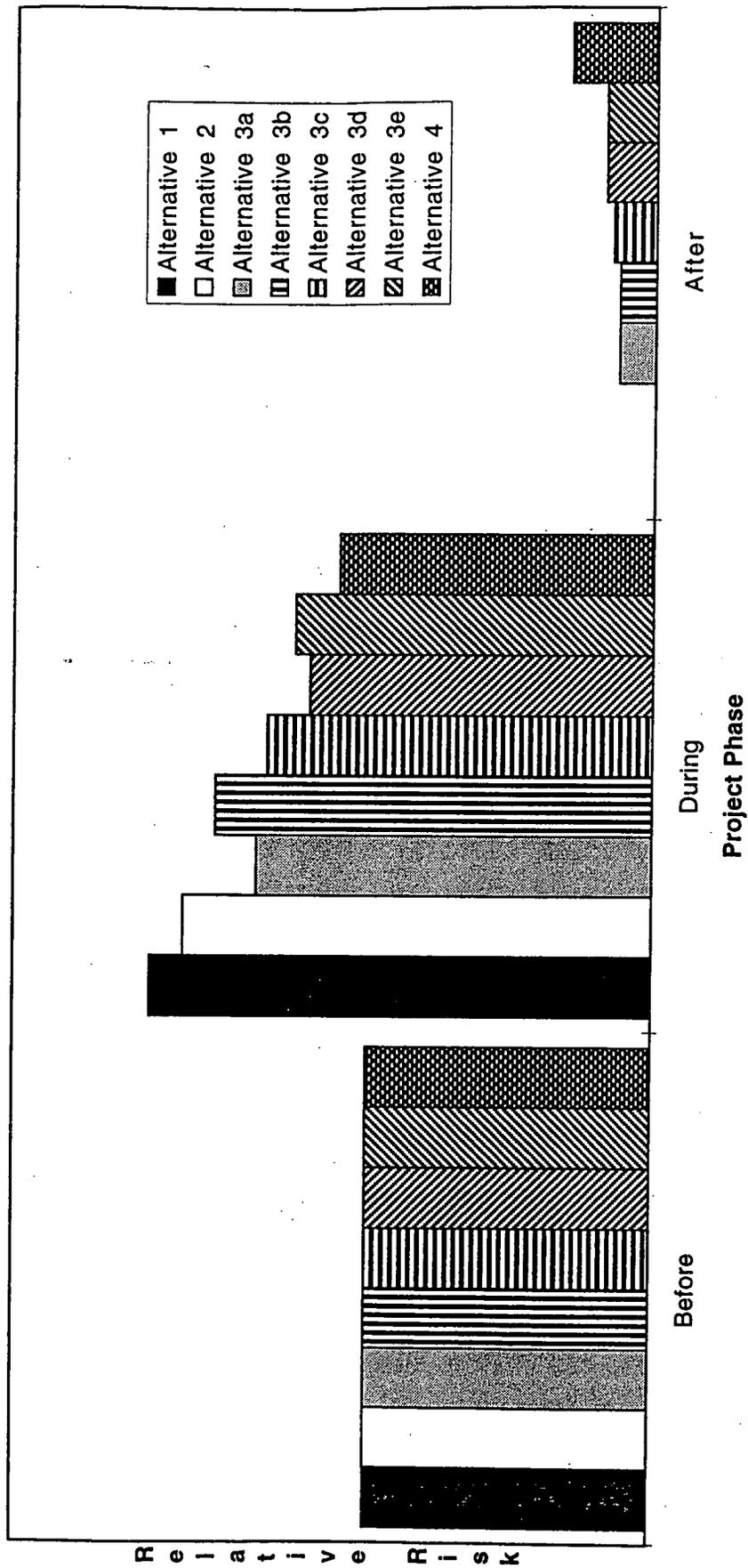


Figure 3-9 Relative Risk Comparisons - Cumulative Worker Radiological Risk

Most alternatives end up with roughly the same residual risk level to the workers. This risk would be lower than the initial risk and roughly equal for Alternatives 3a through 3e. In Alternatives 1 and 2, no workers would be left onsite and therefore worker risk would be nonexistent. In Alternatives 3a through 3e, the workforce would be approximately the same size, and the monitoring activities would be roughly the same as well. Minor variations in the onsite disposal activities would result in minor fluctuations in the risk levels. Alternative 4 in which the most workers would remain onsite, has the highest relative residual radiological risk for reasons similar to those described for residual OSHA risk in Alternative 4.

Figure 3-10 shows the relative radiological risk to the public associated with each alternative. The alternatives all start at a common point because the initial risk is the same for all of them. The relative differences in risk to the public during implementation roughly correspond to those which exist for the workers. However, the residual risks, although lower than the initial risks, are not the same for all alternatives because of the differences in the final disposition of LLW/LLMW and the structures associated with each alternative.

Alternatives 1 and 2 have roughly the same radiological risks during implementation. Alternative 1, the Unrestricted alternative, would remove the most material and meet the most stringent cleanup standards. No structures, material, or waste would remain onsite, and soil would be decontaminated to meet standards for unrestricted use. Alternative 2, which is similar in many aspects to Alternative 1, would not include construction of new facilities (SNM, TRU, LLW) for interim storage. It is assumed that the potential for accidental release of material from these older facilities would be incrementally higher than from the new facilities used in the other alternatives. Therefore, in the implementation phase, the risk in Alternative 2 is higher than the risk in the other alternatives (except Alternative 1, which has substantially more volume shipped offsite).

The relative risks during implementation for Alternatives 3a through 3e are approximately the same, but lower than Alternatives 1 and 2. A slight dip occurs for Alternative 3d because the building foundations would not be removed in Alternative 3d, which minimizes the potential for airborne release of contaminants from the foundations or surrounding soil during removal. For a similar reason, Alternative 4, Mothball, has the lowest relative risk to the public during implementation; this alternative would have the least amount of demolition and soil removal.

After implementation is complete, all alternatives have much lower and somewhat equal residual radiological risk to the public. Note that residual risk is shown for Alternatives 1 and 2. Although these alternatives would remove the most material from the Site, there is still a very small (but finite) potential for exposure to contamination. The level of contamination would essentially be reduced to zero, but some residual contamination might still exist. Therefore, a risk is shown for those two alternatives. The residual risk is approximately the same for Alternatives 3a through 3e, and somewhat higher for Alternative 4. In Alternative 4, many buildings would remain standing, the volumes of soil needing decontamination would be reduced, and most waste would be disposed onsite.

### **3.5 Summary**

This section has highlighted the significant differences between the alternatives with respect to cost and schedule, land-use availability, waste disposition and risk. In selecting the alternatives to be compared, initial assumptions were defined for each alternative and deliberately chosen in order to represent a wide range of possible outcomes. These initial assumptions, when analyzed, led to the cost and schedule, land-use availability, waste disposition, and risk attributes for each alternative. The initial assumptions of each alternative drive the analytical results.

