USDOE
Rocky Flats Project Office

Closure Legacy

from weapons to wildlife

ROCKY FLATS CLOSURE LEGACY

PREFACE

Thank you for taking the time to read some or all of this Rocky Flats Closure Legacy report. The Rocky Flats Closure Project spanned over a decade and was unique in many ways. Recognizing that uniqueness this report takes a unique approach to sharing the lessons learned from the project, by considering not only the technical and scientific lessons, but also the policy and programmatic issues. Communicating "lessons learned" and reaching the target audience has always been difficult. This report was developed recognizing the challenge of communicating lessons learned as discussed in DOE-STD-7501-99, The DOE Corporate Lessons Learned Program. The overall Legacy Project seeks to address that challenge in several ways:

- First, the Rocky Flats Closure Legacy report is introduced by the "Rocky Flats – A Proud Legacy, A New Beginning" brochure, an 18-page, full color summary of the project history. This summary of the Rocky Flats Closure Legacy introduces themes that are explained in more detail by this report, and the visually engaging format is intended to increase interest toward pursuing the more detailed lessons learned. (see http://www.rfets.gov for info)

- Second, this report does not try to represent all viewpoints, or consensus positions reinforcing current DOE policy. Rather it tries to fairly and accurately represent the conditions and influences that existed during the 10-year span of the project from the viewpoint of the DOE/Rocky Flats Managers and staff, and how the DOE and others reacted to them at the time.

- Third, it is brutally frank. The Rocky Flats Closure Project ended well, ahead of schedule, under budget, and with no major injuries to workers. However, hundreds of events occurred along the way, some we learned from at the time and others only became clear in hindsight. It is only through a frank and open look at the project history and lessons, both good and bad, that we can hope to learn and improve for the future.

As the responsible DOE- Rocky Flats Manager at final site closure, I have assembled this report from over three years of diverse excerpts on lessons of various types. However, the report has been prepared to chronicle the full history of the project, and as such capture events and lessons involving previous Rocky Flats Managers and the myriad of other participants. Many people know some of the history and lessons at Rocky Flats. From this comprehensive report both DOE employees and non-DOE may learn from the complete story. I believe there are lessons for us all in the story of the Rocky Flats Closure.

Frazer R. Lockhart
Manager, Department of Energy
Rocky Flats Project Office

EXECUTIVE SUMMARY

The purpose of this Rocky Flats Closure Legacy report is to capture the successes and failures of the Rocky Flats closure experience. The Legacy report fulfills the guidance for capturing lessons learned found in the following DOE documents:
- DOE Order 413.3,
- DOE M 231.1A Chg1,
- Office of Legacy Management Terms and Conditions for transition
- DOE-STD-7501-99, and
- EM Quality Assurance Plan

Although a substantial amount of information is provided, this document is not a template for success, since there is not a single recipe for this. There is no formula that can be applied to every site, since each site is different geographically, in terms of cleanup scope and future mission, and with different cultural and political issues. However, this document presents the experience at Rocky Flats to provoke thought about the vision, mission, project progress, and cooperation of the parties at other Environmental Management sites. And before the Rocky Flats experience is dismissed as an anomaly, it is hoped that some of the lessons from Rocky Flats will be carried forward and adapted to the closure experience at other sites.

Conversations between people that have contributed to the Rocky Flats Closure Project invariably lead to speculation as to why the project was successful. What is said and heard will depend upon the role played by the individuals…the regulators were cooperative…the contractor was incentivized and motivated...the DOE delivered most of its government furnished services and equipment on time…the budget appropriations were consistent and reliable at $650 million per year...closure was managed as a finite project and using project management principles…stakeholders were involved in project planning…workers were involved in work planning. While each person brings a unique perspective, most will agree that no single factor was responsible for achieving accelerated closure, but that in some measure all of these factors and more were necessary for success. Some observers have stated that Rocky Flats was lucky. While there was certainly a measure of good fortune, Rocky Flats was poised and willing to take advantage of it whenever it did materialize.

Beyond any specific innovation, it was through unparalleled cooperation among the interested parties that a conservative and compliant cleanup and closure of Rocky Flats was enabled; ahead of schedule, under cost, and without a fatality or serious injury. For some individuals, engagement in the process of closing and transitioning Rocky Flats was derived from a dedication to the vision and mission. For others it was a more calculated commitment to what was achievable. But regardless of motivation, and with the exception of a few citizen activist groups, each party recognized that it was at the confluence of interests, rather than the satisfaction of any one particular interest, that the vision of accelerated closure would be realized.

It was also realized that while the plant was undergoing risk reduction, the participants in the cleanup would need to take some political and programmatic risks if this project was to be successful. When Congress committed to the closure fund and to a 2006 closure for Rocky Flats they did not have available to them a final integrated project baseline. When the Kaiser-Hill Company L.L.C. (K-H) signed the cleanup contract, Site characterization was not complete and DOE had not lined up the necessary assistance from Carlsbad, Savannah River, Oak Ridge, Richland, LANL, LLNL, and others important to the success of Rocky Flats materials disposition. The regulators had not yet agreed to align project milestones with the lifecycle baseline. The community had not yet agreed to cleanup levels. Long standing issues of distrust needed to be overcome, yet, each of these organizations understood the opportunity to remove the risk from metropolitan Denver, to turn a liability into an asset and to focus on a common vision, even when disagreeing on some of the details. And so, while debates about issues such as cleanup levels, dirty demolition, landfill capping, and 903 Pad remediation were acrimonious at times, they did not cause the cleanup mission to unravel. And when external barriers to closure were encountered, these same groups were largely united in their efforts to remove the barriers.

There are many lessons-learned from the Rocky Flats Closure Project included in this report. Although it is recognized that these lessons are not always directly applicable to every DOE clean-up effort, it is hoped that in some way they can be beneficial to every DOE site, and in fact, any controversial cleanup effort. We consider the following lessons, summarized here and addressed in more detail later in the report, as universally applicable:

- **SAFETY IS JOB 1**: This lesson was reinforced throughout the closure project. If work cannot be safely performed, then the project grinds to a halt. Early on in the project it was recognized that a significant investment in hazard identification, safety planning, and safety implementation during the actual work (i.e., the DOE's Integrated Safety Management System) ensured that work was performed safely without unacceptable risks or unnecessary delays to correct safety deficiencies. Later in the project we came to understand that safety focus did not merely enable work, but facilitated efficiency and acceleration by building trust and engaging the workforce.

- **CONTRACT REFORM WORKS:** The Rocky Flats "experiment" proved that the DOE's contract reforms worked. The first K-H "Integrating Management" contract demonstrated that incentivizing clearly defined performance measures vastly improved actual results. In fact, the performance measures sometimes worked too well, incentivizing results at odds with the ultimate goals of the contract. The Closure Contract took the concept to the next level, providing large incentives to the company and the workers to safely and compliantly complete the clean-up and closure scope within a target scope and cost. Additional incentives for schedule and cost savings resulted in closure more than one year ahead of schedule and $530 million under the contract budget.

- **"WHAT, NOT HOW"**: The DOE must manage to a contract, not manage the work for the contractor. The contractor must learn to respond to contractual direction and not DOE informal requests. This was a difficult transition at Rocky

Flats due to years of conditioning from the "Management & Operations" contract approach typical at large DOE sites. Ultimately, the DOE Rocky Flats learned (although not perfectly) to define the work scope and standards that must be met and observe, evaluate, and report to the manager and contracting officer regarding the contractor's performance on the terms of the contract. This did not undermine, but enhanced DOE's safety and compliance oversight because the contract clearly required the contractor to work safely and compliantly in accordance with clearly defined requirements in the contract. Ultimately DOE's safety and compliance oversight became more objective and technical issues became less subjective as the DOE was forced to clearly cite a contractual non-compliance that required correction per the contract.

- **COLLABORATIVE WORKING RELATIONSHIPS**: As described in detail throughout this report, the Rocky Flats Closure was successful because the stakeholders (in the broadest sense of the word) were engaged in the process and supportive of the ultimate goal. The interests of numerous key figures, including Members of Congress, senior DOE management, state and local elected officials, and state and federal regulators, were actively solicited and ultimately met – the regulatory cleanup agreement, closure contract, desired end state and project parameters were brought to convergence. We communicated openly and often to seek the best solutions, and came to value the input from formerly dogmatic opponents. Although there were differences in the details, the entire Rocky Flats community shared a common goal: Make It Safe - Clean It Up - Close It Down.

- **DON'T WAIT FOR ALL GREEN LIGHTS, BE READY:** As the analogy states, "If we waited for every light to be green we would never get anywhere." The Site moved steadily, ploddingly, painfully, but inexorably toward one goal: 2006 Closure. Early in the project this goal seemed unachievable, in 2003 we started to believe we could beat 2006, and by 2004 the momentum was established to finish in 2005. Nonetheless, if we had focused on what we couldn't do in 1995, when K-H took over the Site, or 1999, when the DOE was trying to open WIPP, or 2002, when we were fighting in court to ship plutonium to SRS, or throughout the project as we debated "how clean is clean enough?" then we would still be sitting here talking about when will Rocky Flats be done. The fact is, we're done! We didn't have all the answers at the beginning but we made course corrections along the way. Good fortune favors those ready to take advantage of the opportunity and momentum builds with progress. Define your goal and get moving!

We hope you can use this report and its lessons as a springboard for action at your respective sites. It is the sincere hope of everyone involved with the Rocky Flats Closure Project that the legacy of Rocky Flats will not be "Look what we did here" but rather, "Look what started here."

ROCKY FLATS CLOSURE LEGACY

INTRODUCTION

The Rocky Flats Closure Legacy report is organized into the following topical areas. The first five sections focus on the strategic issues necessary to establish and sustain the closure project:

1 Accelerated Closure Concept
2 Congressional Support
3 Regulatory Framework
4 Contract Approach
5 Projectization

The remaining ten sections focus on issues associated with implementation of the project:

6 Safety Integration
7 Special Nuclear Material Removal
8 Decommissioning
9 Waste Disposition
10 Environmental Restoration
11 Security Reconfiguration
12 Technology Deployment
13 Future Land Use, End State, and Stewardship
14 Federal Workforce
15 Stakeholder Involvement

The sections are designed to be independent, but also mutually reinforcing. Each section may be read as a stand-alone report, and enough background is provided to give the context and relevance of the section's topic area within the overall Rocky Flats Closure Project. In contrast, a user that reads the entire report from cover to cover will see certain themes and fundamental aspects of the project repeated, being reinforced and interwoven through multiple sections. The intent of this design was to make the lessons readily accessible to readers with a wide variety of backgrounds and interests. The effect can be compared to viewing the same events through different colored lenses, such that the focus of each section is highlighted against the backdrop of the total project. The most fundamental themes and lessons, present to some degree in almost every section, are reflected in the Executive Summary as the "bottom line".

The section format is designed to facilitate both general scanning for topics of interest and detailed discussion of the section topic. Margin quotes are provided to focus attention on key elements of the discussion. A "case study" format, with underlined titles at the beginning of a topic covered in the next few paragraphs also facilitates identification of topics of interest. The "Introduction" subsection is followed by a "Discussion" subsection that contains the details of the project approach and is sometimes further subdivided. The section concludes with a "Key Success Factors" subsection that summarize what Rocky Flats learned in the topic area. Citations are provided both by section and summarized in Appendix 1.

ROCKY FLATS CLOSURE LEGACY

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Rocky Flats Closure Legacy

Accelerated Closure Concept

Sunrise over Rocky Flats and the nearby Rocky Flats communities. The growth of suburban Denver resulted in large populations close to the Rocky Flats Site and was one factor supporting the accelerated closure of Rocky Flats.

Figure 1-1: Rocky Flats Environmental technology Site 1995 versus 2005.

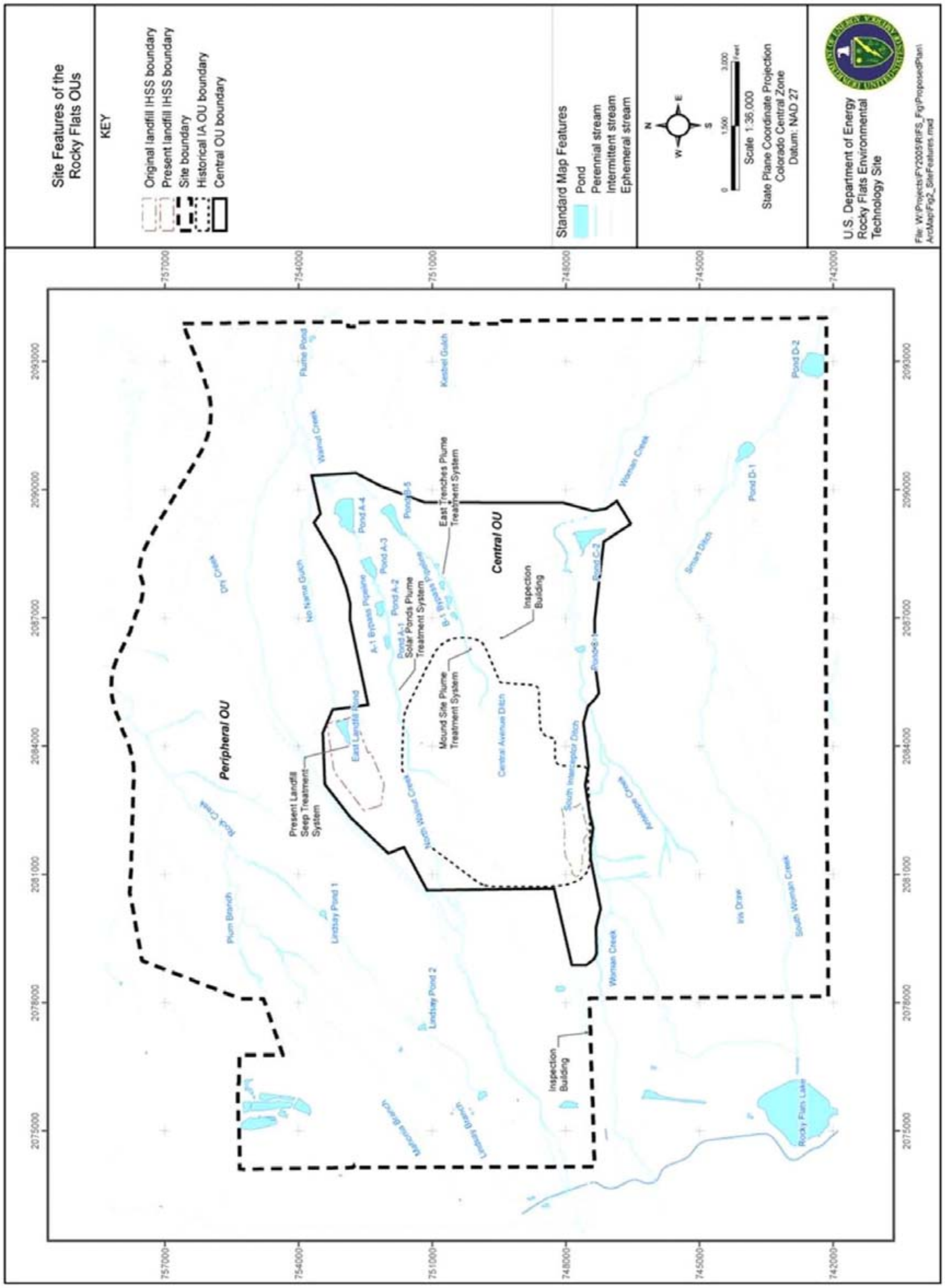


Figure 1-2: Map of proposed boundaries for the DOE Retained lands and the future Rocky Flats Wildlife Refuge lands.