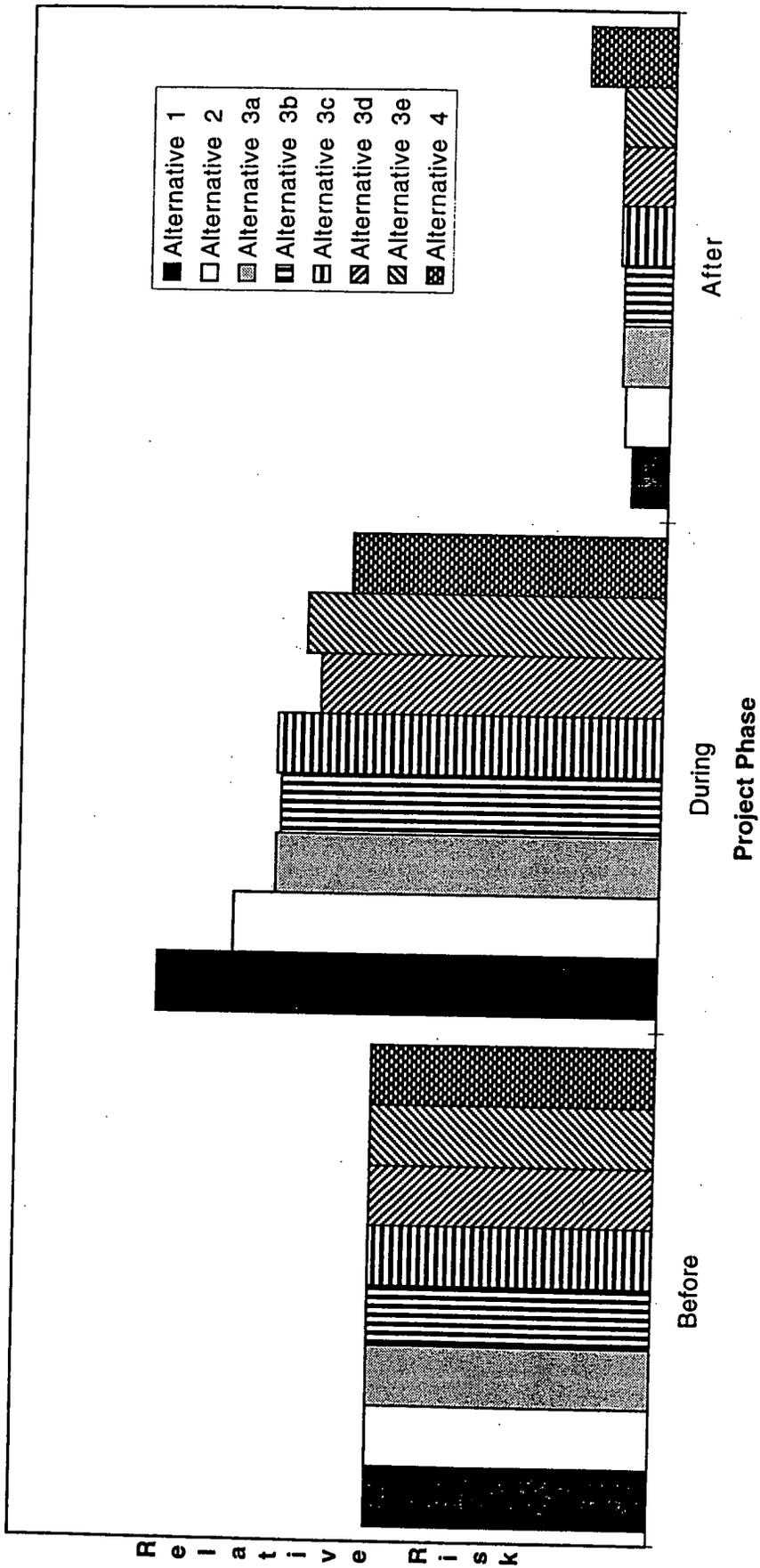


Figure 3-10 Relative Risk Comparisons - Cumulative Public Radiological Risk

Alternative attributes are highly interdependent. It is not possible to change one attribute without affecting other attributes. The alternatives that have lower residual risk, for example, also have a correspondingly greater cost. The alternatives presented in this document represent a wide range of initial assumptions and this analysis of alternatives has produced a correspondingly wide range of results.

## 4.0 PATH FORWARD

The Accelerated Site Action Project is divided into four major phases as described in Table 4-1.

**Table 4-1  
ASAP Path Forward**

Phase	Time Period	Description	Status
Phase I	9/95 to 10/95	Feasibility Study	Completed
Phase II	11/95 to 2/96	Alternative Study	Completed
Phase III	1/96 to 9/96	Selection of the Recommended Alternative	Initiated
Phase IV	8/96 to 12/96	Transformation to the Recommended Approach	

### 4.1 Description of Phases and Milestones

#### 4.1.1 Phase I

Completed in October 1995, Phase I investigated whether an accelerated, safe, and cost-effective path to site closure and remediation existed, and compared it to the existing plan extending to the year 2070, as described in the Congressionally mandated Baseline Environmental Management Report.

ASAP Phase I determined that many, rather than few, alternatives existed to achieve accelerated safe closure, each with differing success probabilities based on risk, safety, technical, regulatory, social, political, and financial considerations. During Phase I, initial adjustments were made to FY96 operating activities to accommodate the most basic features of the strategy.

#### 4.1.2 Phase II

This current study presents four major alternatives and several derivatives for accomplishing accelerated remediation and safe closure. The alternatives bound a spectrum of available options.

The goal in Phase II is to provide a framework for selecting a recommended alternative in Phase III. Alternatives are evaluated in terms of estimated cost, schedule, technical, regulatory, financial feasibility, and risk considerations.

#### 4.1.3 Phase III

Phase III culminates with the selection of a recommended alternative. Phase III activities will focus on evaluating and reducing some of the uncertainties discovered during the Phase II process. Further studies will be conducted to explore elements of the alternatives more clearly to aid in the decision-making process.

After an alternative is selected for recommendation, Phase III will lay the groundwork for the implementation of that alternative and will integrate ongoing site activities and requirements. Some of these activities and requirements include the SISMP, 94-1, 94-3, the SWEIS, the Programmatic Environmental Impact Statement (PEIS), RFCA, the Site Conceptual Vision, and recommendations of the Future Site Use Working Group (FSUWG), and others.

Phase III activities will also include the preparation of a Work Plan detailing the process by which the recommended alternative will become the Site work activities baseline. Proposed 1997 and 1998 budget modifications as well as a Site Work Breakdown Structure (WBS) will also be prepared. The recommended alternative will be one that supports the results of the Draft Conceptual Site Vision Workout Session Part II scheduled in March 1996 and the SWEIS.

#### 4.1.4 Phase IV

ASAP Phase IV represents the implementation phase of the project. During this phase, the future work activities will be defined. The budget documents will be prepared for 1998 to 2000 and to the project level for 2001 and beyond. The implementation of ASAP will effectively "projectize" the site and allow for a definitive shift from the current baseline facility operations mode to a project with an end product goal equalling that of the selected alternative. The output of Phase IV will be the alignment of the Site work activities, strategic planning, and programs to the recommended alternative.

#### 4.2 Stakeholder Discussion and Comment Period ASAP Phase II

Following completion of ASAP Phase II activities, this Phase II report will be widely distributed. A series of meetings will then be scheduled with stakeholder groups to review the Phase II process and to answer questions on the development and comparative analysis of the Phase II Alternatives. It is anticipated that requests for the analysis of additional combinations of various alternatives and options will be received and analyzed. Additional information detailing the ASAP public involvement and labor relations process appears in Appendix F of this report.

## APPENDIX A

### SPECIAL NUCLEAR MATERIAL STABILIZATION, CONSOLIDATION, AND STORAGE

#### 1.0 INTRODUCTION

##### 1.1 Ultimate Goal

The desired goal for Rocky Flats is to ship all Special Nuclear Material (SNM) and SNM-bearing materials safely from the Site as quickly as possible to allow full closure of the Site and to reduce the risks associated with this material. DOE's stated goal is to have plutonium (metal, oxides, and pits) removed from Rocky Flats by FY 2015.

##### 1.2 Purpose

This appendix was prepared to support the analysis of site alternatives discussed in this ASAP document by addressing the SNM aspects of these alternatives. Activities to reduce risks associated with nuclear materials are currently one of the highest priorities on the Site and are generally the highest priority in the ASAP alternatives. Regardless of which alternative is chosen, the nature of SNM and the activities required by it, allow few, if any, variations. Therefore, the same or very similar activities must be planned for each of the alternatives.

##### 1.3 Scope

SNM activities discussed here include: (1) near-term consolidation of SNM and construction of a new SNM interim storage facility; (2) offsite disposal of highly enriched uranyl nitrate (HEUN) solutions; (3) stabilization and interim storage for eventual offsite shipment of plutonium metal, oxides, pits and enriched uranium; (4) stabilization and interim storage of solid residues for offsite disposal; and (5) stabilization and treatment of SNM solutions (liquids) to produce solid materials for offsite disposal.

In general, SNM activities, regardless of the alternative chosen, will include the following:

1. Stabilization, consolidation, and long-term packaging of plutonium metals and oxides, stabilization of SNM oxides by meeting the high temperature heating requirements of DOE Standard 3013-94, and by packaging the material in storage canisters
2. Onsite interim storage of the metals, oxides, and pits until offsite disposition is possible (currently planned for completion by 2015)
3. Continuation of the program to drain HEUN solutions and ship them offsite for treatment and disposal
4. Processing of solid residues to stabilize the material to eliminate future reactivity while it is stored, and packaging the material to allow shipment for further processing or offsite disposal
5. Continuation of the program to drain SNM solutions from tanks and process lines in Buildings 371 and 771 and further processing of the solutions to create solid materials (i.e., impure plutonium or uranium solids, transuranic [TRU] and Low-level waste [LLW])

These general SNM activities will not often vary under the individual alternatives. The few specific differences possible are described below.

*Alternatives 1, Unrestricted; 2, BEMR I; 3a, Phased Shipment; and 3b, Priority Shipment* – Solid residues (including solid residues resulting from treatment of SNM solutions) would need to be processed and packaged to meet interim safe storage criteria and/or WIPP waste acceptance criteria (WIPP WAC). WIPP refers to the Waste Isolation Pilot Plant being readied for underground disposal of TRU waste in salt domes in Carlsbad, New Mexico. WIPP WAC are criteria that specify the form and packaging of the TRU waste material and primarily limit the amount of SNM in the waste and the reactivity of the waste. WIPP WAC does not require small amounts of liquids to be driven off.

*All other alternatives* – Solid residues are processed for interim storage. In general, liquids will be driven from the residue material and the reactivity of the material will be reduced to a safe condition for interim storage. The difference here would be whether additional treatment of more material is needed or whether greater treatment of the same material is warranted. The intent is to reduce the reactivity and place the material into a more stable configuration. In addition, maintenance costs during storage are minimized. Packaging will be done to meet DOE interim safe storage requirements and not necessarily to the requirements of the disposal site (i.e., WIPP).

*Alternative 3b, Priority Shipment* – The schedule for processing SNM would be delayed to free up funds for offsite shipment of radioactive waste materials. Stabilization of the SNM metal and oxides, and treatment of solid residues would continue, but at a slower pace. In addition, the construction of the new SNM interim storage facility would be eliminated, and Building 371 would be upgraded and used for interim storage until the SNM is shipped offsite.

### 1.3.1 Four major categories of Special Nuclear Material

SNM is stored in seven different facilities at the site (Buildings 371, 707, 771, 776/777, 779, and 886) and fall into four general categories:

- Plutonium metal, oxides, and pits and enriched uranium
- SNM solid residues
- SNM solutions (liquids)
- Highly Enriched Uranyl Nitrate (HEUN) solutions

Approximate amounts of SNM currently at Rocky Flats are as follows:

- 6,600 kg plutonium metal
- 3,200 kg plutonium compounds and oxides
- 6,100 kg enriched uranium metal and oxides with 570 kg highly enriched uranium in 2,700 L of solution
- 3,100 kg plutonium in 106 metric tons of residues
- 140 kg plutonium in 29,000 L of solution

## 1.4 Approach

### 1.4.1 Planned Activities by SNM Category

*Plutonium Metal, Oxides, Pits And Enriched Uranium* – The approach is to ship some materials offsite in the near-term. For example, early shipment within one to five years is deemed feasible for some pits and enriched uranium. Processing to meet the DOE STD-

3013-94 requirements would place the metal oxide in a stable form for long-term storage. The SNM would be stored onsite until final disposition is possible. In the near-term, SNM would be consolidated into Building 371 because it is the most resistant to earthquake damage. Interim storage would be in a new facility or Building 371 as noted below.

*SNM Solutions* – The approach for SNM solutions is to drain and treat the solutions remaining in process lines and tanks on Site (Buildings 371, 374, 771, and 774) to create stable, solid material for disposition as SNM impure solids, TRU, and/or some LLW.

*SNM Solid Residues* – The approach to solid residues, the most complex of the nuclear materials to be addressed, includes:

- Processing solid residues to a stable, predictable form. This generally involves calcining or drying to remove moisture, but will include other processes for specific residues. While material is stored onsite and until WIPP opens and the waste is certified, Interim Safe Storage Criteria (ISSC) needs to be met.
- Storing the high plutonium-content residues with the SNM.
- All alternatives except 2, BEMR I and 3b, Priority Shipment, include storing the bulk of the processed residues in a new TRU waste interim storage facility until it is shipped to WIPP.

Solid residue processing may include evaluating, unpacking, sorting, assaying, stabilizing, and/or repackaging, depending on the evaluation and the anticipated period of interim storage onsite prior to shipment as TRU/TRM (transuranic mixed) waste to WIPP for disposal. Alternatives 1, Unrestricted; 2, BEMR I; 3a, Phased Shipment; and 3b, Priority Shipment assume that these shipments to WIPP will begin in 1998 as scheduled. On the other hand, Alternatives 3c, Excavation; 3d, Leveled Buildings; 3e, Entombment and Landfill; and 4, Mothball assume these shipments to WIPP will be later than 1998 and residues will remain at Rocky Flats for some longer period before being shipped.

*HEUN* – The approach for HEUN solutions is the current FY96 program. The HEUN (in Building 886) will be drained to bottles and shipped offsite for treatment and disposition.

*Storage* – The approach in all alternatives except Alternatives 2, BEMR I and 3b, Priority Shipment, is to build a new interim SNM interim storage facility that would contain SNM metal, oxides, and attractive residues until these materials were removed to an offsite facility. In Alternatives 2, BEMR I and 3b, Priority Shipment, Building 371 will be used for SNM interim storage until the materials are removed to an offsite facility. The current DOE goal for complete removal is FY 2015.

The SNM at Rocky Flats poses the greatest risk at the Site. As a result, there are significant plans and activities in place and ongoing to consolidate, stabilize, and store these materials to reduce risk to the workers, public and the environment. As much as possible, the ASAP Phase II SNM stabilization, consolidation, and interim storage effort recognizes and adopts those existing plans and activities. Differences occur only when conflicts arise due to alternative definitions.

In addition, consideration has been given to Recommendations 94-1 and 94-3 of the Defense Nuclear Facilities Safety Board (DNFSB). With few exceptions, the approach is in overall consonance with the response to DNFSB 94-1 which will be presented in the February 1996 revision of the Rocky Flats Site Integrated Stabilization Management Plan (SISMP).

Likewise, the proposed new SNM interim storage facility is aligned with the current conclusions and ensuing recommendations in response to 94-3. It is important to recognize, however, that the evaluations and conclusions of these ASAP activities do not constitute in any manner responses to either of these DNFSB Recommendations.

## **2.0 INTERDEPENDENCIES**

The following interdependencies were identified and possible solutions determined for all conflicts. Specific plans for resolving conflicts were not drafted.

### **2.1 Plutonium Solutions and Facility Decommissioning**

Solution stabilization activities must be completed to allow decommissioning to proceed in buildings with solution inventory. Decommissioning of the liquid waste treatment facilities that support the liquid stabilization processes cannot occur until all solution stabilization is complete. In addition to current inventories, some solution processing capability may be required to conduct closure activities.

### **2.2 Solid Residues and Facility Decommissioning**

Solid residue stabilization activities must be completed before the decommissioning of Buildings 371 and 707 can occur. The amount of space and resources needed for residue operations and storage is likely to be large. The requirements of other activities must be acknowledged and conflicts resolved. The most likely competitors for resources are SNM stabilization and interim storage because those activities will also require the use of secure facilities such as Building 371 and Building 707.

Residue stabilization activities will generate LLW and TRU wastes, which would impact the current onsite storage problem of these materials. Estimates of LLW and TRU waste generation are provided in Appendix B.

### **2.3 Highly Enriched Uranyl Nitrate Solutions**

Building 991 must be available through FY96 for offsite shipments of HEUN.

## **3.0 ASSUMPTIONS**

### **3.1 Risk Assumptions**

The various SNM activities contribute to Site risk. However, the risks are not all equal for each activity.

#### **3.1.1 Near-Term Consolidation of SNM**

An initial planned activity is the consolidation of SNM into a single facility, Building 371, and for most alternatives (except Alternatives 2, BEMR I and 3b, Priority Shipment), the construction of an interim storage facility for SNM metal, oxide, and pits. Consolidation and a new storage facility reduce the overall site risk profile associated with SNM and allow a reduction in building operating costs. The material presents a risk due primarily to its dispersion capability and subsequent potential for uptake by workers and the public under a seismic collapse scenario. Placement in the most seismically resistant building therefore reduces the risk from this potential, but unlikely, event. Consolidation also allows the decommissioning of many of the currently used buildings, eliminating the costs associated with operating those facilities. It is therefore a major driver to reducing site risks from SNM, and maximizing the available funds.

### 3.1.2 Offsite Disposal of HEUN Solutions

A second activity is the bottling and shipping offsite of HEUN solutions for processing and disposal. This is an ongoing activity scheduled for completion in FY 96. Because the HEUN solutions are highly enriched solutions, they pose a risk to workers, the environment, and the public from the possibilities of corrosion of pipes and tanks resulting in spills.

### 3.1.3 Stabilization of SNM Metal, Oxides, Pits and Enriched Uranium

SNM metals, pits, and enriched uranium present a risk to the Site due to the potential for reaction to the highly dispersible oxide form and radiolytic reactions with plastic. The risks posed by pressure buildup in containers from these reactions include breaching of containers and potential release and dispersion of the material. Existing oxides provide the same risks. Containers have been breached in a few cases across the DOE complex, including Rocky Flats. Oxides are particularly hazardous to people because they are extremely small particles that can be easily inhaled.

### 3.1.4 Stabilization and Treatment of SNM Solid Residues

Another area of activity is the stabilization and repackaging of solid residues to reduce these SNM risks and preparation of the material for offsite disposal. The behavior of these materials in storage without treatment is not well defined since most of them have only been present in that state for a few years. However, while their risks are not fully known, they are similar to the risks posed by SNM metal discussed above, in that reactions may cause container breaches.

### 3.1.5 Stabilization and Treatment of SNM Solutions

Generally, SNM solutions are deemed to pose the greatest risks among the SNM activities at the Site. These solutions are generally corrosive and are currently stored in aging process lines, tanks, and bottles that were not intended for long-term storage. The risk of leaks, spills, and unplanned movement may be significant. Stabilization of the solutions to a more manageable form is currently considered the Site's highest SNM activity priority.

## 3.2 General Assumptions

Continued, indefinite storage of solutions in their current state is not an acceptable option. Stabilization of these plutonium solutions is required under all alternatives to reduce risks.