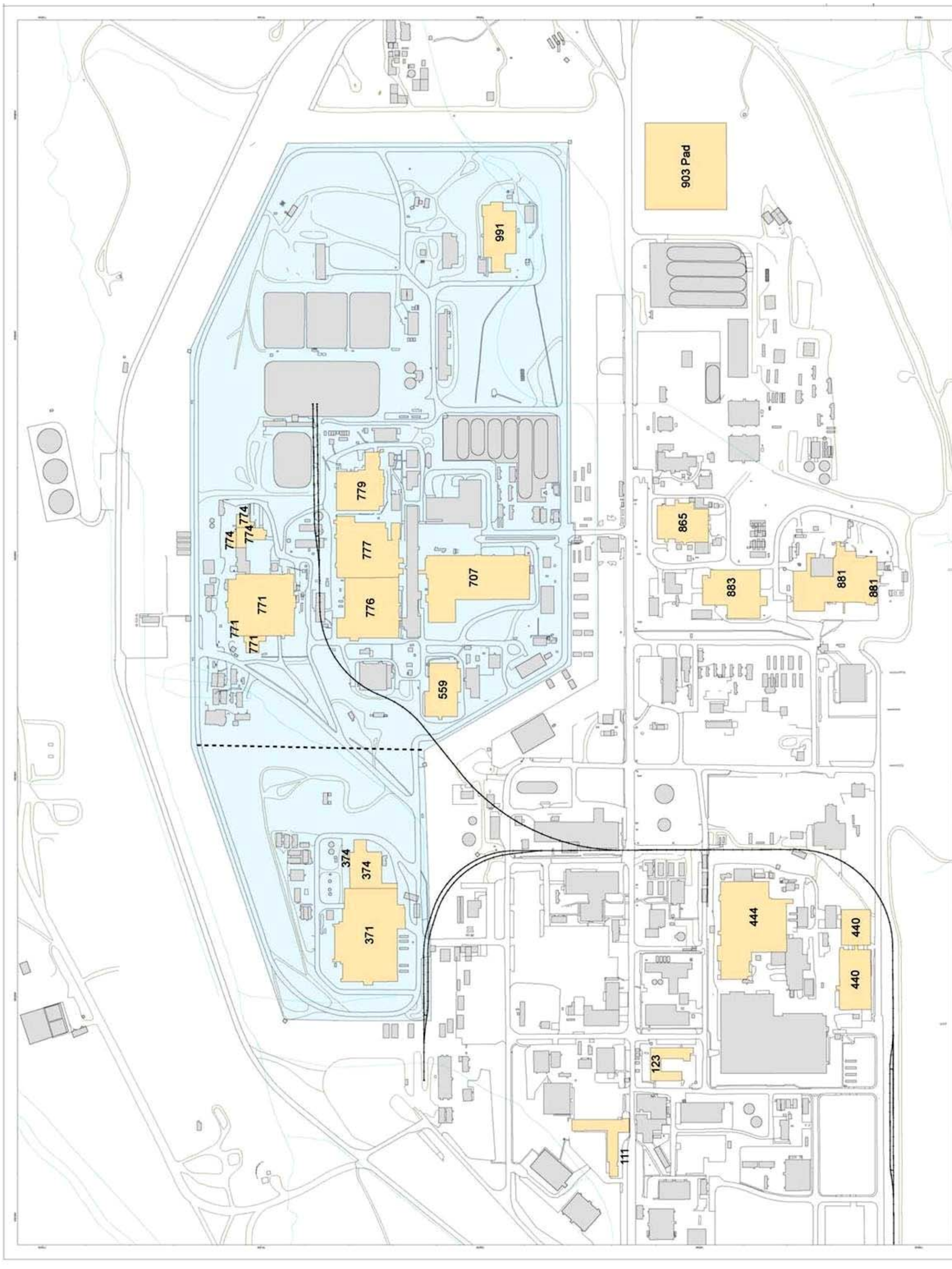


Figure 1-3: RFETS Location Map: major facilities within the former industrial area (DOE Retained Lands).

ROCKY FLATS CLOSURE LEGACY

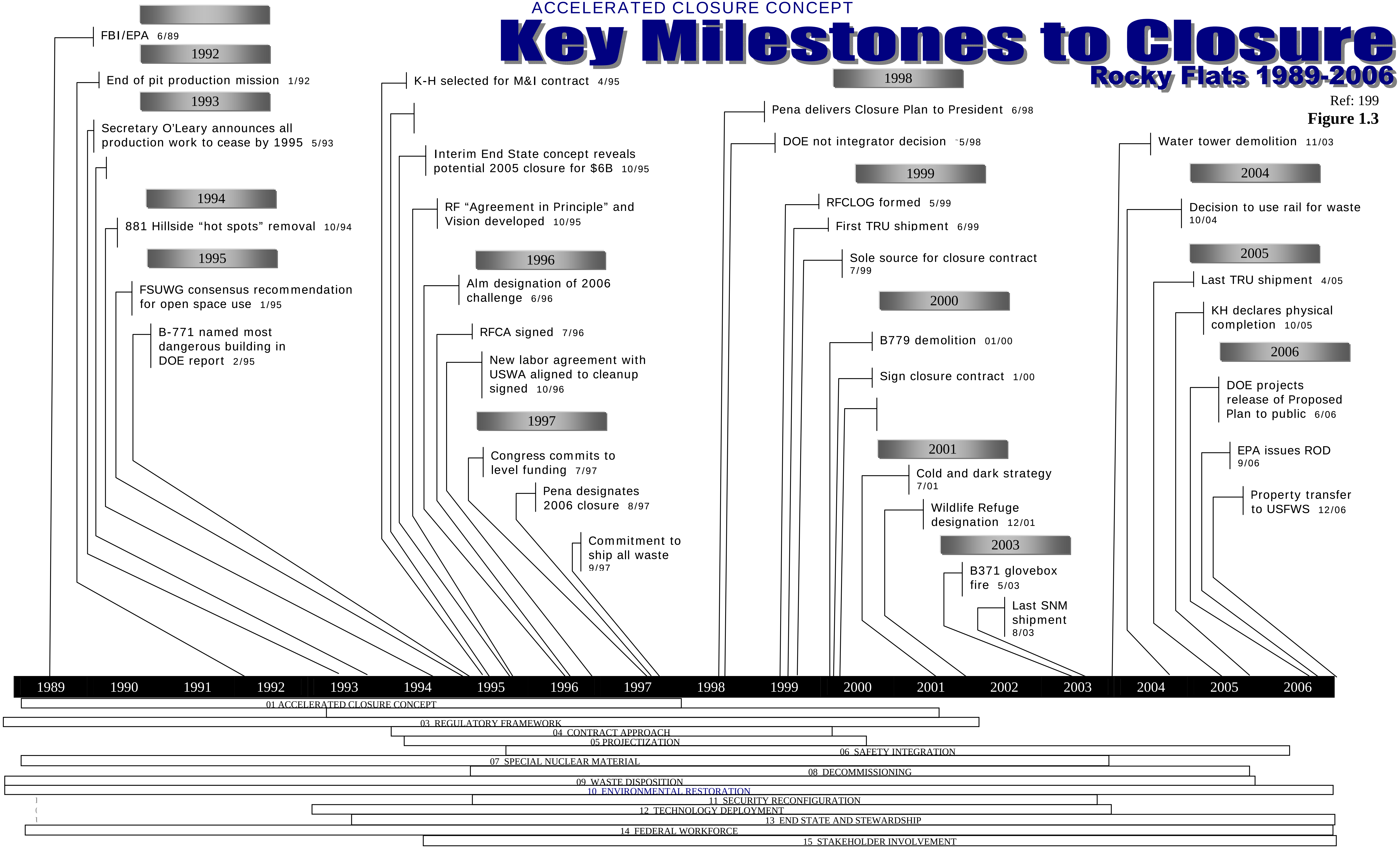
ACCELERATED CLOSURE CONCEPT

Key Milestones to Closure

Rocky Flats 1989-2006

Ref: 199

Figure 1.3



ACCELERATED CLOSURE CONCEPT

INTRODUCTION

From 1952 to 1993, the Rocky Flats Site produced components for the nation's nuclear weapons arsenal. When production of nuclear weapons components ended at Rocky Flats, its mission changed to one of cleanup and closure. As a result of operational problems during the Site's history and its abrupt shutdown in 1989 for environmental and safety concerns, substantial plutonium and beryllium contamination of facilities existed, plutonium liquids were left in process piping and in tanks in unknown quantities and chemical configurations, and classified materials were left where they were being used or processed. The Department of Energy (DOE) was faced with one of the most significant and challenging environmental cleanups in the history of the United States. Closure seemed a distant dream in early 1995, when the DOE estimated the cleanup of Rocky Flats would take approximately 65 years and cost over $37 billion.

For cleanup and closure of the Site to become a reality, a new vision was needed. This section, the first of the overall Legacy report, discusses the preconditions and building blocks of the Accelerated Closure Concept. The concept refers to a process that spans development of the accelerated closure vision through the establishment of the closure project. The accelerated closure vision and resulting project, while ultimately successful, did not evolve smoothly, easily or directly. Establishing and implementing the accelerated closure concept was only possible through innovative and groundbreaking strategies for political support (among the DOE Site leadership, contractor leadership, the DOE political leadership and key congressional committees), regulatory applications and relationships, project management and control, and contract development and management. These accelerated closure project "pillars" are individually discussed in the next four sections of this document: *Congressional and Executive Administration Support; Regulatory Framework; Contract Approach;* and *Creating and Implementing a Closure Project*.

In hindsight, the four pillars of the cleanup project were Congressional support, a regulatory framework that provided a bias for action, projectization by the contractor and DOE and the CPIF Contracting Approach.

Breaking down the closure project into these four areas does not mean that these areas or activities occurred independently of each other. Nor was the progress in each area straightforward, progressive or inevitable. Each of these areas was mutually interdependent. Their development was iterative over time, and in many cases the process was inefficient and difficult. Although the purpose of this document is lessons learned, the lessons related to the political, regulatory, project, and contracting pillars are interwoven and complex. To get at those lessons, the narrative provides some context so that the reader can understand the constraints and influences that may have affected the key decision makers at the time.

Also, some information was neither known or knowable when the decisions were being made and can only be evaluated with the passage of time. Application of these lessons to another site is not straightforward, but will require intellectual consideration of the events, circumstances, outcomes, and most difficult of all, synthesis and extrapolation into current circumstance.

All sites faced with closure encounter their own unique set of circumstances with their associated advantages and disadvantages.

Part of the success story of the Rocky Flats closure is due to the confluence of interests that worked together to make accelerated closure at Rocky Flats a reality. The circumstances at Rocky Flats prior to closure are in some ways unique compared to other DOE sites. No other site in the nuclear weapons complex had attempted a cleanup effort of this size and complexity under an accelerated schedule. Several principal parties, including DOE, its closure contractor, regulators, congress and stakeholder groups were engaged and committed to seeking solutions to safely cleanup and close Rocky Flats. Because of the groundbreaking nature of attempting a first of-its-kind accelerated cleanup and closure project, Rocky Flats had to pioneer processes, many of which have now become standard DOE approaches. However, all sites faced with closure encounter their own unique set of circumstances with their associated advantages and disadvantages, and it is the responsibility of site management to effectively manage the closure.

The importance of leadership, both within and outside the DOE, is evident in each of the pillar areas. The Rocky Flats senior management began to realize through a strategic planning process in 1992[1] that any progress would require alignment of interests of the Site, headquarters, regulators, contractors, Congress, and multiple stakeholders. After that realization, Rocky Flats institutionalized processes to not just inform, but to actively engage the leadership of these widely varied interests. Thus the changes in leadership that occurred through time, internal and external to DOE, marked some of the key events that influenced the accelerated closure effort. The Rocky Flats Site Managers played the most influential roles and their tenure and primary focus is described below. Following that is a table (Figure 1-5) of the key leadership changes over time within DOE and the other key interest organizations. At the beginning of this section several figures are included to provide a backdrop for the narrative in the sections to follow: Figure 1-1, a photo comparison of the Site from 1995 to 2005, Figure 1-2, the proposed division of the Site between those lands that will be retained by DOE, and those that are planned to be turned over to the Fish and Wildlife Service as a Wildlife Refuge, Figure 1-3, a Site Location map, and Figure 1-4,a timeline of key events in the history of Rocky Flats.

Mark Silverman (October 1993 – June 1996): The first manager not tagged with "Acting" since the June 1989 raid. Mr. Silverman recognized the dysfunctionality of existing regulatory and contractual systems, and proposed bold strategies to reverse the downward trends. He also provided the leadership and statesmanship to align senior executives to the first Site closure vision, and rallied the Rocky Flats staff toward its new mission.

Jessie Roberson (June 1996 – October 1999): The first manager with a performance based contract, and a contractor determined to break with M&O past practice. She executed major organizational, personnel, and process changes to institutionalize systems that would implement the closure vision. The accelerated closure concept was developed and new regulatory agreement signed under her leadership, and groundwork laid for the final closure contract.

Paul Golan (October 1999 – June 2000): A Deputy Manager who served acting manager during the transition to the closure contract. Provided management continuity to complete the negotiation for the closure contract, sign the contract, manage the contract transition, and begin implementation of the first-of-a-kind contract for accelerated closure.

Barbara Mazurowski (June 2000 – August 2002): The manager who fully implemented the final closure contract. She championed safety and quality as prime requirements to ensure that the contractor incentives for cost and schedule performance did not overshadow safety. Many detailed administrative and technical processes were developed to implement the new and unfamiliar contract structure and obtain the desired contractor behavior and performance.

Some of these events were known to be pivotal at the time, while the importance of others only became clear in hindsight.

Gene Schmitt (August 2002 – October 2003): The manager who further defined and re-focused the attention of the Site to the final closure scenario. He established a clear direction toward the endpoint as DOE and contractor staff were struggling with the details of some of the most difficult closure work. He developed comprehensive transition plans for the DOE staff, planned the first reduction-in-force, and championed creative benefits and placement techniques.

Frazer Lockhart (October 2003 – Present): The manager who completed the physical cleanup and ensured completion of the entire closure mission and transition. He developed plans for contract performance verification, transition to Legacy Management, and office downsizing, executing these plans to move toward the final mission completion. Regulatory and administrative processes are continuing to complete every aspect of the Site closure and transition.

Although people were the driving force behind the creation and execution of the accelerated closure at Rocky Flats, certain events internal and external to DOE, mark the progress of the closure project. Some of these events were known to be pivotal at the time, while the importance of others only became clear in hindsight. The event timeline below serves as an additional reference point for understanding the situational context of the other sections in this report.

Rocky Flats is the most successful example to date of the accelerated closure of a former nuclear weapons facility. Rocky Flats had a vision, a flexible regulatory agreement, a quasi-fixed price closure contract and a very clear cost, schedule and scope. Rocky Flats management often learned on the go, sometimes moving piece-meal through processes as may policies to facilitate accelerated closure were not yet developed and key decisions had not yet been made. Various strategies and activities were conducted without a complete game plan and without a coherent notion of how the pieces would fit together at the end. It is hoped that describing how the accelerated closure concept was actually developed and implemented at Rocky Flats will help other sites avoid repeating all of the Rocky Flats painful lessons and mistakes, and go straight to the most desirable strategy for achieving successful accelerated closure.

DISCUSSION

Contract Reform and Performance-based Expectations

The Contract should have maximum fixed price scope, with a different project risk strategy for areas of greater uncertainty.

Accomplishment of the accelerated closure vision was made possible, in part, by a change in the DOE approach to contracting. In 1994, the DOE established the Contract Reform Initiative,[2] to pursue a performance-based approach to contracting and to incentivize contractor execution and completion of work, consistent with clearly established performance expectations. In this context, the Rocky Flats contractor could be incentivized to accept aggressive but clear performance measures for the cleanup and closure. While severely limiting reimbursement of contractors who did not meet performance expectations, it also provided contractor management flexibility and incentives for exceptional performance. In 1995, the DOE selected Kaiser-Hill, LLC (K-H), an environmental cleanup contractor under a performance-based contract[37] who was confident and willing to accept the challenge of the accelerated closure vision, given the incentives associated with accomplishing this challenge. The contract reform initiative was a motivating influence to incentivize execution and performance of the Rocky Flats cleanup and closure. In this contracting environment, and given the flexibility to

Rocky Flats Site Managers

Mark Silverman	1993-1996
Jessie Roberson	1996-1999
Paul Golan-(Acting)	1999-2000
Barbara Mazurowski	2000-2002
Eugene Schmitt	2002-2003
Frazer Lockhart	2003-Present

Rocky Flats Contractor Managers

Jim Zane [EG&G]	1990-1993
Anson Burlingame [EG&G]	1993-1995
George O'Brien [K-H]	1995-1996
Marvin Brailsford [K-H]	1996
Robert Card [K-H]	1996-1998
Alan Parker [K-H]	1998-2002
Nancy Tuor [K-H]	2002-Present

Assistant Secretary for Environmental Management

Leo Duffy	1991-1993
Thomas Grumbly	1993-1996
Alvin Alm	1996-1998
Caroline Huntoon	1999-2001
James Owendoff (Principal Deputy)	1999-2002
Jessie Roberson	2001-2004
Paul Golan (Acting)	2004-2005
James Rispoli	2005-Present

Secretary of Energy

James Watkins	1989-1993
Hazel O'Leary	1993-1997
Federico Peña	1997-1998
William Richardson	1998-2001
Spencer Abrams	2001-2005
Samuel Bodman	2005-Present

State of Colorado Executives

Roy Romer	1987-1999
Gail Schoetter [Lt. Governor]	1995-1999
Bill Owens	1999-2007

U.S. Senators (Colorado)

Ben Nighthorse Campbell	1993-2005
Wayne Allard	1997-Present
Ken Salazar	2005-Present

U.S. Congressmen (Colorado)

David Skaggs	1987-1999
Wayne Allard	1991-1997
Mark Udall	1999-Present

RFCA Principals (CDPHE and EPA)

Jack McGraw [EPA]	1995-2004
Max Dodson [EPA]	2004-Present
Tom Looby [CDPHE]	1995-1997
Patti Shudyer [CDPHE]	1997-1999
Doug Benevento [CDPHE]	1999-2005
Howard Roitman [CDPHE]	2005-Present

RFCA Coordinators

Tim Rehder [EPA]	1996-2003
Mark Aguilar [EPA]	2003-Present
Steve Tarlton [CDPHE]	1996-1998
Steve Gunderson [CDPHE]	1998-2005
Carl Spreng [CDPHE]	2005-Present

Figure 1-5, Key Leaders Impacting the Rocky Flats Site Closure

define project-based approaches to accomplish the overall Rocky Flats closure vision, K-H was willing to assume greater risks for closure responsibility and share in greater rewards for closure performance.