In Alternatives 1, 2, 3a, and 3b, the majority of solid residues will undergo minimal processing (stabilization and/or repackaging) for disposition at WIPP as TRU/TRM waste. With the exception of combustibles and some bulky organics, these stabilized residues will be packaged in vented containers inside pipe components. In Alternatives 3c, 3d, 3e, and 4, the solid residues will be processed to a greater extent to minimize storage costs and ensure that no further processing will be required. These stabilized residues (TRU/TRM waste) will meet long-term storage criteria and will be packaged in a condition that could be shipped to WIPP in DOE STD-3013-94 containers without changes to primary packaging.

Residue characterization will also continue current activities and greatly enhance them by adding real-time radiography capability, whether fixed or mobile, to allow all residue drums to be examined. Segmented Tomographic Gamma Scanning (STGS) may also be desirable to allow visualization of nuclear material concentrations within drums. Headspace-gas sampling and gas-generation studies will also be useful for some drums, especially combustibles. The current solid residue characterization program will provide adequate characterization during FY96 and FY97.

The TRU/TRM waste generated as a result of the residue stabilization will be stored in the TRU interim storage facility or facilities.

Residue shipment to WIPP or an other offsite repository will be the final step in the approach to managing residues and will occur as soon as possible.

### **3.3 Basis of Estimate**

The basis of estimate for the SNM activities in this appendix is contained in the SISMP and in the evaluation of facilities in response to the Defense Nuclear Facilities Safety Board Recommendations 94-1 and 94-3. Both efforts are documented and are available upon request. These documents were used because they form the basis for the SNM approach in the ASAP alternatives and represent the best information currently at the Site. The costs were adjusted based on the schedules presented in the differing alternatives. For instance, in Alternative 3e, Entombment and Landfill, the costs were increased to meet the shorter schedule by assuming additional treatment capacity. The cost for an additional treatment line was arrived at by using the cost of the original line. In general, near term activities assumed one shift per day using current staff. Longer term activities assumed multiple shifts per day. It is assumed that once a single Site plan is selected under ASAP Phase III, specific and detailed cost estimates will be prepared.

## **4.0 ALTERNATIVE OPTIONS**

The Alternatives are described and analyzed here on the basis of SNM material because of the similarities of SNM between alternatives.

### **4.1 Plutonium Metals, Oxides, Pits, and Enriched Uranium**

#### **4.1.1 Description**

When production and recovery operations at the Site were stopped in 1989, a large quantity of the SNM inventory was left in forms and packages unsuitable for long-term storage. These include potentially pyrophoric and highly dispersible plutonium oxides; metals susceptible to oxidation and hydriding, which could lead to pressurization or rupture of the storage container; and unsealable and nonrobust storage containers that exacerbate these conditions. A program is underway to resolve immediate concerns about the safety of continued storage of this material, and to bring it in compliance with the requirements of the Rocky Flats Health and Safety Practices Manual.

In addition, DOE introduced DOE-STD-3013-94, Criteria for Safe Storage of Plutonium Metal and Oxides, which specifies packaging requirements for the storage of plutonium metals and oxides. These requirements are substantially different from current packaging practices, and require both facility modifications to establish the packaging capability, and significant operational effort to place all of the stored metal and oxide in the proper storage configuration.

All of the alternatives assume the facility modifications would occur in Buildings 707 and 371. Building 707, J Module, would be modified to install the Plutonium Stabilization and Packaging (PuSAP) Group's prototype process line, which should be operational in the third quarter of FY97. A full scale process line utilizing the same technology would be installed in Building 371 and be operational in late FY98. (Except for Alternative 3b, Priority Shipment, which does not use a full scale processing line.) It is important to note that the ASAP Phase I report initially concluded that Building 707 would be used for all processing. There is an ongoing effort to evaluate the use of Building 371 as opposed to Building 707 for this full scale line.

DOE-STD-3013-94 specifies that both plutonium metal and plutonium oxide, thermally stabilized to 0.5 percent Loss on Ignition (LOI), be packaged in nested, welded stainless steel containers. As currently planned, the operation to provide compliance with DOE-STD-3013-94 will remove loose oxide from plutonium metal, thermally stabilize plutonium oxide at 1000 degrees C, and package metal and oxide in the nested containers, using a bagless transfer system to reduce or eliminate contamination issues.

All alternatives plan that SNM will be consolidated into Building 371. This program is currently in progress at the Site. It is assumed that operations will initially start in the Building 707 process line, be ongoing in both the Building 371 and Building 707 lines as the Building 371 line becomes available, and finish in Building 371 as all material is consolidated there and removed from Building 707.

#### 4.1.2 Data Presentation

The scope will generally be limited to plutonium metals and oxides greater than 50 percent assay by weight, enriched uranium, and pits. However, pits are sealed units, and require only proper packaging, and no processing. Most of the pit inventory is already adequately packaged. Enriched uranium does not have the same reactive properties that plutonium does, so it does not require the same level of processing or packaging. In addition, plans are in place to ship most of the enriched uranium offsite, either immediately, or after decontamination to remove plutonium. A small amount of enriched uranium may remain which will be dispositioned in a manner similar to that of the plutonium.

This nuclear material is currently stored primarily in Buildings 371, 707, 771, 776/7, 779, and 991. There are approximately 6,600 kg of plutonium in metal form, including that in pits, 3,200 kg in compounds, and 6,700 kg of enriched uranium; these are distributed over more than 10,000 discrete items. There are, in addition, approximately 3,100 kg of plutonium in residues which are addressed in Section 4.3 of this Appendix.

The materials are currently in many different forms and packaging configurations. Although intermediate programs will provide some consistency in both form and packaging, the scope of this effort will require any or all of the following capabilities and operations: (1) inspection of metal and removal of loose oxide, (2) resizing of large metal objects to fit within the DOE-STD-3013-94 container, (3) thermal stabilization of oxides, (4) analytical support to verify oxide characteristics, and (5) packaging in the DOE-STD-3013-94 container.

#### 4.1.3 Capital Improvements

There are a number of capital improvements that are specific to the management of plutonium metals, oxides, pits, and enriched uranium.

Installation of the prototype processing line is planned in Building 707 J Module, with operations to begin by the third quarter of FY97. To date, the Site has allocated \$2 million of expense funding to this activity, although it is expected that more will be necessary, depending upon the requirements of the DOE HQ Plutonium Stabilization and Packaging Group.

The same technology is planned to be used for the Processing for Accountability and Safe Storage (PASS) activity in Building 371. This would be installed in Room 3206 and is intended to be a production process, as opposed to a prototype technology demonstration. Total estimated costs for this activity are approximately \$22 million - \$11 million for each of two process lines. (Except for Alternative 3b, Priority Shipment, which does not utilize the PASS.) It can be completed and operational in late FY98.

To create more storage space within Building 371 to accommodate material being consolidated there, Room 3337 will be modified to become a storage vault. This activity will be complete by July 1996, and will have a total estimated cost of nearly \$3 million.

#### 4.1.4 Option Specific Assumptions

Most pits will remain at the Site and require neither substantial surveillance nor repackaging into different containers.

All, or nearly all, enriched uranium will be shipped to offsite locations. In addition, all other currently planned offsite shipments, (e.g., Stockpile Reliability Evaluation Program pits, non-War Reserve pits, and special units) will be shipped to offsite locations as well.

#### 4.1.5 Constraints/Standards

This work will be performed to the requirements of DOE-STD-3013-94.

#### 4.1.6 Analysis and Results

The total estimated costs for conducting stabilization and packaging activities are \$92 million.

### 4.2 **Liquid Residues**

#### 4.2.1 Description

Curtailment of plutonium operations at Rocky Flats in November 1989 was anticipated to last for only a short time while safety and environmental concerns were addressed. However, the end of the Cold War resulted in change of the Site mission. Solutions (liquids) had been left in tanks, piping, and plastic bottles at the time of curtailment, in anticipation of resumption. These solutions must now be stabilized to reduce risk and allow Site closure and they must be stabilized before building decommissioning can occur. During production, solutions were stored for only a short time before being processed to recover the plutonium as metal. Storage in tanks, piping, and plastic bottles now nearing six years, was not envisioned. Leaks from tanks and piping have increased and will continue to increase in frequency and magnitude if stabilization does not occur. Plastic bottles are even more susceptible to failure due to radiolysis, and acid type and concentration.

Solutions are currently being stabilized at the Site and include plutonium and uranium in nitrate and chloride forms. Buildings to be used for solution stabilization include Buildings 371, 374, 771, and 774. The solutions will be removed from process equipment or plastic bottles and converted to a stable solid.

Several potential processing schemes for stabilizing solutions were evaluated. The evaluation yielded a set of preferred processes which are discussed in Section 4.2.2. Solutions are stabilized by one of several methods depending on point of origin and actinide concentration. These processing methods are applicable to all ASAP alternatives.

#### 4.2.2 Data Presentation

**Current Inventory** – The total solution inventory is approximately 29,900 liters. Of this volume, 29,600 liters of nitrate solution contain an estimated 139 kg plutonium, and 300 liters of nitrate and chloride solutions contain roughly 6 kg actinide (0.6 kg plutonium and 5.4 kg uranium).