Consensus on the Accelerated Closure Vision

The performance-based contract concept focused on closure goals and provided performance measures that allowed K-H to propose an accelerated closure approach. There was a broad desire, supported by numerous efforts, to make real progress with the actual cleanup of Rocky Flats. Shortly after assuming management and integration responsibilities for Rocky Flats in August 1995, K-H and the DOE Rocky Flats Field Office proposed a new paradigm for a practical and achievable Rocky Flats end state condition called Interim End State. Working together, the Rocky Flats Field Office and K-H developed an aggressive approach to accelerate real progress toward the cleanup and closure of Rocky Flats. The vision to drastically change the previous approach to closure included shared risks and rewards, accountability, consolidation of material, stabilization and focused cleanup of the Site, with active involvement of stakeholders up front as well as throughout the process.

Congressional support was essential to achieving mandated funding levels. It was achieved, in part, due to the alignment of regulators, stakeholders and DOE to a common vision.

Before this accelerated closure vision was developed and articulated, no general expectation existed that Site closure could be accomplished in the near term or as a defined project with specified schedules. Traditional approaches to Site management and DOE contracting had been based on an operational culture (i.e., process work). In contrast, the accelerated closure vision articulated the possibility that Rocky Flats closure could be accomplished in a short enough time frame, and within an established budget, to represent a legitimate planning horizon.

The development of the closure vision took place at a time when there was not a coherent or unified planning process. In 1995 alone there were at least four distinct initiatives emanating from the Site that all sought to offer a global framework for identifying the new vision and strategy for Site cleanup. Each of these initiatives included the involvement of the workers, stakeholders, regulators and DOE headquarters. The lack of coherence, consistency and coordination among these initiatives was a key, defining feature of the Site's operations and public profile in 1995.

The four major initiatives were:

The Rocky Flats Cleanup Agreement (RFCA) The objective of the RFCA[3] negotiations was to streamline and coordinate regulatory processes and requirements. To be effective, the agreement needed to be based on a strategic vision for site closure, so the effort to craft such a vision for the Site became a part of the negotiations. This vision, associated with an enforceable regulatory agreement, was critical to defining the strategy for cleanup and the Site's relationship with its regulators and stakeholders. Numerous issues critical to the Site's overall cleanup strategy were addressed in RFCA: onsite waste disposal, interim soil and water standards, facility reuse, plutonium disposition and others. RFCA also included a schedule, one that was more aggressive than the Baseline Environmental Management Report (BEMR I)[4] process, but not as aggressive as the more ambitious projections of the K-H planning process.

The Kaiser-Hill Accelerated Closure Planning Process. This initiative was largely internal to DOE and K-H to address out-year technical and management issues that had to be evaluated before concrete baselines could be developed. It included some interactions with the community while the other processes were still unfolding. This planning process was not associated with any specific DOE or regulatory process, but due to the momentum behind the new Performance-based Integrating Management Contract, it had a positive impact both on and off Site.

The lack of coherence, consistency and coordination among cleanup and closure initiatives was a key, defining feature of the Site's operations and public profile in 1995.

Future Site Use Working Group (FSUWG). Convened in 1994 as part of a DOE HQ initiative, this group, comprised of local stakeholders, met for over a year to provide future use recommendations to DOE. The group issued its final recommendations in 1995, and presented them to DOE amidst much public fanfare.[5] DOE funded this group and participated in the meetings. Although the FSUWG planning assumptions were based on BEMR I cleanup estimates (65 years and $37 billion), the FSUWG report included a broad community consensus recommendation for open space as the ultimate end use of the Site. While the "open space" designation was widely interpreted, it provided an important community consensus and the basis for more focused discussion on open space uses in the future. DOE prepared and provided detailed responses to the FSUWG recommendations, but had no formal mechanism at that time to provide the new accelerated closure expectations to the FSUWG for their consideration.

Sitewide Environmental Impact Statement (EIS). DOE was in the midst of revising an overall sitewide EIS to reflect the operational plans at that time. The EIS effort was staffed by a subcontractor (Parsons Brinkerhoff) who initiated a wide range of stakeholder meetings, including scoping the alternatives the community wanted to analyze and produced a Comment Response Document.[6] At the same time the EIS was being developed to evaluate the impact of resuming nuclear operations, the FSUWG was finishing its recommendations, RFCA was being negotiated, and K-H was undertaking initiatives to develop a strategy to accelerate closure. Unfortunately, the EIS ended up bringing more confusion than clarity to the situation and was never finalized.

A few common threads were pervasive in the accelerated closure planning initiatives during the 1994 – 1995 timeframe. First, all of these initiatives sought to put forward a global vision and strategy for Site closure. Second, all of these initiatives demanded community involvement, including scheduled public meetings and interactions. Third, these initiatives were managed by different organizations on Site, within both DOE and K-H. Fourth, DOE lacked the means to ensure consistency among these initiatives. Fifth, each of these initiatives had a separate and distinct constituency so that none of these initiatives could be discontinued without causing considerable consternation.

It is worth noting that these "global initiatives" co-existed with, and were influenced by numerous other, more specific, initiatives. These included: responses to Defense Nuclear Facilities Safety Board (DNFSB) recommendations, close out of the DOE-EH Plutonium Vulnerabilities Report, and the annual exercise for the budget. These specific initiatives also required public meetings and involved messages, policy commitments and strategies that may or may not have been consistent with all or any of the major initiatives. As a result, the closure process, that in hindsight appears to have been efficient and focused, was in fact initially very disjointed and disordered.

The Rocky Flats Manager addressed these multiple efforts in the fall of 1995, with the creation of a strong central Planning & Integration Division to provide order, consistency, and a single strategic path forward. The lesson for other sites is clear. Maximum effort must be made to have a consistent strategy and vision that is reflected in the budget, planning, regulatory, contract and public processes. To succeed, there must be alignment between the DOE Field Office, DOE HQ and the contractor on the strategy and vision, and the initiatives to create them. To the extent feasible, even independent entities such as the DNFSB and DOE-EH need to be sufficiently engaged so that their initiatives remain consistent with the overall plan and strategy. This process took years to work out at Rocky Flats and involved a great deal of injured stakeholder relationships and wasted staff hours. Other sites should strive to avoid this by making a much greater centralized effort up front to ensure coherence and consistency among the various elements of site vision and strategy, and its implementation.

Establish a clear and common vision for the Site with the community and regulators.

DOE and K-H recognized that for accelerated closure to be achieved, a consensus on the vision for closure was needed by all involved parties.

That is, the DOE Field Office, DOE HQ, contractors, regulators, elected officials and the community needed to share a common vision for closure. The first steps toward consensus with Rocky Flats cleanup occurred during a 1995 stakeholders summit where agreement was reached to "Make It Safe – Clean It Up." Clearly, the consensus on cleanup and closure did not mean that all parties agreed to the accelerated closure approach, schedule or endstate. As the consensus developed (i.e., the agreement on the concept among the various groups), the specific details needed to accomplish the vision were worked out as an evolving process. Sufficient clarity was established to initiate more specific discussions of cost, scope, schedule and regulatory end points. In addition, this shared vision and openness in communication allowed difficult regulatory and closure issues to be discussed and resolved between DOE, K-H, the regulators, and the stakeholders. The various parties began to recognize that major benefits could be achieved if common closure expectations were developed and accomplished.

Partner with regulators to align regulatory and project milestones consistent with the vision.

The Interim End State Document,[7] developed in August 1995 as the K-H initial input into the policy arena, proposed a new paradigm for the practical, accelerated, achievable and interim Rocky Flats end state condition. The interim end state led to the first Accelerated Site Action Plan (ASAP I),[8] which proposed a vision of demolishing the buildings in place, with much of the existing radioactivity remaining onsite after closure. When initially shared with the broader community, there was significant surprise and concern because the new vision was so strikingly different from the previous discussions of cleanup.

During a "Rocky Flats Workout" session with DOE and regulators on October 10 - 11, 1995, an "Agreement in Principle" was developed that helped complete a revised regulatory agreement to accomplish work in a quicker and more cost-effective manner. The session focused on identifying a conceptual vision for an interim and final closure of Rocky Flats and resolved several issues to allow a new, comprehensive regulatory agreement to be reached. This vision included the substantive removal of building radioactivity and waste from the site. On February 19, 1996, officials at the Site released a working draft version of the accelerated closure "vision statement" (*Choices for Rocky Flats,*[9] also known as ASAP II), that was intended to guide future activities at Rocky Flats, including cleanup, plutonium consolidation, safety, conversion and land use. This vision provided choices to the community and allowed the accelerated closure concept to proceed.

Know enough about Site characterization to develop a realistic baseline consistent with regulatory endpoints and the vision.

Specifics on the endstate vision, engagement and relationship building with stakeholders and regulators, and the regulatory approach are discussed in the section entitled *Regulatory Framework*.

Achievability of the Closure Vision

To be achievable, the closure vision needed to establish what the cleanup would look like. The vision, while not initially specific, was clear enough to bound certain closure options. In addition, the vision needed to be achievable within a reasonable cost and schedule and within existing technological capabilities. A consensus vision that required 65 years and $37 billion (e.g., BEMR I and the FSUWG) would have been incompatible with accelerated closure, and most likely would not have convinced regulators and stakeholders that a project of such extended duration could be achieved. Similarly, a consensus vision that presumed a technological silver bullet for success would not have been compatible with the existing understanding and technical complexity of accelerated or achievable closure.

Developing a Closure Project

Over time, the accelerated closure vision developed into the concept of a closure project and a closure baseline took shape. In contrast to the previous "business as usual" approach to operations that had projected a 65 year and $37 billion closure effort, the accelerated closure vision established the expectation that closure could be accomplished using a "project" format with specifically established near-term closure milestones and endpoints. In addition, senior DOE and K-H management established a unified closure project message: "Get it done!" The project concept defined closure scope, schedule and cost expectations on a realistic and achievable format. Closure activities were explicitly defined, resources were not diverted to activities that did not directly support closure of the Site, and the workforce (both DOE and the contractor) transitioned from an operations/production culture to cleanup/closure culture. A discussion of project baseline development and project management tools is provided in the section on *Creating and Implementing a Closure Project*.

A critical subset of players supported the concept of the closure vision, and were passionately and energetically committed to accomplishing the vision.

Intensity of Commitment

Continual interface and communication among Rocky Flats DOE, K-H, regulators, stakeholders and DOE HQ personnel over a period of several years eventually allowed a consensus to develop on the concept and achievability of the Rocky Flats closure vision. However, developing and achieving consensus on the vision was only a beginning. Successful closure of Rocky Flats required a singular intensity of commitment to the vision to sustain progress and result in closure.

This intensity was highlighted by a critical subset of players who not only supported the concept of the closure vision, but also were passionately and energetically committed to accomplishing the vision. For Rocky Flats, this intense and sustained commitment was provided by a number of key parties: The DOE Rocky Flats Manager (initially Mark Silverman and then Jessie Roberson), the K-H senior manager (Bob Card), DOE Headquarters managers (DOE Assistant Secretaries Grumbly and Alm, and Secretaries O'Leary and Peña) and, importantly, the Office of the Governor of Colorado (Lt. Gov. Gail Schoettler). The energy and focus to succeed provided by these key individuals overcame initial uncertainty on the part of regulatory agencies such as the Colorado Department of Public Health and Environment (CDPHE) and the U.S. Environmental Protection Agency (EPA). Bob Card, especially, provided a major source of energy on the closure vision that led to increased support from other sources,

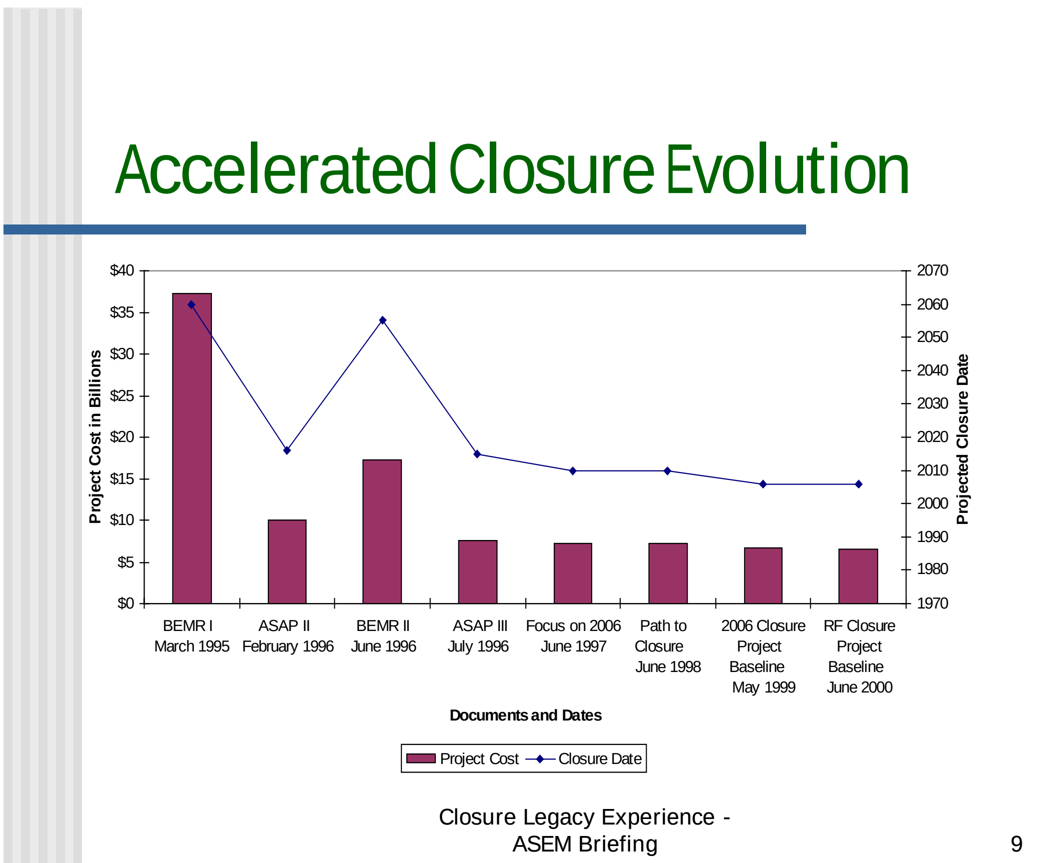


Figure 1-6, Accelerated Closure Evolution

including Congress. At a time when the DOE was adopting new contract mechanisms that focused on and rewarded performance, Card (as the head of the K-H organization responsible for the cleanup and closure of Rocky Flats) was able to reinforce the credibility of the contractor team and demonstrate a willingness to share risks for closure performance and costs.

Singularity of Institutional Focus

The vision for Rocky Flats was cleanup and closure, period. Resources were singularly focused on what it would take to get the job of closure accomplished. Any competing missions or activities were systematically eliminated. Personnel focused on the end goal of closure, acknowledging that success would mean that they were working themselves out of a job. In addition, many functions previously being carried out for potential return to operations and production missions were eliminated. Although for a few years (until 1997) there was some lingering thought of potential building reuse, this was minor. A community/DOE working group analyzed the situation and concluded, based upon a market and infrastructure analysis, that re-use was not economically viable. The clarity of focus enabled difficult complexities (e.g., funding, regulatory, technology) to be overcome, and first time approaches such as single source funding to be obtained.

DOE must manage to the contract, not the contractor. Do not create or entertain additional scope items.

Reaffirmation of the Closure Vision

The overall vision of cleanup and closure was constantly repeated and reaffirmed in management behavior and in writing. It was incorporated in the Rocky Flats Cleanup Agreement, in the Collective Bargaining Agreement with the American Federation of Government Employees local union, in the Rocky Flats Closure Contract and funding, and in every budget testimony before Congress. It became the dominant element of Site "corporate culture". This was not some bureaucratic program, nor was it one more planning document to gather dust on a shelf. The Rocky Flats accelerated closure vision was repeated like a mantra over weeks, months and years by managers, workers, regulators and stakeholders. The paradigm change of "Make It Safe – Clean It Up – Close It Down" became a guiding principle of behavior.

The economic vitality of the local region is often overlooked in the overall success of Rocky Flats.

Economic vitality of region

While Rocky Flats was one of the larger employers in the Denver-Boulder area, it represented a small fraction of the large and generally growing Colorado Front Range economy. Thus, local concerns over the loss of jobs due to the eventual closure of the Site never became an issue or a persistent topic in the local media. Site closure also represented a gradual loss of jobs over a number of years. The political success of the closure mission would have been far more difficult if unions, communities, businesses, contractors, and congressional delegations had pushed back on the closure mission with pressure to keep jobs and playing to local concerns about the economic impacts of closure. The timing of the growth of the local economy was fortuitous; if Rocky Flats closure had been attempted a decade earlier or later, economic issues might have been a factor. The economic vitality of the local region is a key factor when pursuing accelerated closure of DOE sites, and is often overlooked in the overall success of Rocky Flats.

KEY SUCCESS FACTORS

Why was the development and implementation of an accelerated closure vision possible at Rocky Flats? Success at Rocky Flats was possible, in part, because the DOE Contract Reform Initiative provided for the selection of a contractor willing to assume the risks and incentives for performance-based cleanup work. In addition, the contractor possessed the credibility and ability to work with the DOE, State regulators, elected officials and the public to obtain a workable agreement that allowed closure to proceed and unnecessary scope to be eliminated. DOE and the contractor were committed to treat closure of the Site as a "project" with a defined endpoint, schedule and budget. This allowed them to develop a Work Breakdown Structure and validated Lifecycle Baseline that could be used for performance measurement. Both the DOE and the contractor were eager for and committed to this changed approach to close Rocky Flats. They changed the "corporate culture" of the Rocky Flats Site to "get closure done." Finally, significant growth in the local economy minimized community concerns relative to the need for a continued Rocky Flats mission.

Based on the experiences of the Rocky Flats closure legacy it is possible to discern the challenges and approaches that led to closure success, and to suggest how DOE may transform other closure sites into accelerated closure sites. While the process at Rocky Flats was not necessarily as straightforward as described below, the lessons of the Rocky Flats closure legacy indicate the following are necessary:

1. A clear vision of the desired cleanup end state should be established. Gain support for this vision from groups that will allow the vision to be achieved (e.g., DOE HQ, regulators, elected officials and the community). At any given site, the importance of specific groups will vary. The vision need not initially be specific, but it needs to be clear enough to bound

certain options. The vision needs to be achievable in a short enough time frame to represent a legitimate planning horizon.

2. DOE and regulators should work together to align the closure end state vision and establish regulatory processes that include appropriate end points based on the vision. This should lead to a fixed or bounding set of objectives for the cleanup end state.

3. There should be sufficient site characterization to establish a baseline and scope of work needed to achieve the vision and the regulatory end points. A scope of work should be developed, based on this characterization. The scope should be specific enough to develop a cost, schedule and project plan. The scope should include a schedule for Government Furnished Services and Items (GFS&I) necessary and sufficient to close the site.

4. Congressional support is required to establish mandated funding that reduces the annual internal DOE budget review effort and provides single source funding (rather than traditional DOE-HQ program funding).

5. DOE should develop a contract that is attuned to the level of certainty and uncertainty in the scope of work. This contract should be as fixed-price as possible for the scope that is known, but perhaps with a different project risk strategy for areas of greater uncertainty. The contract should include specific schedules for GFS&I delivery and should incentivize the contractor for total project performance.

6. DOE and the contractor must achieve a sufficient level of regulatory certainty. They should resolve technical issues to allow the development of a comprehensive closure baseline (with independent review) to build credibility and provide the framework for the closure project measurement.

7. DOE should reassess its oversight role and change its traditional approaches to managing contract execution (i.e., manage the contract, not the contractor).

8. The fundamental focus of the DOE and the contractor must be on closure. Activities that do not support and add value to the closure mission should be critically reviewed prior to being pursued.

In each of these areas there is an evolution towards greater flexibility and less micro-management. In the regulatory framework, there is the effort to establish joint goals with the regulators, but to reduce the number of enforceable milestones that constrain a site's flexibility to accomplish the work. In planning and project management there is the move away from annual re-baselining drills and towards viewing each year as simply one moveable slice of an established multi-year project. In the contract approach, there is the effort to remove DOE from managing how the contractor does work and to focus on letting the contractor do the work in the most flexible way possible. There is also a continual move towards greater integration, sometimes seen as an effort to avoid stovepiping. This is seen in the move towards a single source of funds from congress and DOE HQ, the move to integrate safety into the projects, the move to understand the entire Site as one project and the move to integrate nuclear work into environmental work in the RFCA.

Successfully pursuing an accelerated closure vision means that individuals needed to throw away old paradigms regarding DOE site operations and question strategies and activities which exist because "that's how it has always been done." Success in implementing an accelerated closure vision at Rocky Flats, because it was different, required that all parties maintain the will to "break the DOE mold" and sustain the focus and resources on what it took to achieve closure. Accelerated closure also required a focus on transitioning the culture of the workforce, both DOE and contractor, from production to closure. The concept of project management ("projectization") became a reality, in that there was a defined start and end date for the Rocky Flats cleanup, with specified milestones, budgets and performance.

Focusing on and committing to an accelerated closure vision provides a new basis for dialogue that affects everything including budget decisions, project performance expectations, approaches to regulatory compliance and application of human resources. It allows the alignment of interests among organizations and individuals in achieving and accelerating closure. The initial vision, presented in *Choices for Rocky Flats* (ASAP II), provided clear expectations for closure efforts, resulting in savings of over $27 billion in closure costs and 44 years in the closure schedule. The accelerated closure vision resulted in a paradigm shift in closure thinking and demonstrated that previous estimates and approaches were unnecessary. The vision provided a realistic sense of urgency and became a catalyst for a culture change in the way the DOE and the public viewed Rocky Flats closure. Based on subsequent refinement and implementation of the accelerated closure vision, savings of over $30 billion in closure costs and 54 years in the closure schedule have come to fruition.

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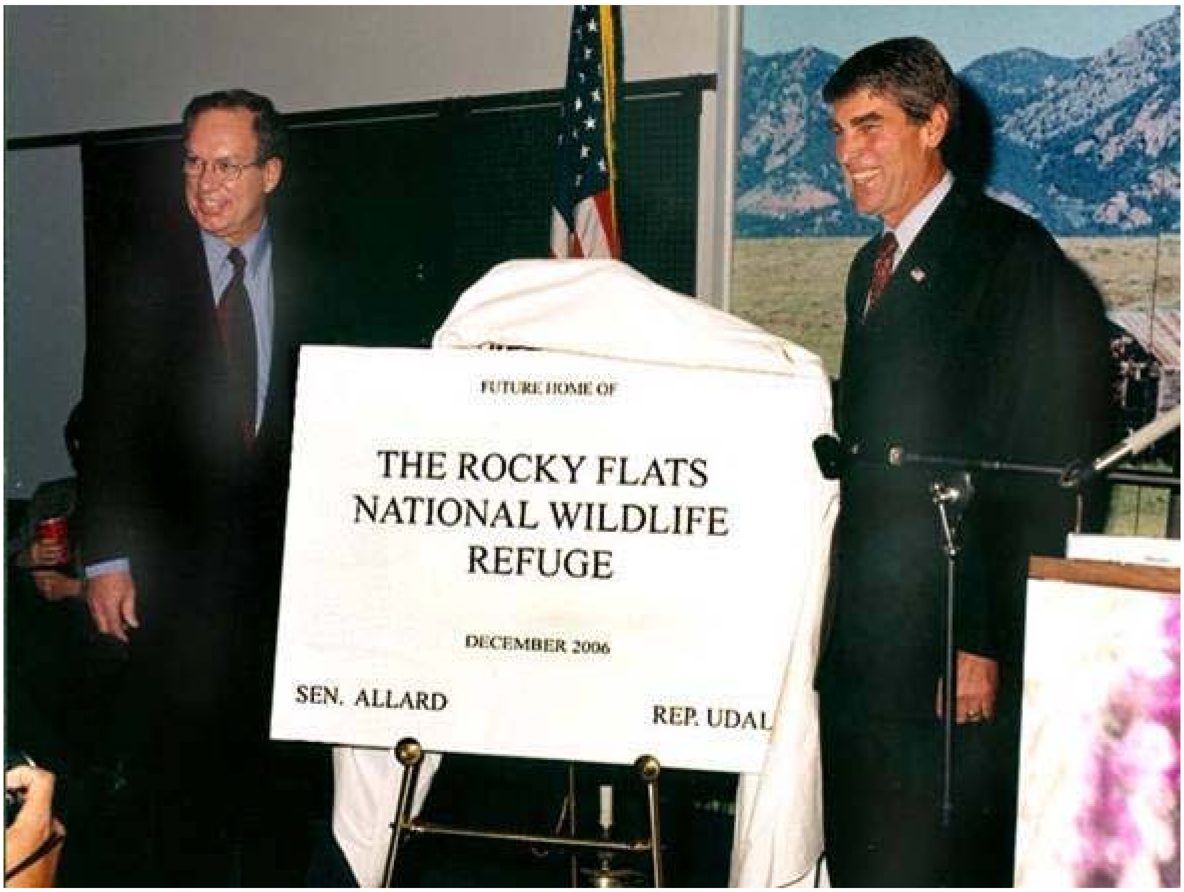
ROCKY FLATS CLOSURE LEGACY

CONGRESSIONAL AND EXECUTIVE ADMINISTRATION SUPPORT



THE ROCKY FLATS CLOSURE PROJECT RECEIVED STRONG BI-PARTISAN SUPPORT FROM LOCAL, STATE, AND FEDERAL GOVERNMENTS FOR ACCELERATED CLOSURE, DISPOSITION OF MATERIALS, CLEANUP LEVELS, AND FUTURE SITE USE.

INTRODUCTION

The Rocky Flats Closure Project required a complex and focused political strategy for its success. Rocky Flats Site was at the outset of this effort a controversial, even notorious DOE site – the site of the first ever FBI raid of a federal facility, the occasion of the largest ever contractor penalty payment for violations of environmental laws, and the facility containing “the most dangerous building in America.” Success at Rocky Flats relied on a series of innovative, high-risk strategies in regulatory reform, contract reform and strategic orientation and planning. None of these initiatives could be developed or implemented in a political vacuum. They would all take place in the crucible of public and media opinion, intense scrutiny from interest groups and the bureaucracy, and as part of an ongoing political tug of war between the political leadership of the Department and the key interested Members of Congress.

Given the nature of the challenge facing Rocky Flats an approach gradually developed to overcome these challenges, a political strategy that was absolutely essential to the success of the project. The political strategy for Rocky Flats was not conceived and developed all at once. Like the other elements of the closure project, it took form gradually, through iterative steps and sometimes in divergent and inconsistent directions. Initially, the political strategy had a few key goals: to obtain sufficient funding to enable the project to succeed; to ensure that DOE-HQ actions were integrated in a manner that would enable DOE success at the Field Office level; and to ensure that the regulators worked to enable success of the new Rocky Flats Cleanup Agreement (RFCA).[3] Over time, the political strategy developed into a set of implicit understandings among the key participants that were interwoven throughout the Site vision, comprehensive closure plan, and regulatory approach. In this section, for simplicity of presentation and readability, the multiple commitments and understandings will be referred to as “The Strategy”. It should be clearly understood that the strategy was not any specific written or verbal contract, nor was it secret. Rather, it was a set of understandings regarding responsibilities and accountabilities, often publicly discussed, and necessary to enable the vision of closure by 2006.

Every closure site needs a strategy that the political leadership, career bureaucracy and state regulators can buy into.

This section will analyze the strategy. It will address the definition, the evolution, the parties, the preconditions, what the parties hoped to gain from it, how the strategy relates to and is impacted by the other elements of closure, and the changing circumstances at Rocky Flats and how they in turn impacted the strategy. Almost all the actions and events described in this section occurred in the 1995 to 1998 timeframe. By the end of 1998 the strategy had reached sufficient maturity that the management focus turned to the challenges of implementation, of making it happen. Those implementation steps are described in succeeding sections of this report.

DISCUSSION

The strategy was not any specific written or verbal contract, nor was it secret. Rather, it was a set of understandings regarding responsibilities and accountabilities, often publicly discussed, and necessary to enable the vision of closure by 2006.

Definition of the Strategy

At its simplest, the strategy is straightforward:

- Rocky Flats would maintain a credible project plan for closure by 2006 and demonstrate steady progress towards 2006 closure.
- Congress and the political leadership of DOE would provide steady funding for the project and provide the support needed to keep the project on track. (This support could range from providing receiver sites and containers on a timely basis to ensuring that external or internal issues are appropriately addressed.)

If DOE failed to deliver on either of these core commitments, the strategy would be at risk. For example, if Rocky Flats started making extravagant commitments for additional cleanup, or stated publicly that the 2006 date was no longer a DOE priority or started reporting that it was no longer on track for 2006, it risked losing congressional and executive administration support. A third part of the strategy was maintaining regulator and community support. As the project became more secure, this element became less at-risk. For example, in the 1996-97 time frame the office of the governor organized several letters from area mayors to DOE HQ urging support for the Rocky Flats cleanup on a wide range of issues. By the year 2000, Congressional officials were willing to tell the community that they should not expect more time or money for the project, since the commitment gained from colleagues outside of the Colorado for Rocky Flats funding was contingent on Rocky Flats being finished by the end of 2006.

Alignment of the contract, the regulatory agreement the budget and site planning documents must be achieved.

The strategy required constant reinforcement and reaffirmation. During the late 1990s, the Site was very cognizant of the competitive environment it faced. Since the case for funding Rocky Flats relied largely on the credibility of its claim that it could be the first major site to close, maintaining that credibility in the face of increasing challenges from other quarters became critical. The Site had to continually demonstrate that it was "investment grade" and that the ongoing investment was worthwhile.

Specifically, this meant meeting regulatory milestones, using and refining planning tools, demonstrating beyond doubt and without spin that real work was progressing against a finite and achievable project scope. For example, the contractor, Kaiser-Hill (K-H), and the DOE Rocky Flats Field Office made a conscious effort to annually report to Congress and to the community using clear and objective metrics how the project was performing compared to the plan, and what work needed to be done in the next year. Another key indicator of progress was the Site's ongoing effort to align the project, the contract and RFCA. At a time when typical reporting protocols described achievements as stand-alone items or annual summaries, Rocky Flats showed all of its work as one year's slice of a total, multi-year project. Increasingly detailed projectization established and maintained Rocky Flats' credibility in Congress as "investment grade." Rocky Flats' annual reports reported progress towards completion, in contrast to previous reporting which showed annual metrics of accomplishment, but not towards a goal of completion.

Over time, other elements of the strategy emerged. These included:

Avoiding excessive cleanup scope. Throughout the late 1990s Rocky Flats actually used the RSAL (residual soil contamination levels) issue as a positive argument in presenting the project to DOE-HQ and congressional sponsors. The RSAL controversy in the local community demonstrated that the cleanup was risk based and predicated on reasonable future use assumptions. Partial evidence of the Site's seriousness toward a reasonable and focused closure was lingering community resentment. If the community felt we did not go far enough in cleanup commitments, then in DOE-HQ and congressional eyes we clearly were willing to make tough decisions to get the important work done. This became a key message for all DOE-HQ and Congressional visits, where we took visitors to the observation area near Trench 3 and described the Site's risk-based environmental remediation approach in precisely those terms.

Avoiding safety mishaps and other controversies. A presumption underlying political support for the cleanup was fending off the criticism that this would be a profit-driven "dirty-cleanup", or one that involved "cutting corners" on safety to earn fee. This meant ensuring safety and, perhaps just as important, ensuring the perception of safety. Looking back, the Site's safety record was exemplary for most of this time period, with an almost ten-fold decrease in lost workday rates and recordable injuries over the project period, despite completion of some of the most dirty and dangerous demolition work. Despite the overall positive safety trends, there were several high profile safety events discussed in detail in the *Safety Integration* section. These few events did not result in any serious worker injuries, but reflected system lapses and gained significant attention because of the pervasive perception that increased performance incentives degraded safety. Issues with safety did not raise serious questions about the viability of the project until the January 2001 letter from the DOE Rocky Flats Manager,[10] which raised some concerns among key players that the strategy might be threatened. Similar concerns appeared in any safeguards and security issues that arose.

The Site needed enough community support to show a united front before Congress and the administration, but not so much support as to lend credence to the idea that this project represented a sweetheart deal.

Ensuring a threshold level of community support. This was always in tension with the two elements above. The Site needed enough community support to show a united front before Congress and the administration, but not so much support as to lend credence to the idea that this project represented a sweetheart deal between Congress, the political leadership of DOE, the Site and the community. Balancing these elements was an ongoing challenge during the late 1990s.

The Key Participants for the Closure Strategy

Many parties had interests that aligned or had some nexus with Rocky Flats. For decades the Site had served as local fodder for political and media attacks; something about Rocky Flats was in the newspaper, often on the front page, almost daily in the early 1990s. As the closure plan started to emerge and take shape, key participants began to be identified. Some were destined to play key roles due to organization or office, others due to job assignment or interest. The table on the following page lists the key parties by organization and name during the primary period of the closure project discussed in this report.

The parties to the strategy might be surprised to see themselves identified here as participants. Indeed, they were likely not aware at the time that they were in the business of strategizing a nuclear plant closure. But in hindsight, their efforts can only be characterized that way, as stated earlier through their input on approaches and expectation of shared responsibilities and accountabilities. The parties to this strategy shifted over time as Figure 2-2 reflects. In some cases, the principals were only vaguely aware of their role in sculpting this strategy, in that they delegated the details to staff. In other cases, the principals knew exactly what they were doing and their staffs had only a vague notion of the strategy.

The project cannot succeed without political support from DOE Headquarters.