Current Storage Locations – Building 371 contains 29 kg actinide in 18,700 liters, in tanks and piping. Building 771 contains 110 kg actinide in 7,400 liters in tanks and piping. There are 6 kg actinide in 3,750 liters solution in 4-liter plastic bottles. Most of the bottles are currently in storage in gloveboxes in Building 771, but there are also bottles in Buildings 371, 559, and 779.

Carrier (chemical) precipitation will be used to treat waste nitrate solutions in Buildings 774 and 374. Actinide concentration is limited to 0.0245 g/l in Building 774 and 0.001 g/l (0.004 g/l if from Building 371) in Building 374. The process uses ferric sulfate, magnesium sulfate, calcium chloride, and a flocculent to precipitate actinide as a sludge. The sludge will be stored until a sludge-processing system is on-line. The sludge will then be converted into a shippable solid waste form.

Direct Cementation occurs in Building 774 and involves pH adjustment with sodium hydroxide and actinide solution mixing with portland and Ramcote cements in a 55-gallon drum. Concentrations are limited to less than 6 g actinide/l for criticality safety. The resulting waste form is TRU waste and would be stored at the Site until WIPP is available.

Oxalate precipitation will be used to treat actinide (plutonium and americium) nitrate solutions containing more than 6 g actinide/liter. Oxalic acid is added to precipitate the actinides; a second precipitation with magnesium hydroxide removes additional actinide. The precipitates are filtered and calcined to the oxide for storage as SNM. The filtrate is sent to carrier precipitation.

Hydroxide precipitation will be used to treat mixtures of uranium and plutonium in nitrate and chloride solutions containing more than 6 g actinide/liter. Magnesium hydroxide is used to precipitate the plutonium as hydroxide and uranium as uranates. The precipitate is calcined to plutonium oxide and magnesium uranates and stored. The filtrate is cemented in Building 774 regardless of actinide concentration due to chloride corrosivity.

Hydroxide precipitation of plutonium with magnesium hydroxide will also be used in the Caustic Waste Treatment System in Building 371 to stabilize all solutions in tanks and piping. The products would be treated and stored the same as in Building 771.

It is anticipated that the Liquid Stabilization Program will produce waste and product as follows:

- |   |                |
|---|----------------|
| • Sludge produced from carrier precipitation in Buildings 374 and 774 | 11,075 pounds  |
| • 55-gallon drums of cement from Building 774 Bottle Box              | 60 drums       |
| • Boxes of saltcrete from Building 374 evaporation                    | 44 boxes       |
| • Kilograms of actinide solids from Buildings 771 and 371 processing  | ~145 kilograms |

#### 4.2.3 Capital Improvements

Three related capital improvement activities are required to support liquid stabilization. The three activities are in progress and construction is scheduled for completion by April 1996. These activities will install process storage tanks, provide a vacuum system for solution transfer, and install precipitation processing equipment. The total estimated costs for these activities is \$1.5 million.

#### 4.2.4 Option Specific Assumptions

Liquid stabilization is considered the highest priority risk-reduction activity. Under all the alternatives, the current SISMP liquid stabilization schedule and funding support each alternative appropriately.

#### 4.2.5 Constraints/Standards

The draining of six tanks in Building 371 must be completed by August 31, 1996 in accordance with the Mixed Residue Tank Management Plan prepared in accordance with CDPHE Consent Order 93-04-23-01.

#### 4.2.6 Land Use Implications

Land use options will not be affected by liquid stabilization activities. Liquid stabilization will be required under all alternatives, and once completed, will support implementation of any of the land use proposals.

#### 4.2.7 Barriers/Uncertainties

One portion of liquid stabilization program involves draining liquid from piping and tanks where the liquids may be entrained (e.g., some tanks contain Raschig rings for safety purposes. The presence of these rings precludes complete draining of the liquid from these tanks). Preliminary work is complete to identify low points and design prototype hardware. Draining has not yet occurred to provide validation for cost and schedule projections.

#### 4.2.8 Analysis and Results

The schedule objectives are to eliminate all actinide aqueous solutions in Building 771 by December 1997 and to eliminate all actinide aqueous solutions in Building 371 by June 1999. The total estimated costs for conducting liquid stabilization activities are \$63.5 million.

### 4.3 **Solid Residues**

#### 4.3.1 Description

During the years of plutonium-parts manufacturing at Rocky Flats, plutonium-contaminated wastes were generated. If these wastes contained economically recoverable quantities of plutonium, they were designated as residues and retained for plutonium recovery processing. These residues were packaged for short-term storage, with the expectation of prompt plutonium recovery processing. The material is, for the most part, still in the same storage configuration and, in many cases, the plutonium-containing residues are in intimate contact with hydrogenous substrates or packaging materials. Some of the residues could contain reactive metals, metallic plutonium, and suboxides of plutonium. There are 103 residue types, or Item Description Codes (IDCs), amounting to approximately 106,000 kilograms of residues, containing 3,100 kilograms of plutonium, that are currently stored at the Site.

Currently, DOE has no programmatic need to separate the plutonium from the residue matrix. In Alternatives 1, 2, 3a, and 3b (treatment and repackaging to meet WIPP WAC), all of the material is scheduled for disposition, resulting in 28,800 drums of transuranic (TRU) and transuranic mixed (TRM) waste to WIPP. In Alternatives 3e, 3d, 3c, and 4 some

actinide separation is proposed to facilitate sealing of stabilized residue in DOE STD-3013-94 containers, resulting in 4,000 drums for interim storage in the TRU waste interim storage facility and 300 containers in the SNM interim storage facility. Following repackaging, the 4,000 drums will ultimately result in 13,000 drums of TRU and TRM wastes disposed at WIPP.

The U. S. District Court (District of Colorado), in its judgment No. 89-B-181, found that the hazardous portion of mixed residues is subject to RCRA regulation. As a result of this judgment, the DOE, its Site integrating contractor, and the Colorado Department of Public Health and Environment through a series of agreements have entered into Settlement Agreement and Compliance Order on Consent No. 93-04-23-01. The order establishes the Mixed Residue Reduction Program (MRRP) and requires DOE and its Site integrating contractor to "timely and adequately implement the MRRP" by the following two actions:

- "The processing of backlog mixed residues to put them in a shippable and/or disposable form as expeditiously as reasonably possible."
- "Removal from the Site of the backlog mixed residues and the TRU mixed wastes generated by their processing as expeditiously as reasonably possible once a final offsite disposal facility becomes available."

The DNFSB, in its Recommendation 94-1, stated the following: "Thousands of containers at the Rocky Flats Plant hold miscellaneous plutonium-bearing materials classified as 'residuals,' some of which are chemically unstable." "It is well known that plutonium in contact with plastic can cause formation of hydrogen gas and pyrophoric plutonium compounds leading to a high probability of plutonium fires." There is concern that a portion of the residues could be respirable if released. These respirable fines need to be contained, so that in the event of a credible accident (such as a major earthquake), they would not be released.

The Site is embarking on plans to stabilize or repackage materials representing immediate risks over the next couple of years. Major risk reduction has already been achieved through drum venting. The two options proposed herein represent very different approaches to managing the overall solid residue population. The first approach, supporting Alternatives 1, 2, 3a, and 3b, treats or repackages solid residues to meet WIPP WAC and thus prepares the residues for eventual shipment to WIPP when it opens. The second approach, supporting Alternatives 3c, 3d, 3e, and 4, stabilizes and repacks residues for longer storage due to delayed shipment to WIPP. This option also minimizes the probability of long-term problems in the interim during which these materials are stored onsite. In all the alternatives, WIPP is the ultimate disposal site for the solid residues.

#### 4.3.2 Data Presentation

Residues and wastes are categorized by IDCs, which specify a unique physical and/or chemical combination of material making up a subpopulation. Residues are material that was previously stored in order to reclaim plutonium, and they generally differ from TRU wastes only in actinide content. Residues were previously distinguished from TRU waste based upon plutonium content, with the demarcation between TRU waste and residue being an (now obsolete) Economic Discard Limit (EDL). The EDL was a specific actinide content limit, different for each IDC, above which the material was considered residue and below which the material was TRU waste. Roughly speaking, the average residue plutonium content is about 3 percent, ranging from a low of 0.1 percent to a high of 90 percent.

The solid residues consist of about 106 metric tons of bulk material containing the SNM. Primary categories of solid residues are pyrochemical salts, ash, metal, filters, combustibles, graphite, crucibles, glass, resins, gloves, firebrick, and sludge. Some of this material is mixed residue because it contains RCRA-regulated material mixed with radioactive material. It is this material that is subject to RCRA regulation.