The strategy evolved almost entirely in the 1995 to 1998 timeframe. By the end of that period enough understanding had been gained and tangible progress demonstrated, that the focus turned to ensuring execution of the strategy. The principal participants in the evolution of the strategy were the DOE Rocky Flats Managers, Kaiser-Hill Presidents, Assistant Secretaries for Environmental Management, Secretaries of Energy, Colorado Senators and Congressmen, and Colorado Governors. In addition, the strategy received Congressional support from outside Colorado, most notably from influential Congressmen and Senators, as well as Senate Armed Services Committee and House Appropriations Committee staffers, interested in supporting a project focused on completion. The Colorado Lt. Governor also played a pivotal role in the mid-1990s by supporting the RFCA negotiations, by maintaining a bipartisan focus among elected officials in Colorado on the cleanup, and by intervening often in Washington to keep the closure on track.

Rocky Flats Site Managers

Mark Silverman	1993-1996
Jessie Roberson	1996-1999
Paul Golan-(Acting)	1999-2000
Barbara Mazurowski	2000-2002
Eugene Schmitt	2002-2003
Frazer Lockhart	2003-Present

Rocky Flats Contractor Managers

Jim Zane [EG&G]	1990-1993
Anson Burlingame [EG&G]	1993-1995
George O'Brien [K-H]	1995-1996
Marvin Brailsford [K-H]	1996
Robert Card [K-H]	1996-1998
Alan Parker [K-H]	1998-2002
Nancy Tuor [K-H]	2002-Present

Assistant Secretary for Environmental Management

Leo Duffy	1991-1993
Thomas Grumbly	1993-1996
Alvin Alm	1996-1998
Caroline Huntoon	1999-2001
James Owendoff (Principal Deputy)	1999-2002
Jessie Roberson	2001-2004
Paul Golan (Acting)	2004-2005
James Rispoli	2005-Present

Secretary of Energy

James Watkins	1989-1993
Hazel O'Leary	1993-1997
Federico Peña	1997-1998
William Richardson	1998-2001
Spencer Abrams	2001-2005
Samuel Bodman	2005-Present

State of Colorado Executives

Roy Romer	1987-1999
Gail Schoetter [Lt. Governor]	1995-1999
Bill Owens	1999-2007

U.S. Senators (Colorado)

Ben Nighthorse Campbell	1993-2005
Wayne Allard	1997-Present
Ken Salazar	2005-Present

U.S. Congressmen (Colorado)

David Skaggs	1987-1999
Wayne Allard	1991-1997
Mark Udall	1999-Present

RFCA Principals (CDPHE and EPA)

Jack McGraw [EPA]	1995-2004
Max Dodson [EPA]	2004-Present
Tom Looby [CDPHE]	1995-1997
Patti Shudyer [CDPHE]	1997-1999
Doug Benevento [CDPHE]	1999-2005
Howard Roitman [CDPHE]	2005-Present

RFCA Coordinators

Tim Rehder [EPA]	1995-2003
Mark Aguilar [EPA]	2003-Present
Steve Tarlton [CDPHE]	1996-1998
Steve Gunderson [CDPHE]	1998-2005
Carl Spreng [CDPHE]	2005-Present

Figure 2-2, Key Leaders Impacting the Rocky Flats Site Closure

Preconditions for the Strategy

The key preconditions for the strategy were: a site large enough to be tough, but not so large as to be too tough, contractor and DOE leadership committed to cleanup and closure and not seeking any other mission, bipartisan in-state support, and a supportive community and regulators.

DOE and the contractor must collaborate. The contractor will have more flexibility to work with Congress and the political system. DOE will have more flexibility to work the internal system. Both are needed for success.

Relationship of the Strategy to the other elements of the Closure Project

The political strategy was intricately inter-related to the contract approach, project planning and budgeting mechanisms and the regulatory approach. These tools helped implement the strategy, but they also helped refine and support the strategy, and the competitive pressures of the strategy impacted these mechanisms. First, the strategy could never have been fully consummated without having superior tools in each of these areas. Part of the strategy was to secure funding for Rocky Flats ahead of projects with greater risks, more complex technical challenges, more invasive regulatory agreements and more powerful Congressional Delegations. Rocky Flats' principle argument was that it should be funded because it could close early, and this would allow funding for other priorities after Rocky Flats was completed. Rocky Flats needed to establish and bolster its case in part by the superiority of its implementation tools.

It is important to note that the political environment in Congress is dynamic and not static; it is competitive and not monopolistic. Other sites, other contractors and other elements of DOE with diverse interests served to bolster a competitive environment that pushed Rocky Flats to continually refine the contract, the plan and the RFCA to maintain the Site's competitive advantage. The evidence of this constant pressure to innovate was the annual Amelia Island and Congressman Doc Hastings breakfast presentations. Each year, these presentations were crafted to not only demonstrate the Site's progress in real work, but also the refinement in the tools and elements of closure. These included the evolution from regular Performance Measures[12] to Stretch Performance Measures to Gateway and Superstretch Performance Measures,[13] or the evolution of RFCA milestones to the earned value approach. These tools did not develop solely due to political pressure, but the reality of the political situation was a factor driving the Site's need to continually innovate.

Why did the parties want the strategy? What were their interests?

The parties to the strategy had different interests. The DOE needed a success story that could maintain the viability of the program in the face of severe criticism (several members of Congress had called for elimination of the Environmental Management program in DOE during the 1995-1996 timeframe). K-H had stated an overall corporate strategy to build and maintain a global reputation as the best environmental cleanup firm in the world. The Senate Armed Services Committee and House Appropriations Committee needed a plan to compel support for DOE Environmental Management (DOE-EM) current and out-year funding. DOE Rocky Flats managers needed a compelling case for funding that would enable further progress towards cleanup and would reverse the competitive disadvantage they faced with larger sites. Later, this evolved into a self-reinforcing mission. Rocky Flats became so invested in accelerated closure that its interest in the strategy required no further justification. Similarly, Colorado public officials were initially invested in the strategy for reasons of public health and safety. Eventually, their political reputations were linked to success at Rocky Flats.

They sensed what was possible at Rocky Flats and seized the opportunity to create the possibility of a landmark accelerated closure.

None of these players bought into the strategy easily or readily. Senior DOE officials supported the strategy out of political necessity to show some dramatic turnaround within the Environmental Management program. Rocky Flats Site Managers faced a dilemma of Site health, safety, and compliance; the strategy represented the only way out of it. The Congressional committee staffers understood intuitively that a strategy was needed, but from their perspective it did not have to be Rocky Flats. K-H needed success at Rocky Flats, but they could have achieved success under the contract and success politically without this strategy. That is, K-H could have claimed success at Rocky Flats without going nearly as far as it did. K-H senior managers and corporate officers took a set of business interests for K-H and pushed them beyond what was needed to satisfy their immediate corporate interests. They sensed what was possible at Rocky Flats, and seized the opportunity (really a series of opportunities over time) to create the possibility of a landmark accelerated closure. It is also true that K-H could not have been successful without energetic, risk-taking support from DOE Managers, a visionary and courageous Assistant Secretary for Environmental Management and determined and politically skillful support from the Secretary's office.

Implementing the Strategy

All of the players had an interest in Rocky Flats' success. Rocky Flats had all of the pieces to be poised for success and the climate was ripe for DOE-EM to promote a success story. But the ongoing success of the strategy still depended on skillful implementation. The key players in DOE, Congress, the media and Colorado had to be told and reminded of the elements of the strategy. They had to be persuaded to continuously and vocally support it. The Site needed to be attentive to political and budgetary threats, and needed to respond appropriately. Some elements of the successful implementation of the strategy include:

Non-traditional support. A key element in Rocky Flats' success in Washington, DC was persuading Members of Congress, with no apparent interest in Rocky Flats, to speak out and support the project. It was expected that members with a local or parochial interest would speak out on behalf of their site. A member with no apparent interest speaking out gets far more notice. K-H was able to persuade numerous Members of Congress that expeditious closure of Rocky Flats would serve their own local interests by freeing up funds for their sites and priorities. This support was invaluable in cementing overall political support for the project.

Community lobbying. At least once a year, the communities surrounding Rocky Flats visited Washington, DC and met with key officials at DOE (career and political) as well as with Members of Congress and their staffs. While the communities often had specific local differences with the Site, in Washington, DC they tended to adhere to their common support for the main mission and strategy for the Site. Such community engagement was common for DOE sites and often simply dismissed as parochialism. However, since Rocky Flats had no long-term mission and the communities were not seeking jobs or economic development, the community support for the cleanup repeatedly demonstrated alignment with a common mission and strategy.

Accountability. About three times a year, Site representatives went to key opinion leaders to state explicitly the progress made in the past year, how it compared to the expected progress, the projected progress for the following year, and how much of the project remained. Further, the Site always had available a very specific account of how it would spend more money, down to quantities, waste streams and other specifics. The venues for these presentations varied. They included the House Cleanup Reform Caucus breakfast (the Doc Hastings breakfast), the Weapons Complex Monitor Decisionmakers' Forum (Amelia Island), the annual K-H visits to Congress and the annual DOE Rocky Flats "State of the Flats" meeting. This consistency of presentation provided a level of accountability sought in Congress, where the typical story throughout the 1990s tended to be of projects over cost, behind schedule and out of compliance.

Every presentation, every slide show, every Hastings brief or Amelia Island presentation must contain the same basic message. In exchange for funding and support we pledge to achieve specific progress annually, and get the whole job done by a date certain.

Funding Stability. A key element in the Rocky Flats success was aligning DOE HQ and Congress around the need for stable funding. Starting in about 1997, Rocky Flats identified a baseline funding level needed to sustain the project through closure in 2006. Once this was established in DOE documents and with Congress, it became unnecessary for Rocky Flats to wrangle with Congress regarding money. This meant that there were no energy draining disputes about plus ups or other funding issues, and it enabled the Site to distinguish itself by not asking for money and to go on to request help in other areas. This early alignment on funding is in part a consequence of the mission – Rocky Flats was not seeking a new mission, hence it did not need more funds. In part it was also due to the political alignment achieved earlier. In any case, it helped enormously in cementing Rocky Flats' credibility and in maintaining the political support for Rocky Flats closure.

Strong support from the Office of the Secretary. The Site leadership understood that the project was a priority for the Secretary of Energy, particularly in the late 1990s. The Site was sometimes asked to work directly with Secretarial staff to expedite resolution of issues that might otherwise have taken months. The Secretary releasing his action plan for Rocky Flats closure in 1998 reflects the level of engagement and is discussed later in this section.

Congressional interest in resolution of issues. A key priority of the political strategy was getting decisions made quickly. Sometimes, the DOE could not resolve an issue. Continued congressional interest and inquiry on issues provided the push necessary to get some issues resolved. Usually, this outside interest was only successful when a decision was delayed simply due to slow staff-work or inattention. In the case of a real internal difference of opinion on a policy issue, Congressional inquiries were not sufficient to resolve an issue.

A key priority of the political strategy was getting decisions made quickly.

The Evolution of the Strategy

The strategy took on its basic form over a three-year period from 1995 to 1998. In early 1995, Rocky Flats was managed under a Management and Operating contract that provided full reimbursement for costs. Rocky Flats labored under a dysfunctional regulatory agreement, with negotiations for a new agreement seemingly at an impasse. The Site was seriously worried about sufficient funds to protect against a major event or accident. Even the much-derided closure cost projections of DOE's Baseline Environmental Management Review were months away. With contract reform and with stakeholder support, by late 1997 the Rocky Flats Manager had signed onto an agreement with DOE-HQ committing the Site to a 2006 closure goal. This agreement was codified in a letter from the Secretary to the President in June 1998.

Starting in 1995, DOE as a whole was hungry for any sign of progress or success in the complex. The fact that DOE had designated the Fernald Site in Ohio and also Rocky Flats as the first targets for contract reform made Rocky Flats (and Fernald) well poised to be promoted to Congress as a success story. DOE touted both the new contract mechanism and the new contractor as precursors to great success. In April of 1995 the Secretary of Energy personally announced the selection of the new contractor at Rocky Flats. Similar high hopes were invested in the new regulatory agreement. The Undersecretary announced boldly in the spring of 1996 when the new RFCA was issued for public comment that "this agreement will mean that DOE starts moving dirt, not paper."

As discussed above, the new contract, the new regulatory agreement, the paradigm shift to a closure concept and improved Site performance all played into the development of the strategy. But the earliest form of the strategy was simply the argument to key members of Congress that more money spent at Rocky Flats would lead to more specific and concrete cleanup accomplishments. This early plus-up of funding was linked to accelerated cleanup initiatives, not accelerated closure of the Site as a whole. For example, the Conference Report for FY 1996 Energy and Water Appropriations bill offers strong support for "efforts at sites such as Fernald, Ohio and Rocky Flats, Colorado which have developed detailed plans to expedite the cleanup actions and reduce costs to the taxpayer."

The story did not end with a simple understanding of more funding from Congress due to better performance. In fact, the deal quickly evolved into a much more significant change in thinking that enabled it to take on its more current form. Early on in the re-thinking of the Rocky Flats cleanup, planners at K-H and at DOE were considering moving not merely from operations to cleanup, but all the way to closure. This intellectual planning effort began as work by a tight circle of K-H and DOE Rocky Flats staff. By late 1995, it began to be briefed to the community around Rocky Flats as a proposal to get the entire cleanup completed on an expedited and finite budget and schedule.

While the community was still considering what this new proposal might mean, and while DOE was still pondering how to force-fit this plan into awkward budget and planning processes, the DOE-EM program as a whole was fighting for its life. In 1994, a resurgent Republican movement swept the November elections and took control of the House of Representatives. They vowed, among other things, to shut down four cabinet agencies, among them DOE. Indeed, the DOE-EM cleanup program had been a target of bipartisan congressional ire since at least the early 1990s, due in part to annual reports from the Congressional Budget Office, General Accounting Office (now Government Accountability Office) and others that the cost, schedule and scope of the program were huge, escalating and out of control. Indeed, the early DOE reports on the cost and schedule for DOE-EM confirmed Congress's ideological predispositions. The Baseline Environmental Management Report (BEMR) I[4], published in 1995, projected completing the DOE-EM mission in over 70 years at a cost of over $200 billion dollars. BEMR II,[6] published in 1996, only improved slightly on these projections. All of these reports cumulatively seemed to support the notion that DOE was out of control and ripe for elimination.

The basic principles of the strategy must be continually repeated and reaffirmed. Every presentation, every slide show, must contain the same basic message.

Other federal agencies, most notably the Army Corps of Engineers, were interested in DOE-EMs mission. The Corps was aware of DOE-EMs vulnerability and of the interest by the new House majority in eliminating a cabinet agency. They offered Congress an easy solution for the single largest program in DOE: turn it over to us and we will run it efficiently.

It was in this context that Alvin Alm succeeded Tom Grumbly as Assistant Secretary for Environmental Management in 1996. Where Grumbly faced a chaotic program under constant criticism from Congress, Alm faced a determined ideological adversary committed to the dismemberment of his program. Where Grumbly could sincerely ask Congress for more time to get his program on a stable footing, Alm knew his time had run out. Alm recognized that for DOE-EM to survive it needed to promise Congress a strategy that could move radically to accelerated cleanup and closure. To address this Alm rejected the BEMR process and launched a "Ten Year Plan" for the DOE-EM complex. In its simplest terms, the plan meant that sites should bypass the BEMR process and identify the cost and strategies needed to get their sites to a steady state with substantial (~90%) risk and mortgage reduction in ten years. Alm had no proof that this was feasible, either technically or politically, at each of the sites. He did know it was critical for his success with Congress. He knew he would face resistance from the bureaucracy, foot dragging from the field offices and skepticism from Congress. His success therefore required at least one major site to have a credible strategy to close in ten years. This was the minimum he needed to maintain congressional support for DOE-EM.

Due in part to the new RFCA (signed by Assistant Secretary Alm in July 1996), the new contract, several early K-H performance improvements, and in some part due to his personal ties to the Denver area, Alm looked to Rocky Flats to be his showcase site, the one that would prove the viability of his strategy. It was through this marriage of Alm's political needs and the regulatory and contract changes at Rocky Flats that the basic features of the strategy took shape.

DOE and the closure contractor must collaborate. No political strategy can be successful if it is the sole product of either DOE or the contractor.

While DOE-EM was conceptualizing the 10-year plan, Rocky Flats planners were moving slowly towards convergence of the RFCA and the closure planning process. The initial K-H Accelerated Site Action Plan (ASAP)[8] had evolved into a suite of alternatives for the community. After a series of briefings and informal public input (since there was still no clear linkage of the closure planning process to any formal NEPA or CERCLA process), a consensus was emerging towards ASAP 3c[15,16] a closure plan that turned out to be quite consistent with RFCA. This plan received validation after a team from DOE-HQ reviewed the still draft RFCA to assess whether it was affordable. This hybrid RFCA/3c scenario gradually became the working plan for the Site. Nevertheless, it still presumed closure in the 2010-2015 timeframe. Over time, this led to the development and approval of an official Site baseline that contemplated closure by 2010.

Although DOE-EM initially looked to the accelerated plans at Rocky Flats as the model, they also realized that even the expedited plans at Rocky did not go far enough. Completion by 2010 was four years too late. Politically, DOE-EM needed a major site to close in 10 years, and that meant 2006. For months, DOE-EM staff wrangled with Rocky Flats over what it would take to get to closure in 2006. DOE-EM believed that all sites operated with massive inefficiencies and that the key to shaving years off of projected schedules was simply identifying and eliminating these inefficiencies. This exercise was followed throughout the complex in implementing the 10-year plan. DOE-EM staff believed Rocky Flats should behave like the other sites: commit to wringing inefficiencies out of the baseline in order to meet a 2006 closure date.

Rocky Flats believed that 2010 was achievable, but argued against committing to phantom efficiencies in support of a 2006 closure.

Rocky Flats argued against committing to "phantom efficiencies". Rocky Flats believed that the 2010 baseline was credible and had been widely briefed to the community, the regulators and Congress. But the Site had explained widely that committing to 2006 would require additional funding, even if it would save life cycle costs. DOE-EM HQ had specifically told Rocky Flats to assume steady funding. This was part of what helped mold the 2010 baseline. Rocky Flats believed that emerging from a one-day meeting to announce that 2006 was now achievable without any additional funding simply due to efficiencies would lack credibility. Further, Rocky Flats argued that even achieving a 2010 closure was contingent on numerous political issues that HQ had to resolve, and contingent on a change in culture at DOE-HQ that thus far was far from evident. Rocky Flats demanded solid commitments of funding and receiver sites for waste shipments before moving to a 2006 schedule.

These discussions came to a head in November of 1997, when the Assistant Secretary and a team from DOE-EM came to Rocky Flats for a "work-out" to resolve these issues. The result was a commitment from the Rocky Flats and K-H Managers to achieve efficiencies and scope accelerations of 12% a year "that will result in savings of $1.3 billion and making closure in 2006 possible." DOE-EM in turn committed to expedite Special Nuclear Materials (SNM) removal, open WIPP and other receiver sites, avoid scope creep and other measures. At the time this seemed a breakthrough for both sides. Rocky Flats committed to DOE-EM to move to a 2006 closure target. DOE-EM committed to Rocky Flats to support expedited cleanup without language on phantom efficiencies Rocky Flats believed that if in fact DOE-HQ delivered on its commitments, it could be possible to achieve true 12% acceleration a year.

This evolution of the strategy is also reflected in the evolution of congressional language. The 1997 appropriations bill described positively, “accelerated cleanup programs” at sites such as Fernald and Rocky Flats, and called for additional funding of up to $50 million to support these efforts. The notion of a specific end date for the Rocky Flats closure was not discussed explicitly until the 1998 appropriations bills, where the potential cost savings of $1 billion by moving from 2010 to 2006 was explicitly cited by Congress as the basis for increasing the funding for Rocky Flats. The strategy cannot truly be said to be fully implemented by Congress until Congress established the Closure Fund in 1998, a separate appropriations account specifically designed for “those DOE sites which have an established cost, schedule and project plan which permits closure of the entire site by 2006. At that time, the conferees are aware of only two sites which met those criteria: Rocky Flats, Colorado and Fernald, Ohio.”

Unfortunately, Congress documented its position too quickly. The November 1997 “work out” agreement did not mean Rocky Flats was now on an official 2006 schedule. Rocky Flats interpreted the “work out” commitment to mean that it would make every effort to accelerate its 2010 schedule to enable the stretch goal of 2006. During the 1998 budget discussions, this ambiguity became intolerable to the Secretary of Energy. The Secretary, in an October 1997 speech in Jefferson County, Colorado, declared Rocky Flats an “accelerated cleanup pilot project” and declared a cleanup date of 2006. Rocky Flats personnel considered the Secretary’s statement to be simply a glorification of the status it already enjoyed based on Congressional support and its commitment to target 2006 closure. Similarly, DOE-EM believed the 1997 agreement with Rocky Flats gave the Secretary what he needed to back up his 2006 commitment. Both DOE-EM HQ and Rocky Flats managers were wrong.

When the Secretary announced that Rocky Flats would move to a 2006 schedule, he neither understood nor accepted the fine distinction between 2006 as a stretch goal and as a firm commitment. The divergence between the understanding of just what kind of commitment DOE had to a 2006 closure became evident as the next budget cycle came around. The Secretary and his staff were shocked at statements from the Site that the likelihood of closure by 2006 was “remote.” The Site was shocked that the Secretary’s office seemed not to understand that the 2006 commitment under the proposed funding was still a stretch goal based on DOE-HQ delivering the seemingly impossible. The Site’s baseline continued to describe a 2010 closure, and the Site claimed that a firm commitment to 2006 would only be possible with substantial extra funding.

In early 1998, shaken by statements from Rocky Flats that conflicted with DOE-HQ budget statements that Rocky Flats would close by 2006, the

Secretary dispatched his policy advisor to achieve the political clarity missing from the November 1997 agreement. The goal was to achieve "message discipline" – to end the divergent public statements. The Secretary's advisor realized that Rocky Flats' reluctance to embrace 2006 was not mere bureaucratic turpitude. He was sympathetic to Rocky Flats' sense that the system simply would not deliver what was needed to enable closure by 2006. So the Secretary's Office worked with Rocky Flats, K-H, and DOE-EM to craft the document designed to seal the 2006 deal. It was an overall management plan that described in specific detail every complex-wide action needed to support 2006, with a schedule.[17] This document, the Rocky Flats Closure Project Management Plan, later became a report to the President, and was released to the media by the Secretary. This completed the formal process of aligning the Rocky Flats planning process to the Secretary's public commitments. Rocky Flats was now committed to 2006. DOE-HQ was committed to 2006. And the 2006 commitment was presented to Congress as a core element of the strategy of the success of the entire DOE-EM complex.

This completed the formal process of aligning the Rocky Flats planning process to the Secretary's public commitments. Rocky Flats was now committed to 2006.

For most of the period since completion of the Rocky Flats Closure Project Management Plan in June 1998, the political path to closure consisted mainly of implementing the strategy. There were some rough moments, such as when K-H in 1999 informed Congress that despite congressional funding at the requested levels, DOE was imposing costs on Rocky Flats out of the closure scope. These costs, K-H argued, were in effect "taxes" on the cleanup that were impacting 2006. When confronted with information from K-H suggesting that Rocky Flats needed tens of millions of dollars extra to be kept whole, the Secretary rejected the notion and proclaimed Rocky Flats can and will close by 2006 with the money already provided them.

The Secretarial decision to attempt a non-competitive procurement for a contract succession at Rocky Flats in July 1999 and the negotiations and supporting decisions that led to signing a closure contract with K-H in January 2000 are evidence of the final maturation of the strategy. While these decisions do not reflect a significant change in the political path to closure, they do demonstrate the strength of the political momentum of, and investment in, the Rocky Flats closure project. The Secretary of Energy received letters in support of a non-competitive procurement for K-H, one from Democratic Governor Roy Romer and one from Republican Senator Wayne Allard. At various points in the procurement process, the Secretary had to contend with rumors that the decision was motivated by politics. Further, both internal DOE rules and standing appropriations language called for DOE to use competitive procurements unless the Secretary certified to Congress that a specific non-competitive process was justified for a specific procurement, and this could only be done for specified reasons.

The fact that the Secretary was willing to overcome these obstacles to seek a closure contract with K-H, that the Secretary did indeed face political opposition to this move, and that this political opposition was overcome by a bipartisan coalition of lawmakers supportive of this decision is a fitting testimony to the importance of the overall strategy to closure. The lesson is that a strategy, such as described in this section, made it possible for the DOE to consider an action of potentially enormous value to the public that also carried with it enormous political risks.

The lesson is that a strategy, such as described in this section, made it possible for the DOE to consider an action of potentially enormous value to the public that also carried with it enormous political risks.

The Colorado Dimension of the Strategy

The political path to closure did not run only from the Site to Washington, D.C. – it ran through Denver as well. Political support for the Rocky Flats Closure Project would not have been possible without the active and energetic engagement of the political leadership of the state in the critical years of 1995-1998.

This engagement took many forms. The involvement of the Lt. Governor was essential to the successful negotiation of RFCA. (See *Regulatory Framework* section.) As discussed above, the RFCA was a key element enabling the political support from Congress necessary to secure the deal. In the period after the signing of the RFCA in 1996, the Lt. Governor's presence was critical to the effective implementation of RFCA. Staff at DOE, the Colorado Department of Public Health and Environment (CDPHE) and the U.S. Environmental Protection Agency (EPA) felt far more obliged to behave in the spirit of the "consultative process" knowing that the lieutenant governor would in the end adjudicate any staff level disputes.

Colorado's support for the closure project went beyond support for the RFCA. Colorado's elected officials – mostly the Lt. Governor but also at times the Governor – intervened at key moments with Washington policy makers (in Congress and DOE) to provide political support to Rocky Flats closure. Further, the Lt. Governor played a key role in building and maintaining a consensus among local elected officials in support of Rocky Flats closure. Lt. Governor Gail Schoettler had served as state treasurer from 1990-1994 and was selected by Governor Romer as his lieutenant governor running mate for his 1994 re-election. After his re-election, Lt. Governor Schoettler was tapped to be the state's chief negotiator on cleanup agreements at the Rocky Mountain Arsenal and Rocky Flats. To many, it was clear that the Lt. Governor was being groomed as the Governor's heir apparent when his third and presumably final term would end in 1998. Success at Rocky Flats was thus critical to the Lt. Governor's own political career.

The Lt. Governor's interventions took many forms. She frequently called or wrote to the Secretary of Energy on a funding issue or to expedite a decision on a shipping campaign. Perhaps her most consistent efforts involved mobilizing local governments to act in unison in support of Rocky Flats. The Lt. Governor organized numerous of these "mayors letters" between 1996 and 1998, stating the community's consensus view on the need for more funding, opening WIPP and expediting removal of waste and materials. The Lt. Governor's internal credibility was further enhanced by her role on the Commission to Study External Regulation of DOE Nuclear Facilities. While this specific commission and its recommendations did not have a great deal of lasting impact (DOE dropped its pilot program for NRC regulation in 1999) it provided the Lt. Governor with both technical credibility and high level agency access at a critical moment in the development of the Rocky Flats closure project. Overall, the Lt. Governor's work on RFCA, her interventions with the Secretary and various assistant secretaries and her mobilization of the community on behalf of a consensus view of the Rocky Flats cleanup helped enable the strategy. She was able to demonstrate on many issues, over many years, that community and regulator support for the cleanup was real.

KEY SUCCESS FACTORS

A great deal of this narrative is unique to Rocky Flats. It depended on a specific set of players, a specific configuration of circumstances and even certain socio-economic preconditions that are less likely to be replicated at other sites. However, every site has its own unique set of circumstances, challenges, and opportunities that must be understood, analyzed, and addressed. The fundamental lesson for this section is that any site that moves from a steady-state ongoing operation to closure will experience massive dislocations and traumas, internal and external. Overcoming these traumas will require political support. Political support will necessitate a strategy.

1. <u>Every closure site needs a strategy</u>. This is not profound to state, but it is extremely difficult to implement. Early in the process of closure planning a site needs to establish clear and specific performance targets. These targets need to be described to congressional members in easily understandable terms. The site needs to explain what it needs to achieve these targets, and what consequences it is prepared to bear if it fails. These targets need to be part of an achievable overall plan for closure, and accountability to these targets must be maintained constantly. State political leaders, environmental regulators and DOE HQ – political leadership and the career bureaucracy – must buy into and support these goals and plans. Ideally, this should be more formal than it was at Rocky Flats and should be laid out clearly at the outset of planning, as opposed to developing iteratively through recurring controversies as it did at Rocky Flats.

2. The strategy cannot succeed without political support from DOE. No strategy can succeed without support from the political leadership of the Department, at the highest level.

3. Alignment among the contract, the regulatory agreement, the budget and site planning documents. The strategy cannot be one of many activities pursued by the site. Either the strategy governs the entire mission focus and closure process or it is irrelevant.

4. DOE and the Contractor must collaborate. The contractor will have more flexibility to work with Congress and the political system; DOE will have more flexibility to work the internal system. Both are needed for success. At Rocky Flats there were occasional divergences between DOE and K-H. When these occurred they made things harder. This collaboration will mean DOE occasionally takes risks that make them uncomfortable. It will mean the contractor often having to address issues that make them uncomfortable. This is the way it must be. No strategy can be successful if it is the sole product of either DOE or the contractor.

5. The basic principles of the strategy must be continually repeated and reaffirmed. Every presentation, every slide show, every Hastings brief or Amelia Island presentation must contain the same basic message. In exchange for funding and support, we pledge to demonstrate specific annual progress and get the whole job done by a date certain. There is no such thing as over-repetition of the message.

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Rocky Flats Closure Legacy

Regulatory Framework

State of Colorado, EPA and DOE recognize workers upon completion of Pu-contaminated soils at 903 Pad and Lip Area. The DOE, EPA, and state of Colorado had an outstanding working relationship and the same goal for Site cleanup. From left to right, Colorado Environmental Director Howard Roitman, EPA, Region 8 Administrator Robbie Roberts, and Rocky Flats Manager Frazer Lockhart.

INTRODUCTION

During the early 1990s, several key issues and events shaped the environmental program at Rocky Flats. Following a federal raid alleging criminal violations of environmental laws, operations were curtailed in late 1989 to make various safety improvements as the government contemplated the resumption of nuclear weapons production. By 1992, and with the end of the Cold War, the need for Rocky Flats to provide nuclear weapons was eliminated and the post-production era had commenced. The Site's mission had shifted from one of weapons production to risk reduction, cleanup, and closure. Although an accelerated closure vision had not yet been fully developed, the future of the Site as an environmental cleanup project of enormous proportions was becoming clearer.

In January of 1991 the Interagency Agreement (IAG)[18] among the U.S. Department of Energy (DOE), the Colorado Department of Public Health and Environment (CDPHE) and the U.S. Environmental Protection Agency (EPA) became the binding regulatory agreement governing environmental remedial action at Rocky Flats. However, beginning in 1993 representatives from DOE, EPA and CDPHE began discussions to create a new regulatory agreement for Rocky Flats, which clearly focused on cleanup to achieve ultimate Site closure. Their efforts were groundbreaking and resulted in an agreement which clearly supported and accelerated cleanup of the Site. The result of these discussions, The Rocky Flats Cleanup Agreement (RFCA)[3] signed in July of 1996, set in place the concepts and commitments for Site closure and the goal to align the project with community preferences. The development of the Rocky Flats regulatory framework, which includes the journey from the IAG to the successful implementation of RFCA, contains valuable lessons for DOE closure sites complex wide.

Each of the parties involved in the cleanup of the Rocky Flats Site – EPA, CDPHE, DOE, and K-H - had a vested interest in, and a commitment to, achieving closure in 2006.

Several key issues underline the success of the effort. Critical analysis of the IAG resulted in specific process and regulatory improvements, which became the basis for RFCA. RFCA realigned the roles and responsibilities for all parties of the agreement to refocus on accelerated Site closure and streamlined the processes necessary to accomplish remediation work. The relationships built and the focus on accelerated closure shared by both regulators and DOE created tremendous synergy for closure efforts. Aligning the regulatory framework with the Closure Project Baseline and the 2000 Closure Contract helped enable the accelerated closure of Rocky Flats to become a reality.

DISCUSSION

Compliance Agreement (1986)

On July 31, 1986, DOE, CDPHE, and EPA entered into a Compliance Agreement[19] which defined roles and established milestones for major environmental operations and response action investigations for the Site. The 1986 Compliance Agreement predated the IAG and established requirements for compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Through this action, the 1986 Compliance Agreement established a specific strategy, which allowed for management of high-priority past disposal areas and low-priority areas at the Site.

The 1986 Compliance Agreement also established roles and requirements for compliance with the Resource Conservation Recovery Act (RCRA) and Colorado Hazardous Waste Act (CHWA) through compliance with interim status requirements and submittal of required permit applications and closure plans. Through the 27 specific tasks identified in the five schedules included in the 1986 Compliance Agreement, DOE and Rockwell identified over 2,000 waste generation points and 178 solid waste management units (SWMUs) and RCRA/CHWA-regulated closure sites. The SWMU terminology is a RCRA designation consisting of inactive waste disposal sites, accidentally contaminated sites, and sites found to pose potential environmental concern due to past or current waste management practices. SWMUs were initially identified in 1985 in the Draft Comprehensive Environmental Assessment and Response Program (CEARP) Phase I: Installation Assessment.[20] The study consisted of record searches, open literature survey, inspections, and interviews with Site employees.

Implementation of the IAG (1991)

The 1986 Compliance Agreement did not reflect the requirements of the 1986 Superfund Amendments and Reauthorization Act, in particular the requirements governing federal facility National Priorities List (NPL) Sites pursuant to Section 120 of CERCLA. EPA's and CDPHE's priorities for investigation of the Site were also clarified based on increased knowledge of the Site gained from the ongoing investigation. The new priorities placed greater emphasis on Operable Units (OUs) that, based on information available, were known to pose the greatest risk to humans and the environment through actual or potential contact with wastes or contaminated soil, air, or water. EPA and CDPHE established criteria reflecting priorities for addressing both human health and environmental issues. These factors necessitated revision of the 1986 Compliance Agreement beginning in 1990.