Generally, residues have the following characteristics:

- Are not DOT shippable in current form (do not conform to DOT requirements)
- Do not meet WIPP WAC in current form
- Are stored in 55-gallon drums, 10-gallon cans, 2-liter metal containers, and other containers
- Are stored in multiple buildings

Treatment/repack of the material will result in a significant expansion of the number of residue containers, regardless of the option chosen. Table A-1 presents solid residues in major subcategories and, for both options, depicts the type of stabilization to be conducted for each material subcategory, along with the numbers of drums of TRU waste to be staged in the TRU waste interim storage facility. Table A-1 also depicts the number of sealed containers of SNM produced from Alternatives 3c, 3d, 3e, and 4 that will be stored in the new SNM interim facility. Dry combustibles that are not contaminated with nitrates (oxidizer/fuel problem) could be overpacked to meet the DOE interim safe storage criteria and transferred to the TRU waste interim storage facility for potential direct disposition at WIPP, under these alternatives, without further stabilization. In Alternatives 1, 2, 3a, and 3b, the same dry combustibles would be repacked to meet WIPP WAC, also without stabilization.

**Table A-1  
Processing Methods and Waste Quantities**

Description	Bulk kg	Alternative 1, 2, 3a, & 3b		Alternative 3c, 3d, 3e, and 4			
		Processing Method <sup>a</sup>	TRU Drums to WIPP <sup>b</sup> (<200 FGE limit <sup>c</sup> ) (number)	Processing Method	DOE STD-3013s (<200 FGE limit <sup>c</sup> ) (number)	Minimum Storage in TRU Drums (1 kg Pu limit)	SNM produced (DOE STD-3013s) (number)
Incinerator Ash	19,682	calcine	5,878	calcine	5,878	1,965	
Classified Inorganics	6,673	sanitize <sup>d</sup>	91	sanitize <sup>d</sup>	0	91 <sup>d</sup>	
DOR & DCHP MSE Salt	2,903	pyro-oxidize	1,153	pyro-oxidize	1,153	385	
Dry Combustibles	6,579	repack	1,900 <sup>e</sup>	overpack/re-pack	0	225 <sup>f</sup>	
ER Salts	9,327	pyro-oxidize	3,009	pyro-oxidize/distill	N/A	89	167
Fluorides	316	convert to oxide	0 <sup>g</sup>	convert to oxide	0	0	49
Glass	1,925	dry	62	dry	280	56	
Greases/Oily Sludge	7	calcine	7	calcine	7	3	
Ion Exchange Resins	268	cement	12 <sup>h</sup>	cement	0	12 <sup>h</sup>	
MSE & Salt Scrub Salts	3,780	pyro-oxidize	1,860	pyro-oxidize/distill	N/A	35	104
SS&C; Graphite, Firebrick & Inorganics	38,784	calcine/repack	4,004	calcine	4,004	774	
Organic Contaminated Combustibles	2,138	thermal desorption	860	pyrolyze	82	29	
Sludges	661	calcine	158	calcine	158	55	
Nitrate-Contaminated Combustibles	13,291	wash/dry	9,823 <sup>e</sup>	wash/pyrolyze	923	310	
<b>Totals</b>	<b>106,334</b>		<b>28,817</b>		<b>12,609</b>	<b>4,029</b>	<b>320</b>

- a As required
- b Packing to WIPP WAC only, not necessarily meeting interim safe storage standards
- c Actually 167 plus 2 times +/-10% error
- d Becomes TRU waste after being sanitized to physically remove classified features
- e Number of drums to WIPP may be reduced by a factor of ~10 pending gas generation rate studies
- f Overpacking existing drums
- g Forty-nine containers stored in vault
- h If 10 percent loading in cement by weight

### 4.3.3 Capital Improvements

#### *Alternatives 1 Unrestricted; 2 BEMR I; 3a Phased Shipment; and 3b Priority Shipment*

A Salt Residue Stabilization and Repack facility is to be constructed in Module A of B707, with some support facilities in Module F of Building 707. Pyrochemical Oxidation will be used to stabilize salts that require treatment, and some may be repacked without treatment. This will allow the salts to be stored for an indeterminate period and prepare them for shipment when WIPP becomes available.

An Ash Stabilization and Repack facility will stabilize and repack incinerator ash; sand, slag, and crucible; and graphite fines in Module E of Building 707, with support facilities in Module F of Building 707. Calcination will be used to stabilize those materials that require treatment, and respirable fines (primarily ash) may be solidified to ensure that the material will not be dispersible (to satisfy DNFSB Recommendation 94-3), or the materials may be repackaged in containers that are safe in the event of an accident.

A repack line will be constructed in Module D of Building 707, again supported by systems in Module F. This line will provide for the unloading, size reduction and repackaging of primarily dry combustible and inorganic residues. It is planned that this facility will also be used to destroy the shape of certain classified shape residues, which will be repacked subsequent to shape destruction.

A facility to treat moist residues, or those containing aqueous components, will be constructed in room 3701 of Building 371, which has the capability to handle liquid components. This facility will treat sludges through drying and immobilization/repacking; fluorides through decomposition, drying, and immobilizing; HEPA filters and aqueous wet combustibles through shredding, washing, drying, and repackaging; and organic wet combustibles and Ful-Flo filters through thermal desorption and repackaging.

The expected costs for equipment and installation are \$60 million. In Alternative 3b, the processing schedule is slowed considerably because of the decision to accelerate offsite shipment of radioactive wastes.

#### *Alternatives 3c, Excavation; 3d, Leveled Buildings; 3e, Entombment and Landfill; and 4, Mothball*

Three modules of Building 707 will be cleared for installation of solid residue modular processing capability. This capability includes unpackaging, assay, characterization, feed preparation, stabilization (cementation, declassification, pyrolysis, calcination, salt oxidation and distillation, washing, and drying), repackaging, and certification (WIPP or vault). The expected cost for equipment and installation is \$120.6 million.

### 4.3.4 Assumptions

The following general assumptions apply to solid residues:

- The interim storage standards for these materials will not change.
- Adequate funding (expense and capital) will be available as needed.
- All stabilization and repackaging will be complete by May 2002 (except for Alternative 3b).

*Alternatives 1, Unrestricted, 2, BEMR I, 3a, Phased Shipment, and 3b, Priority Shipment Specific Assumptions for solid residues are that:*

- WIPP will open in 1998.
- The Pipe Component, a new container under development by DOE, will be accepted for packaging and allow up to 200 grams plutonium per container
- An increased FGE limit for TRUPACT II will be approved

*Alternatives 3c, Excavation, 3d, Leveled Buildings, 3e, Entombment and Landfill, and 4, Mothball Specific Assumptions for solid residues:*

- Materials will be stabilized for storage and packaged in sealed containers.
- Sealed containers will be DOE STD-3013-94 type, welded containers; <1 gallon volume for WIPP disposition or standard 3 kg material containers for SNM interim storage.
- High-assay plutonium residue stabilization byproducts (attractive residues) will be stored onsite in the SNM interim storage facility.
- Most stabilized solid residues will be staged for disposition at WIPP and will be stored in the TRU waste interim storage facility (five DOE STD-3013-94 containers per drum).
- Processing will be completed in time to meet the 94-1 interim safe-storage schedule of May 2002.
- Actinide separation, besides that accomplished by matrix destruction, will be conducted only for ER and MSE salts (those readily amenable to distillation).

#### 4.3.5 Constraints/Standards

The ship-immediately-to-WIPP option (Alternatives 1, 2, 3a, and 3b) will meet the material standards of the DOE Interim Safe Storage Criteria, and in those instances in which the Pipe Component is used in the WIPP packaging, it will also meet the packaging requirements.

In Alternatives 3c, 3d, 3e, and 4, solid residues will be stabilized to meet long-term storage requirements including packaging in DOE STD-3013-94 type welded containers. Materials destined for WIPP will meet the WIPP WAC and will be certified for disposal. WIPP-required sampling will be conducted before containers are sealed. Attractive residues will be certified for storage in the SNM interim storage facility (less than 3 kg Pu per sealed DOE STD-3013-94 container).

#### 4.3.6 Land Use Implications

*Alternatives 1 Unrestricted; 2, BEMR I, 3a, Phased Shipment, and 3b, Priority Shipment*

Existing facilities will be used, and all residues will be treated as required by characterization and shipped offsite, given current plans. However, should an offsite facility not become available, then the new SNM interim storage facility (or an upgraded Building 371) and an interim storage facility for TRU waste would be required for storage of these materials.

*Alternatives 3c, Excavation, 3d, Leveled Buildings, 3e, Entombment and Landfill, and 4, Mothball*

This option allows for optimum interim storage of both TRU waste and attractive residues and considerably reduces the size of the TRU waste interim storage facility and the SNM interim storage facility. This in turn reduces the size of the Protected Area during the interim storage period and, therefore, reduces impact on land use.

**4.3.7 Barriers/Uncertainties**

The main uncertainties for Alternatives 1, Unrestricted, 2, BEMR I, 3a, Phased Shipment, and 3b, Priority Shipment are the opening date of WIPP and the ease of disposition of residues at WIPP. Because all residues will not be offsite by May 2002, relief from interim storage standards will be required for materials not packaged in the Pipe Component. Otherwise, overpacking of dry combustible drums will be required.