On January 22, 1991, DOE, EPA, and CDPHE signed Federal Facility Agreement and Consent Order CERCLA VIII-91-03, RCRA (3008[h]) VIII-91-07), and State of Colorado Docket #91-01-22-01, referred to as the Rocky Flats Interagency Agreement (IAG). The IAG regulated and provided for enforcement of DOE's investigation, planning, and conduct of response and corrective actions at the Site. It also established a comprehensive plan for integrating CERCLA and RCRA/CHWA requirements for these actions. The IAG divided the remedial activities into 16 OUs. In the IAG the SWMUs were renamed individual hazardous substance sites (IHSSs). IHSSs are specific locations within OUs where solid wastes, hazardous substances, pollutants, contaminants, hazardous wastes, or hazardous constituents may have been disposed or released into the environment within the Site at any time, irrespective of whether the location was intended for the management of these materials.

The 16 OUs were groupings of IHSSs into single management areas based on similarities of contaminants, geographical location, and possible interrelation of the IHSSs. EPA or CDPHE, or in some cases EPA and CDPHE jointly, were identified as the Lead Regulatory Agency (LRA) for each designated OU. The IAG also established a schedule including 221 milestones spread over ten years to guide and enforce activities related to these 16 OUs. The identified LRA had approval authority over DOE's remediation activities and compliance with the schedule and milestones for each OU.

Problems with the IAG

Problems with the IAG began almost immediately. Milestones in the IAG had been prepared based on detailed analysis of the work, and budgets were prepared that were coordinated with and supported the milestones. Two weeks after the IAG was signed the environmental restoration budget was cut by more than $20M, about 15 percent. This action directed from DOE's Environmental Management (DOE-EM) headquarters organization confused and outraged the regulators and created challenges to successfully meeting the milestones almost immediately.

The process of negotiating linked, sequential milestone extensions on a one-by-one basis resulted in fewer resources being available for accomplishing cleanup work.

Any milestone that was missed or expected to be missed required an individual request for extension and negotiation through a tiered process. This was true even when milestones for a specific OU were linked in serial order and dependent on completing one to begin the next. The process of negotiating milestone extensions on a one-by-one basis resulted in fewer resources being available for accomplishing cleanup work. These "high transaction costs" could not be recovered, and difficult negotiations between Rocky Flats and the regulatory agencies led to entrenched positions on all sides regarding who was at fault, eroding what little good faith and trust existed at the time.

Compounding this difficulty was the requirement that DOE obtain approval of both CDPHE and EPA on documents submitted for approval, even though only one agency was the designated lead for a particular OU. In several instances, the agencies submitted inconsistent comments or opposing positions on resolution of a particular concern. Rocky Flats was required to resolve these differences to obtain approvals. This also contributed to poor working relationships and slowed progress of work.

In several instances, the CDPHE and EPA submitted inconsistent comments or opposing positions on resolution of a particular concern. Rocky Flats was required to resolve these differences to obtain approvals

During 1992 and into 1993, it became apparent that unrealistic schedule and cost assumptions would make it impossible for Rocky Flats to fully comply with the IAG schedules. Although in 1991 and 1992 Rocky Flats was able to juggle resources and priorities to avoid missing milestones, a "bow wave" of work was building, and DOE began missing several milestones in March 1993. The agency projected that a series of future milestones were likely to be missed. In early 1994, DOE proposed an agreement to toll the stipulated penalties associated with these milestones for a certain period. According to the terms of the Tolling Agreement,[21] signed by the IAG Parties on July 7, 1994, DOE paid cash penalties to EPA and the State, and conducted Supplemental Environmental Projects, for a total value of $2.8 million. The agreement tolled stipulated penalties until January 31, 1995.

Although much of the IAG activity became focused on milestones, the fundamental purpose of the IAG was to reduce the risk to the public from current and past Site activities. Several OUs were proceeding to no-action decisions, but these addressed low or non-existent risks, with higher-risk OUs delayed pending cessation of production operations in the buildings. Meanwhile, the widely recognized priority for risk reduction associated with plutonium solutions and residues in aging systems and buildings, and deteriorating conditions, was not addressed at all by IAG-required environmental restoration activities. On a sitewide basis high priority nuclear hazards competed with relatively low risk OUs for available cleanup resources. Budget tension became a key concern and led to a persistent belief that the failure to meet IAG milestones was due to inadequate allocation of funding to do the work, this owing largely to the 1991 IAG budget cut. In reality, increases to the budget could not fix the underlying flaws inherent in the IAG process. This was evident in that unspent environmental remediation annual funding was sometimes carried over into successive years, unable to be spent in the year in which it was authorized. The DOE believed the IAG difficulties were a result of a lack of project direction by the Site and a poorly defined process with the regulators.

Transition to RFCA

Because of the IAG concerns, Tolling Agreement, and issues surrounding the scope of work for response actions at the Site and given that the Rocky Flats nuclear weapon component production mission had ended, beginning in mid-1994 DOE, CDPHE, and EPA began negotiations to substantially modify or replace the IAG. Subsequently, in light of negotiations proceeding well toward a new agreement EPA and CDPHE agreed not to assess further stipulated penalties for violations of the IAG milestones occurring after January 31, 1995. DOE continued appropriate investigation and remediation work in the IAG OUs subject to LRA approval during this period.

The regulatory challenges were addressed by two fundamental shifts in thinking that occurred during the approximately 2-1/2 years of negotiations that resulted in RFCA. First and most importantly, it was agreed that resources must preferentially go to address the highest risks (e.g., environmental cleanup would in most cases await the special nuclear material cleanup). Second, a Site-wide or holistic approach to planning and execution of cleanup work would allow these risks to be addressed while progress towards environmental cleanup was achieved. A marked change in the mission for Rocky Flats as a weapons production facility to one of a cleanup Site provided an even greater emphasis on developing a regulatory agreement for the cleanup of Rocky Flats. K-H, the contractor awarded the project in July of 1995, brought specific expertise in environmental remediation. With these changes in place, the need for a regulatory agreement outlining the cleanup process became of paramount importance.

The successful negotiation and implementation of RFCA was a critical aspect of achieving accelerated Site closure. It provided the regulatory flexibility necessary to implement accelerated closure with a bias for action.

Broadening the Regulators Scope

Early in the negotiations for RFCA, the negotiation teams became preoccupied with defining the process to request and obtain adequate project funding from DOE Headquarters and Congress. Rocky Flats had been viewed as having reduced very little risk, despite the investment of millions in government funds in the early 1990's. During the timeframe of the negotiations, a bold decision on the part of Rocky Flats' senior leadership increased the scope of regulatory discussions to incorporate activities Site-wide. These discussions included the traditionally non-regulated activities associated with special nuclear materials. Once the focus of negotiations broadened to include regulated and non-regulated

Site-wide activities, the ability to reallocate funds to high priority cleanup efforts removed project funding language as a roadblock.

Once the focus of negotiations broadened to include regulated and non-regulated Site-wide activities, the ability to reallocate funds to high priority cleanup efforts removed project funding language as a roadblock.

The negotiating team decided to also shift the milestone focus and drive the environmental restoration effort towards completion, reducing the spending on studies and research. This effort became known as a "Bias for Action" and fundamentally redirected efforts toward planning and executing cleanup work through accelerated actions rather than through the "traditional" paperwork-intensive CERCLA process. The application of risk-based prioritization techniques provided a level of predictability to the project planning. The team's goal was to prove that investing in Rocky Flats was money well spent in real risk reduction and closure efforts.

Rocky Flats' decision to broaden the scope of regulatory discussions had another motive, to improve relationships with regulatory agencies. Information was provided on priorities, planning, and budgeting activities not previously regulated by either the EPA or CDPHE to provide an integrated approach to Site cleanup. This flow of information began to change the mistrust between agencies, building credibility for the Rocky Flats Field Office (RFFO) and its subsequent efforts for cleanup. In turn, the EPA and CDPHE allowed Rocky Flats to develop a more flexible approach to regulatory compliance to best support a cost-effective cleanup process. Rather than have the regulatory agencies mandate the specific sequence and timing for completion of project milestones, the goal was to provide the framework for cleanup activities based on an understanding of how non-regulated activities were being accomplished in the early 1990's.

Involvement of Colorado's Elected Officials

Well into the negotiation process for RFCA, Colorado's Governor assigned the Lt. Governor to represent the state in obtaining a cleanup agreement that would result in the accelerated closure of Rocky Flats. The Lt. Governor, a driving force in the development of the Rocky Mountain Arsenal Agreement (a Defense Superfund site also near Denver), provided focus for the development of the vision for closure of Rocky Flats. The RFCA negotiation team recognized the commitment to Site closure on the part of congressional stakeholders, including then State Senator Wayne Allard, and Congressmen David Skaggs and Mark Udall, along with local elected officials and the governor's office. The commitment and involvement of senior state and congressional officials created a sense of urgency in cleanup efforts. External pressure from key community members continued to drive accountability for DOE, EPA and CDPHE to not impede the overall cleanup and closure progress.

RFCA Vision

The RFCA negotiation parties realized that certain guiding assumptions about the future of Rocky Flats could be agreed upon as a means to achieve common understanding regarding the major objectives of the cleanup. The RFFO Manager suggested that the best way to satisfy this realization was to package these understandings as a "vision statement." In its simplest form, a vision is a concise statement that clearly expresses a common theme for complex activities. The Manager used President Kennedy's early 1960's declaration that the United States would put a man on the moon by 1970 as a prime example of a vision.

With the vision concept in mind, the RFCA parties solicited input from a broad range of stakeholders and used recommendations from previously completed community studies to construct the "Rocky Flats Vision." As finalized, it was agreed as follows:

> The Vision provides a broad statement for the future of Rocky Flats. All activities, agreements, planning documents and other legal agreements shall be guided by the vision and preserve, to the maximum extent possible, the full range of options and opportunities necessary to help accomplish and attain the vision (RFCA, Appendix 10).

The RFCA framework and regulatory approach to Site closure marked a unique and successful partnership between the DOE and state and federal regulatory agencies.

Senior policy and regulatory authorities signed the document outlining the Vision, including the Governor and Lt. Governor of Colorado, the EPA Deputy Administrator, the Executive Director of the CDPHE and the Acting Regional Administrator for EPA Region 8. The established Rocky Flats vision was:

- To achieve accelerated cleanup and closure of Rocky Flats in a safe, environmentally protective manner and in compliance with applicable state and federal environmental laws;
- To ensure that Rocky Flats does not pose an unacceptable risk to the citizens of Colorado or to the Site's workers from either contamination or an accident; and,
- To work toward the disposition of contamination, wastes, buildings, facilities and infrastructure from Rocky Flats consistent with community preferences and national goals (RFCA, Appendix 9).

The Vision included goals supporting Site closure and addressed the major assumptions for cleanup; the reduction of risks posed by plutonium, other special nuclear material and transuranic wastes was the highest priority. Other areas addressed are listed in the section below as objectives for RFCA. The Vision also outlined the need for public involvement and local government consultation regarding Site activities. It stated that the Site would be cleaned up "to the extent feasible" within current technology and budgetary resources or legal requirements, but would not be cleaned up to background levels. To paraphrase the Governor's words, it was a less than perfect cleanup, but it was the right agreement.

Implementation of RFCA (1996)

On July 19, 1996, DOE, EPA, and CDPHE signed Federal Facility Agreement and Consent Order CERCLA VIII-96-21, RCRA (3008[h]) VIII-96-01, and State of Colorado Docket #96-07-19-01, referred to as RFCA. RFCA terminated and replaced the IAG and has since served as the regulatory agreement to accomplish the required cleanup of radioactive and other hazardous substance contamination at the Site.

Each objective included a description of the anticipated near-term and intermediate site conditions for the covered topic.

As discussed, RFCA expanded the cleanup scope to include disposition of all buildings, which were not covered in the IAG OUs, and changed the regulatory approach in several significant respects. It incorporated an unenforceable Preamble recitation of the objectives for eight topics that influenced cleanup decision-making that were developed in consultation with the community and local governments, resulting in the Vision for the Site. In addition, each objective included a description of the anticipated near-term and intermediate site conditions for the covered topic. Per the RFCA Preamble, Section B paragraph 9g, the Intermediate Site Condition is:

> the period of time during which all weapons useable fissile material and transuranic wastes will be removed from RFETS [the Site]. By the end of this period, none of these materials, nor the buildings that contained them, will remain. Also by the end of this period, all low-level, low-level mixed, hazardous, and solid wastes will have been shipped off-site, disposed, or stored in a retrievable and monitored manner to protect public health and the environment. Any remaining cleanup will be completed. Activities occurring in this period are anticipated to be completed about 12 to 20-25 years from now.

RFCA Objectives and Status

The following descriptions of the summary objectives and intermediate site conditions are taken from Section B of the RFCA Preamble. The status as of early 2006 of each topic in relation to its anticipated intermediate site condition is also described.

1. *Disposition of Weapons Useable Fissile Materials and Transuranic Wastes*

Summary: DOE will stabilize, consolidate, and temporarily store weapons useable fissile materials and transuranic wastes on-site for removal; ultimate removal of weapons useable fissile material is targeted for no later than 2015.

Intermediate Site Condition: Weapons useable fissile materials are targeted for removal from RFETS by 2015. By the end of the Intermediate Site Condition, all transuranic waste will have been removed from RFETS.

Status: All weapons useable fissile material was removed by 2003 and transuranic waste removal for disposal at WIPP was completed in 2005.

2. *On-Site and Off-Site Waste Management*

Summary: Waste management activities for low-level, low-level mixed, hazardous, and solid wastes will include a combination of on-site treatment, storage in a retrievable and monitored manner, disposal, and off-site removal. Low-level and low-level mixed wastes generated during cleanup will be stored in a safe, monitored and retrievable manner for near-term shipment off Site, long-term storage with subsequent shipment off Site and/or long-term storage with subsequent disposal on-site of the remaining wastes.

RFCA left open the option for disposal of low-level wastes on-Site.

Intermediate Site Condition: Waste materials that are to be removed will have been shipped off Site. Any necessary follow-up cleanup related to the former storage sites will have been completed. By the end of this period, decisions will have been made regarding stored material for its continued storage, treatment or disposal.

Status: All waste materials generated during the Project were shipped off site for disposition. Cleanup for closure of former storage sites was completed in October 2005.

3. Water Quality

Summary: At the completion of cleanup activities, all surface water on Site and all surface and ground water leaving RFETS will be of acceptable quality for all uses.

All surface and ground water leaving RFETS will be of acceptable quality for all uses.

Intermediate Site Condition: By the time cleanup activities are completed, all on-site surface water and all surface water and groundwater leaving RFETS will be of acceptable quality for all uses, including domestic water supply. Ground water quality in the Outer Buffer Zone and off Site will support all uses. On-site ground water will not be used for any purpose unrelated to RFETS cleanup activities. Reliable monitoring and controls to protect water quality during storage of plutonium and other special nuclear material and wastes, and during storm events, will continue. To assure the above described water quality, long-term operation and maintenance of waste management and cleanup facilities will continue.

Status: Surface water from the Rocky Flats industrial area originates from rainwater surface runoff and underground seeps. It is collected and naturally attenuated through a series of ponds. After leaving the "terminal ponds" (the last in the series), surface water exits the Site boundary.

All surface water and groundwater leaving the Site boundaries currently meet the RFCA objectives based on the results of routine, continuous surface water monitoring for radionuclides and historical, non-routine monitoring of surface water and groundwater for a limited number of other analytes of interest. Surface water downstream of the Woman Creek and Walnut Creek terminal ponds currently meets this objective and Colorado water quality standards based on the results of routine, continuous surface water monitoring for radionuclides and predischarge monitoring of the terminal ponds for radionuclides and a limited number of other analytes of interest.

Upstream of the terminal ponds, surface water sample results do not always meet Colorado surface water quality standards for some analytes at some on-site monitoring locations. However, the objective should eventually be met based on remedial actions completed during closure. Completed accelerated actions have removed significant sources of surface water contamination. The Solar Ponds, East Trenches, and Mound Plume barriers and passive treatment systems, and the Present Landfill seep collection and passive aeration treatment system continue to reduce surface water contaminant loading from residual subsurface soil and groundwater contamination.

4. *Cleanup Guidelines*

Summary: Cleanup activities will be conducted in a manner that will:

– reduce risk;

– be cost-effective;

– protect public health;

– protect reasonably foreseeable land and water uses;

– prevent adverse impacts to ecological resources, surface water, and ground water; and

– be consistent with a streamlined regulatory approach.

Cleanup Guidelines supported a streamlined regulatory approach.

Intermediate Site Condition: After off-site disposition of plutonium, other special nuclear material and transuranic wastes, the cleanup of the buildings that contained these materials, and of any residual waste from their shipment or storage, will be completed. Appropriate monitoring, operation and maintenance of any remaining treatment, storage, or disposal facilities will continue.

Status: Building cleanup and waste disposition is complete. Several areas containing wastes buried more than 30 years ago, two historical landfills with engineered covers meeting landfill closure criteria, and some infrastructure and building slabs/basement walls below three feet from the surface remain. Infrastructure and building structures that have measurable residual contamination are six feet or more below the ground surface, with contamination fixed in place. Appropriate monitoring and operation and maintenance of the site has been identified and implemented.