Alternatives 3c, 3d, 3e, and 4 minimize uncertainties by stabilizing solid residues to more rigorous storage standards which provide predictable storage configurations for all of the materials. However, along with more robust stabilization of the materials comes a higher up-front cost.

Pyrolysis of combustibles is being used at Los Alamos for similar materials but is a thermal process that will be closely scrutinized by the public. It is not incineration, but the process may require major public involvement, similar to that experienced with the initial campaign to calcine plutonium oxide.

**4.3.8 Analysis and Results**

*Alternatives 1, Unrestricted, 2, BEMR I, 3a, Phased Shipment, and 3b, Priority Shipment*

*Project Risk*

The primary risk for this option is a schedule risk, because a very large portion of the activities are on the critical path. Schedule slippage could occur for many reasons. Slippage of the activity schedule will result in a slippage of the operation time for the facilities, extending treatment beyond the projected end state. Other risks are in funds availability. There are no technological or public acceptance risks anticipated.

The possibility that the portion of the activity to be conducted in Building 371 may have to move to Building 707 is being analyzed. It is possible that a modular unit can be constructed for operation in Building 371.

The total estimated costs for the residue stabilization and packaging activities for these alternatives are \$129.2 million.

*Alternatives 3c, Excavation, 3d, Leveled Buildings, 3e, Entombment and Landfill, and 4, Mothball*

*Project Risk*

Most of the technologies proposed in these alternatives are proven to work on materials similar to those scheduled to be stabilized, and the modular approach to implementation has been well documented over the past year. Therefore, schedule risk is minimal. Process optimization and development activities are scheduled for FY96 and FY97 in these alternatives and should decrease remaining uncertainties to within the planned contingency.

The alternatives, by design, reduce most of the other risks to a minimum. Materials are stabilized and packaged for storage, should there be delays in shipment to WIPP or in getting the SNM offsite.

The total estimated costs for the residue stabilization and packaging activities for these alternatives are \$192.9 million.

#### Schedule

The current schedules for both efforts are presented in Appendix I.

#### 4.3.9 Summary

##### *Alternatives 1, Unrestricted, 2, BEMR I, 3a, Phased Shipment, and 3b, Priority Shipment*

The repackaging or treatment of solid residues to meet WIPP WAC can be accomplished through modification of existing gloveboxes in Building 371 and Building 707 and installation of minimal treatment capability. Repackaging of all 106,000 kg also will be accomplished. The material criteria of the draft interim storage standard will be met by May 2002 (except for Alternative 3b, Priority Shipment). Those materials then packaged in the Pipe Component for disposition at WIPP will also achieve compliance with the packaging criteria of the interim safe storage standard. Other solid residues that are shippable to WIPP without the Pipe Component would have to be overpacked to meet the double containment barrier requirement of the standard or a variance from the requirement would have to be obtained.

In summary, while all of the solid residues will require repackaging to meet WIPP WAC, characterization may support the premise that many of the residues already meet the material requirements for WIPP disposition and for interim storage. Operating costs could therefore be lowered, if all of the material does not require treatment for disposition at WIPP. Storage of drums packaged and ready for disposition at WIPP presents a challenge and is being coordinated with the TRU waste storage planning program.

##### *Alternatives 3c, Excavation, 3d, Leveled Buildings, 3e, Entombment and Landfill and 4, Mothball*

The treatment of the residues to give a demonstrated safe, predictable storage form exceeds the interim storage standards developed by DOE to address the concerns of DNFSB Recommendation 94-1. Although some of the initial milestones of the current site baseline, described in the Site Integrated Stabilization Management Plan (SISMP), might be delayed, all final milestones for completion of the residue stabilization activities should be met. The more conservative storage criteria are driven by the need to meet the established low cost mortgage requirements and the need to maintain minimal processing capability to repackage and certify the material for offsite shipment when a repository becomes available.

In summary, stabilization of the residues minimizes the cost of surveillance and eliminates the need for future stabilization processing capabilities during the ASAP. Staging and consolidating the residues in a single facility expedite D&D and minimize the costly authorization-basis issues. Storage of high-plutonium-content residues (attractive residues) in a future SNM interim storage facility will facilitate meeting safeguards and security requirements. Storage of low-plutonium-content residues in a future waste storage facility minimizes the footprint of the high-cost SNM interim storage facility and addresses the need to store TRU wastes during the interim. Finally, placing the residues in a form that is readily convertible to a shippable form will facilitate their eventual removal from the Site.

## 4.4 Highly Enriched Uranyl Nitrate Solutions

### 4.4.1 Description

The HEUN removal project alternative removes the HEUN from Building 886, ships the HEUN offsite for processing for storage, and stores it offsite as an oxide. Completion of the HEUN Removal Project will result in eliminating the risks of HEUN spills and leaks in Building 886, prepare the building for decommissioning, and reduce building baseline costs. Surveillance, and safeguards and security requirements will decrease after the solution is removed. This is an ongoing project scheduled for completion in FY97.

### 4.4.2 Data Presentation

The scope of the HEUN Removal Project is to drain and remove the HEUN contained in eight tanks and associated piping in Building 886. This HEUN consists of two concentrations (1700 L of 121 g/L solution in five tanks and 1000 L of 368 g/L solution in three tanks) of 93.2 percent U<sup>235</sup>. The scope includes rinsing the tanks and piping, as necessary, so that Nuclear Safeguards and Security requirements are not an issue.

The logic flow for this option is as follows:

- Implement the Basis of Interim Operations in Building 886.
- Bottle the HEUN in approved shipping containers.
- Transfer to a shipping dock (Building 991) and load Safe, Secure Transport (SST) vehicles.
- Transport to Nuclear Fuel Services (NFS) facility in Erwin, Tennessee for processing prior to shipment to Oak Ridge.

This option meets the planned dates for removing the liquid, minimizes the waste generated, limits the dependency on resources and interfaces at Rocky Flats, and is weather-independent because SST vehicles are used for shipments.

### 4.4.3 Capital Improvements

None

### 4.4.4 Specific Assumptions

- Oak Ridge National Laboratory is the U.S. repository for Highly Enriched Uranium (HEU) oxide.
- The HEU oxide is acceptable for storage at Oak Ridge.
- Storage at Oak Ridge is in agreement with DOE strategy for HEU material.
- Building 991 is available through FY96 for offsite shipments.

### 4.4.5 Barriers/Uncertainties

The following major issues must be managed to ensure the successful completion of the removal of HEUN by the end of September 1996:

- The availability of 10-liter shipping containers which have been identified at Hanford. Refurbishment has begun and approximately 40 should be available for use.

- The availability of SST vehicles must be finalized. DOE Albuquerque has committed verbally to a convoy of three SST vehicles every two weeks from Rocky Flats.
- The final storage or sale of the HEU oxide must be determined. The HEUN is processed at NFS to an oxide. However, the final storage or sale of this oxide is not resolved. An interim resolution of this issue is to store the oxide at NFS for a fee. Oak Ridge has made a verbal commitment to store this material.

#### 4.4.6 Analysis and Results

The estimated costs for HEUN removal and processing are \$27.5 million. The HEUN removal is to begin by June 1996 and be completed by October 1996. The decommissioning of Building 886 is scheduled to begin in FY97, a date that is supported by this subtask.

### 4.5 New SNM Interim Storage Facility

#### 4.5.1 Description

In all alternatives the requirement exists to place SNM into storage for an interim period until the national policy on final destination is determined and the material can be shipped offsite.

DNFSB Recommendation 94-3 addressed the need to assess the suitability of Building 371 for consolidation of SNM at Rocky Flats. New facility alternatives were included in the assessment primarily as fallback in the event that making Building 371 acceptably safe was not practical. In the evaluation, practical means for ensuring safe interim storage in Building 371 were identified. A new passive vault, nevertheless, emerged from the evaluation as superior, principally from operation, reliability, and cost perspectives. The need to differentiate between a near-term SNM consolidation mission already assigned to Building 371 and an interim storage mission for most of the Site's SNM also became clear. The interim storage mission is to begin after planned DNFSB 94-1 material stabilization and repackaging (completion committed by 2002) and to continue until offsite shipment. The current DOE goal for completion of offsite shipment is 2015.

#### 4.5.2 Data Presentation

There are approximately 6,600 kg of plutonium in metal form, 3,200 kg in compounds, and 6,700 kg of enriched uranium. These are distributed over more than 10,000 discrete items. The amount of residues to be stored in an interim storage facility is yet to be determined. All plutonium metals and oxides greater than 50 percent must be packaged to meet DOE-STD-3013-94 criteria which will allow it to remain in a stable form for an extended period of time. This standard will require that all metal is brushed and packaged in a welded container and sealed in another welded container that will contain an inert atmosphere. All oxides will require thermal stabilization to at least 1000 degrees C prior to packaging to meet Loss on Ignition less than 0.5 percent. All residues that may be stored in this facility must also be processed in various ways to reach a stable condition. The enriched uranium is intended to be shipped to an offsite location for storage and will not be included in the new facility.

#### 4.5.3 Capital Improvements

In all alternatives except 2, BEMR I and 3b, Priority Shipment, the selected approach is to construct a new interim storage facility and transfer all stabilized SNM material into this building. The conceptual design of such a new facility is not completed. The following describes a potential design for a new vault facility. A conceptual drawing of such facility is presented in Figure A-1. This new facility would be constructed to meet all engineered safety,

security and safeguards requirements. This facility would be constructed outside of the current Protected Area to facilitate construction. Maximum utilization of existing designs developed for other DOE sites will enhance and expedite the construction process.

This facility would consist of a hardened area and a nonhardened support area. The hardened area will contain the passive storage vault. The vault would have sufficient area for 1,000 storage tubes. The vault storage design would be similar to the Los Alamos National Laboratories passive storage design with an array of vertical steel tubes which are accessible from the top. DOE-STD-3013-94 storage containers will be stored ten-high in the vertical tubes. The hardened area would be a below-ground structure because of safeguards and security considerations. Ventilation will consist of convection cooling only. The vault area and associated equipment would be designed for all material to be placed and retrieved from the vertical tubes remotely.

An aboveground 10,000-square-foot pre-engineered structure would house a covered loading dock, guard station, building support or control room, break room, two change rooms, maintenance area, utility room, International Atomic Energy Agency (IAEA) room (20x20x10 ft), abnormal package handling room (20x20x20 ft), and a loading area. An IAEA room would be a separate room for the exclusive use of the IAEA in processing records, studying documents, calibrating and repairing instruments, and loading and unloading cameras. The loading area would be the area for unpacking all shipping packages which enter the facility, checking them for external contamination, and for accountability measurement before packages are shipped to the vault area. The loading area would also be used for packaging of the material from the vault for outgoing shipment. Any abnormal, damaged and/or contaminated shipping packages would be sent to the abnormal package handling room. In this room, the package would be handled on a case-by-case situation. This room would contain appropriate HVAC support and will also be used if any container from the vault area needs to be evaluated or repackaged and readied for shipment to another facility either at Rocky Flats or in the DOE complex. This room would not be designed as a processing room.

For Alternatives 2, BEMR I and 3b, Priority Shipment, the approach is to upgrade Building 371 and use it as the interim storage facility. Upgrades to Building 371 would include structural and safeguards and security improvements.

#### 4.5.4 Option Specific Assumptions

- Pu metal, oxide, pits and high plutonium content residues will be stored in this facility. All other residues are repackaged for onsite storage and eventual shipment.
- IAEA will be involved early in the repackaging phase and the design of the facility, and will approve extended inventory frequencies or a continuous inventory and inventory methodologies.
- All SNM will be packaged in accordance with DOE STD-3013-94 criteria.
- The interim storage facility will be passive and contain no processing capabilities.

#### 4.5.5 Constraints and Standards

The primary constraints will be stakeholders and regulators acceptance of a new interim storage facility and capital funding availability to support its construction.

DOE STD-3013 applies to all packaging of the material.

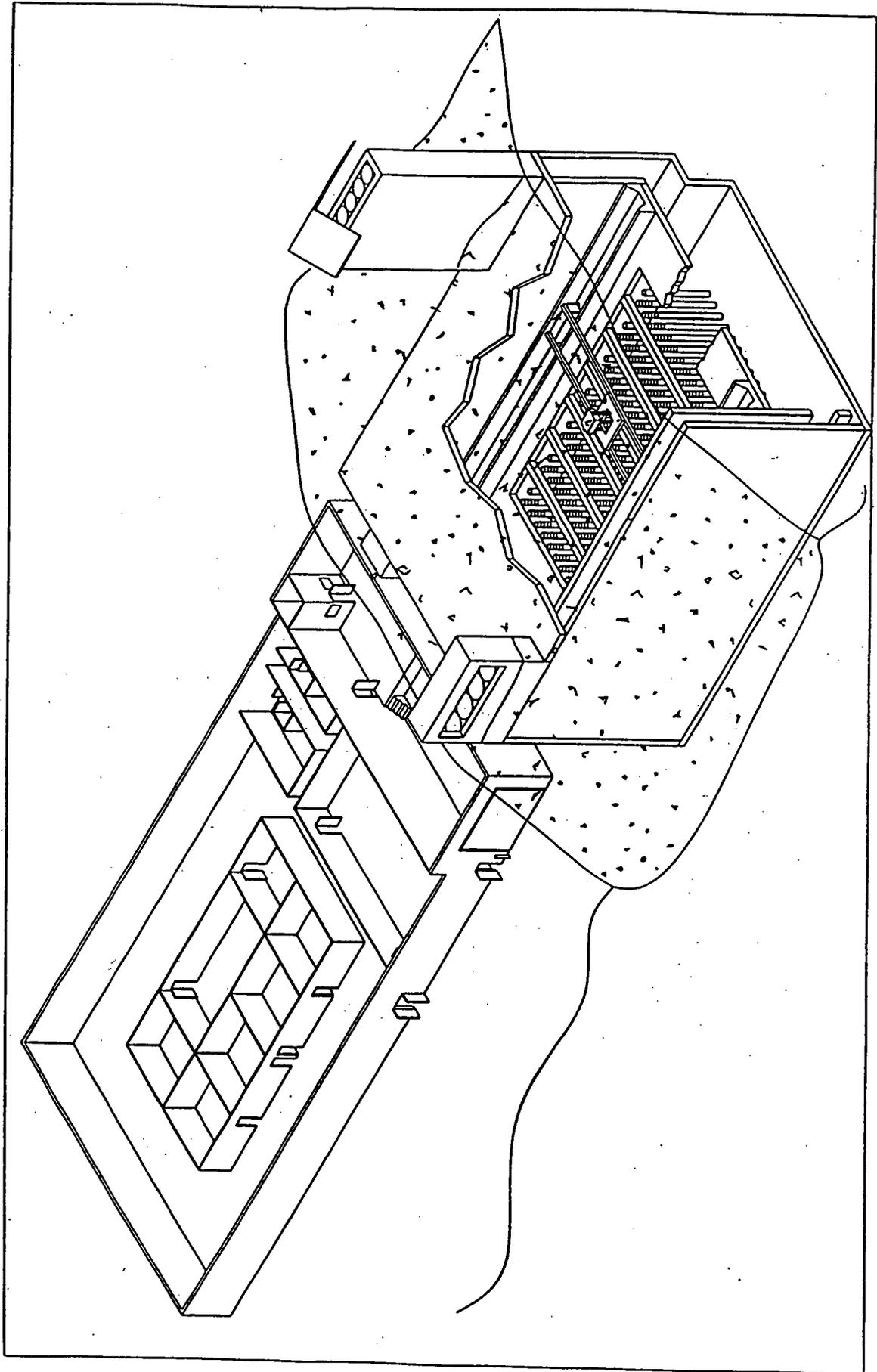


Figure A-1 Proposed Plutonium Storage Vault (Concept Only)

#### 4.5.6 Land Use Implications

For economical and construction schedule reasons, this new facility would be constructed in an area outside of the current Protected Area.

#### 4.5.7 Barriers/Uncertainties

See 4.5.5 above.

#### 4.5.8 Analysis and Results

The costs for constructing a new interim storage facility are estimated to be approximately \$93 million. These costs are currently being refined. The schedule as it fits with the other tasks of ASAP is realistic and feasible.

### 5.0 **SUMMARY**

The approach to SNM and SNM-containing materials for purposes of this study is generally constant with three major variations. Alternatives 1, 2, 3a, and 3b differ from the others in that solid residues are stabilized for early transportation to the Waste Isolation Pilot Plant (WIPP) in New Mexico. Under all other alternatives, solid residues are more thoroughly stabilized to allow for longer onsite storage times before they are disposed at WIPP. In addition, under Alternative 3b, Priority Shipment, the schedules for SNM metals and oxides, and residues treatment are extended, and construction of a new SNM interim storage facility is canceled.

In general, this document uses the current plans for SNM and SNM-containing materials prepared primarily under the SISMP and the response to the DNFSB Recommendation 94-3 concerning storage of SNM in Building 371.

The approach to SNM metal, oxides and pits is to stabilize the material according to DOE guidance for long-term storage and place it in a storage facility until it is disposed offsite. DOE's target date of 2015 is used for planning purposes. The approach to HEUN is to complete the current program underway which will have all of this material offsite for disposal by FY97. SNM liquids will also follow the current plan to stabilize the material under the SISMP schedule. Solid residues will be treated and the resulting TRU waste will be stored for ultimate shipment to WIPP. In Alternatives 2, BEMR I and 3b, Priority Shipment, Building 371 will be used for SNM storage. A new SNM interim storage facility will be constructed under all other alternatives. The facility will incorporate a passive design, which does not rely on the ventilation system as part of the containment strategy.