5. *Land Use*

Summary: Cleanup decisions and activities are based on open space and limited industrial uses; the particular land use recommendations of the Future Site Use Working Group (FSUWG) are not precluded; specific future land uses and post-cleanup designations will be developed in consultation with local elected officials, local government managers, Rocky Flats Local

Impacts Initiative (RFLII), Citizen's Advisory Board (CAB), other groups and citizens. The Parties recognize the legal authority of local government to regulate future land use at and near RFETS.

Intermediate Site Condition: At the beginning of this period, access to the Buffer Zone will continue to be controlled consistent with the safety and security needs of plutonium, other special nuclear material, and transuranic wastes. After weapons useable fissile material and transuranic wastes are removed, DOE will work with local elected officials, local government managers, RFLII, CAB, other groups and citizens to determine the optimal use of the Buffer Zone. Any access controls and/or institutional controls that are necessary or appropriate for public health, environmental protection, ongoing monitoring and operation and maintenance activities, will continue.

Cleanup decisions and activities are based on open space and limited industrial uses;

Status: The future land use for RFETS is a National Wildlife Refuge, with a portion of the Site retained by DOE for long-term surveillance and maintenance activities.

6. *Environmental Monitoring*

Summary: Environmental monitoring will be maintained for as long as necessary.

Intermediate Site Condition: After plutonium, other special nuclear material and transuranic wastes are gone, the monitoring system will continue to address remaining waste management facilities and water quality needs. This monitoring system will remain in place for as long as necessary for the protection of public health, environment, and safety.

Status: Environmental monitoring is conducted pursuant to the Integrated Monitoring Plan (IMP) established in accordance with RFCA. The IMP was first approved in 1997 and is reviewed annually and updated as needed (through Fiscal Year 2003 reviews and any needed updates were performed quarterly).

7. *Building Disposition*

Summary: All contaminated buildings will be decontaminated as required for future use or demolition; unneeded buildings will be demolished.

Intermediate Site Condition: By the end of this period, the remaining buildings that were used for plutonium, other special nuclear material, and transuranic waste storage will have been demolished. Also by the end of this period, decisions will have been made regarding material that has been stored in a retrievable and monitored manner for its continued treatment, storage or disposal.

Status: All Site buildings were decommissioned, decontaminated as necessary, and demolished except for the east and west vehicle inspection sheds that DOE retains for future use.

8. *Mortgage Reduction*

Summary: Weapons useable fissile material and transuranic wastes will be safely consolidated into the smallest number of buildings to reduce operating costs and shrink the security perimeter; contaminated and non-contaminated buildings will be decommissioned and either demolished or turned over for other non-DOE uses.

Intermediate Site Condition: During this period, the secured area will be further reduced and eventually removed. Operating costs will be minimized. By the end of this period, weapons useable fissile material and transuranic wastes will have been removed from RFETS and the related buildings will have been decontaminated and either demolished or converted to non-DOE uses. Closure or conversion to non-DOE use of non-contaminated buildings will be completed by the end of this period. Also by the end of this period, in consultation with local officials, the Community Reuse Organization, and interested members of the public, existing RFETS infrastructure will be essentially eliminated, except for monitoring, and operation and maintenance of any remaining waste storage or disposal facilities, or to support RFETS reuse activities, to the extent that it is paid for by the users.

Status: See the status descriptions for On-Site and Off-Site Waste Management, Land Use, and Building Disposition presented earlier.

Implementation of a Streamlined Regulatory Approach

The streamlined regulatory approach summarized in Objective 4, Cleanup Guidelines, was implemented in several ways. Two new OUs were established: the Industrial Area (IA) OU with CDPHE as the LRA, and the Buffer Zone (BZ) OU with EPA as the LRA. The 16 IAG OUs were realigned and consolidated to fit within these OUs, as was LRA planning,

The 16 IAG OUs were realigned and consolidated to fit within these OUs, as was LRA planning, investigation, and decision document review and approval authorities.

investigation, and decision document review and approval authorities. RFCA also coordinated all of DOE's cleanup obligations under CERCLA, RCRA, and CHWA in a single agreement to streamline compliance with these three statutes.

A consultative, accelerated action approach for the IHSSs was also delineated in RFCA. RFCA paragraph 79 provides, in part, the following:

> To expedite remedial work and maximize early risk reduction at the Site, the Parties intend to make extensive use of accelerated actions to remove, stabilize, and/or contain IHSSs. Focusing on IHSSs rather than OUs will allow most remedial work to be reviewed and conducted through one of the accelerated review and approval processes described in Part 9, rather than the RI/FS process….

The RFCA approach resulted in development of a credible planning and funding baseline from which enforceable RFCA regulatory milestones were established and almost always met.

The RFCA approach resulted in development of a credible planning and funding baseline from which enforceable RFCA regulatory milestones were established and almost always met. The RFCA Quarterly Reports provide a report of the annual milestone setting process and the "score cards" related to milestone achievement. Implementation of RFCA resulted in reducing the projected time and funding needed to achieve required cleanup. Eventually, relatively level annual "closure project" congressional appropriations for the Site were approved.

<u>The Action Level Concept</u>

In addition, to aid in evaluating accelerated action determinations for IHSSs, action levels (ALs) were established and used as described in RFCA paragraph 75:

> The Action Levels and Standards Framework, Attachment 5, establishes action levels for ground water and soil as well as action levels and cleanup standards for surface water. Attachment 5 also establishes a deadline for setting additional action levels for soil and interim cleanup levels for soil. Action levels and standards are requirements of this Agreement, but exceedance of an Action Level is not subject to penalties. The Framework action levels describe numeric levels of contamination in ground water, surface water, and soils which, when exceeded, trigger an evaluation, remedial action and/or management action. The Framework surface water standards are in-stream contaminant levels that, contingent on action by the Colorado Water Quality Control Commission to align stream classifications and standards with the Action Levels and Standards Framework, the regulators will require DOE to meet for activities undertaken prior to the final

> CAD/ROD, and which constitute the Parties' current joint recommendation for the CAD/ROD….

RFCA Attachment 5, Rocky Flats Action Levels and Standards Framework for Surface Water, Ground Water and Soils (ALF), has been modified several times.[22] ALs for soil are based on risk to the wildlife refuge worker (WRW) human receptors and ALs for groundwater are based on drinking water standards for groundwater: thus, an accelerated action evaluation for these media is based on impacts to human health. ALs for surface water are based on Colorado Water Quality Standards, which are protective of human health and ecological resources. Once an evaluation was triggered by the exceedance of soil or groundwater ALs, the threat to ecological receptors was considered in determining whether to take an accelerated action. An ERA, for purposes of the final remedy decision, is part of the CRA.

<u>Basis for Action Levels</u>

RFCA ALs were numeric levels that, when exceeded, triggered an action determination evaluation in accordance with RFCA Attachment 5 and an appropriate accelerated response action

RFCA ALs were numeric levels that, when exceeded, triggered an action determination evaluation in accordance with RFCA Attachment 5 and an appropriate accelerated response action (RFCA Attachment 5, Section 1.1). In general, RFCA ALs were based on the following:

<u>Soil ALs</u> were calculated to be protective of a wildlife refuge worker based on 1) a lifetime excess cancer risk of 1 x 10^{-5} and 2) a hazard index of 1. The more conservative of the two values was used as the soil AL (RFCA Attachment 5, Sections 4.0 and 5.0).

<u>Groundwater ALs</u> were based on surface water protection (RFCA Attachment 5, Section 3.1) by applying maximum contaminant levels (MCLs). Where an MCL for a particular contaminant was missing, the residential groundwater ingestion-based PRG value applied (RFCA Attachment 5, Section 3.2).

<u>Surface water ALs</u> (RFCA Attachment 5, Section 2.2) were based on Colorado surface water use classifications for the Site: water supply; aquatic life – warm 2; recreation 2; and agricultural. Numeric values were derived from the following:

- For metals, the site-specific standards or the basic standards applied. If the basic and site-specific standards differed for a particular metal, the site-specific standard applied.
- For inorganics, the site-specific standards or the basic standards applied. If the basic or site-specific standards differed for a particular inorganic, the site-specific standard applied.

- For organic chemicals, the more stringent of the basic standards or the site-specific standard applied.
- For radionuclides, the basic standards applied.

The surface water standards ALF was designed to protect are found in WQCC Regulation No. 31: Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) (basic standards) and the site-specific water quality standards in the WQCC Regulation No. 38 (5 CCR 1002-38) (site-specific standards). If a numeric value existed for multiple use classifications, then the lowest numeric value was selected as the AL.

<u>RFCA Accelerated Actions and Action Levels</u>

As discussed above, the need for a RFCA accelerated action was based on an action level (AL) evaluation. Characterization results were compared to RFCA soil ALs specified in ALF to evaluate whether the levels and extent of contamination triggered an accelerated action. Because of concerns by some in the community over the exposure parameters used to establish the radionuclide soil action levels (RSALs) in 1996, these levels were considered interim. The interim RSAL for plutonium was set at 651 pCi/g, corresponding to a $1x10^{-4}$ excess cancer risk for an open space user. Following an extensive public process, the RFCA Parties conducted a review to determine whether the interim RSALs should be modified. During the period of review, from 1996 to 2004, the future land use as a National Wildlife Refuge became law. Thus, the RSAL review expanded to reconsider soil ALs for all analytes, using the Wildlife Refuge Worker (WRW) exposure scenario. As a result of the review, soil ALs and the evaluation and implementing criteria for RFCA accelerated actions required under ALF were modified in 2003 based upon levels that were calculated to result in a lifetime excess cancer risk of $1x10^{-5}$ to the WRW. However, while this risk level equated with a surface soil concentration of 116 picocuries per gram (pCi/g) for plutonium-239/240, the RSAL for plutonium was established at a lower level of 50 pCi/g, which equates to about $3x10^{-6}$ risk. This lower RSAL was designed to help ensure the total risk from all radionuclides would be below $1x10^{-5}$ and to reduce plutonium concentrations that could migrate through the soil erosion pathway. The lower plutonium RSAL also met acceptable risk and annual radiation dose Applicable or Relevant and Appropriate Requirements (ARARs) for an unrestricted user scenario. For further discussion on the public process leading up to the modification of the RSALs see the *Stakeholder Involvement* section.

Because of concerns by some in the community over the exposure parameters used to establish the radionuclide soil action levels (RSALs) in 1996, these levels were left open for subsequent reconsideration.

In addition, the modified ALF implementing criteria required soils within three feet of the surface contaminated above the plutonium RSAL to be removed to below the RSAL. This also addressed the soil erosion pathway concerns. Thus, in the disposition of all IHSSs where plutonium 239/240 was the soil contaminant, 50 pCi/g in surface soil was the accelerated action trigger for soil removal.

Implementation of a No Further Accelerated Action Decision

If no accelerated action was required for an IHSS, the data were summarized in a Data Summary Report and the IHSS or IHSS Group was recommended for No Further Accelerated Action (NFAA). The Data Summary Report summarized, in tabular and graphical format, the data that justify the NFAA for the IHSS Group. Information provided in the Data Summary Report was used in the update to the Historical Release Report (HRR)[23] pertaining to the IHSS to further document the basis for NFAAs. If an accelerated action was taken, the confirmation sampling results were used to demonstrate that NFAA requirements were met for the IHSS.

Implementation of an Accelerated Action Decision

If an accelerated action was determined to be required, it was proposed in a draft decision document for LRA approval. Three types of RFCA accelerated actions have been conducted in accordance with the following RFCA decision documents:

- Proposed Action Memorandums (PAMs) implemented when remedy selection was straightforward, and remedial activities were estimated to take less than 6 months from commencement of the physical work to completion;
- Interim Measure/Interim Remedial Actions (IM/IRAs) implemented when a formal evaluation of remedial options was necessary or remedial activities were estimated to take more than 6 months from commencement of physical work to completion; and
- RFCA Standard Operating Protocols (RSOPs)[24,25] implemented for routine accelerated actions that are substantially similar in nature, for which standardized procedures were developed.

RFCA also provides that a RCRA/CHWA-permitted or interim status unit may be closed under a separate closure plan, or under a RFCA decision document.

At the completion of the accelerated action, regardless of the type of decision document implemented, a Closeout Report was prepared and submitted to the LRA for approval. The purpose of the Closeout Report was to document accelerated action activities for an IHSS Group. The Closeout Report summarized characterization data, the action taken, demarcation of excavation, confirmation sampling results, remediation waste volume and disposition, any changes in remediation approach and the rationale behind the change, stewardship recommendations, and the demarcation of residual contamination left in place.

Building Demolition: Development of the Decommissioning Program Plan (DPP)[26]

Development of the DPP was one of the early tests of RFCA and the consultative process. RFFO worked with CDPHE to develop this policy document and ultimately succeeded in establishing the framework for collaborative problem solving with the regulators.

The DPP refined the definitions of what work did and did not require regulatory approval, set out the parameters and the approval process for decommissioning decision documents, provided a means to obtain quick approval of work, and removed hundreds of uncontaminated buildings from the decision document approval process.

The DPP was a Sitewide decision document contemplated by RFCA, whose purpose is to establish an overall regulatory process for decommissioning all of the buildings at Rocky Flats. RFCA provided little guidance on how this process would work, and somewhat ambiguous definitions of what kinds of decommissioning work were to be regulated under RFCA. This made the development of the DPP a challenging endeavor, especially since building decommissioning projects were the first large, complex closure activities that would be done under the RFCA regulatory umbrella.

The DPP resolved a number of issues that were critical to striking a balance between adequate regulatory oversight and accelerated Site closure. The DPP refined the definitions of what work did and did not require regulatory approval, set out the parameters and the approval process for decommissioning decision documents, provided a means to obtain quick approval of work, and removed hundreds of uncontaminated buildings from the decision document approval process. The DPP also documented the expectations that the RFCA parties have for one another in their working relationships. The success of the decommissioning program is due, in part, to the working relationships that were established in the difficult development and negotiation of the DPP.

The Building Demolition Process Under RFCA

In accordance with RFCA, decommissioning activities were conducted as CERCLA removal actions. By October 2005, all buildings were removed except for the east and west vehicle inspection sheds retained for DOE uses.

Each Site facility was preliminarily screened as a Type 1, Type 2, or Type 3 facility (see below) based on the levels of contamination known or believed to exist within the facility. The EPA and CDPHE approved Decontamination and Decommissioning (D&D) Characterization

Protocol[27] and the Reconnaissance Level Characterization Plan, Appendix D of the D&D Characterization Protocol, guided the identification of hazards necessary for proper building typing. Generally, a building-specific Reconnaissance Level Characterization Report (RLCR)[28] was prepared that provided the basis for the building type for LRA concurrence. Prior to demolition of Type 2 or Type 3 buildings after decontamination, a Pre-Demolition Survey was conducted in accordance with the LRA approved Pre-Demolition Survey Plan. Then, a Pre-Demolition Survey Report (PDSR)[29] was prepared for LRA review and approval. Demolition was then conducted after the LRA approved the PDSR. The buildings were identified as Type 1, 2, or 3 as follows:

- Type 1 - Buildings Free of Contamination. "Free of contamination" means that the following conditions were met:
  - Hazardous wastes, if any, were removed and any RCRA units were properly closed in accordance with regulatory requirements for unit closure prior to demolition;
  - Routine surveys for radiological contamination showed the building was not contaminated;
  - Surveys, if required, for hazardous substance contamination showed the building was not contaminated; and
  - If any hazardous substances, including polychlorinated biphenyls (PCBs) in light ballasts or friable asbestos were present, they were an integral part of the building's structural lighting, heating, electrical, insulation, or decorative material.

- Type 2 - Buildings without Significant Contamination or Hazards, but in Need of Decontamination. Type 2 buildings contained some radiological contamination or hazardous substance contamination. The extent of the contamination was such that routine methods of decontamination sufficed and only a moderate potential existed for environmental releases during decommissioning. Most buildings where industrial operations occurred that used hazardous substances and/or radioactive materials fell into this category.

RSOPs were used for repetitive decommissioning activities regardless of the facility type.

- Type 3 - Buildings with Significant Contamination and/or Hazards. Type 3 buildings contained extensive radiological contamination, usually as a result of plutonium processing operations or accidents. Contamination existed in gloveboxes, ventilation systems, and/or the building structure. Those buildings that were used for plutonium component production along with the major support buildings for such production included Buildings 371/374, 771/774, 707, 776/777, and 779.

For Type 2 and Type 3 buildings, four types of RFCA decision documents, which were approved by the LRA, were used for decommissioning activities:

- PAMs, written when activities took less than 6 months to complete;
- IM/IRAs, written when activities took more than 6 months to complete;
- Decommissioning Operations Plans (DOPs), used for Type 3 buildings; and
- RSOPs, used for repetitive decommissioning activities regardless of the facility type.

Decommissioning of Type 2 buildings was typically conducted under the RSOP for Recycling Concrete,[30] the RSOP for Facility Disposition,[31] and the RSOP for Facility Component Removal, Size Reduction, and Decontamination Activities,[32] although several buildings were decommissioned under an IM/IRA or PAM. Type 3 buildings were decommissioned pursuant to DOPs.

Closeout Reports document the completed building decommissioning activity. The Closeout Reports for Type 2 and 3 buildings were submitted for LRA approval. Closeout Reports for Type 1 buildings were provided to the LRA for information.

Contractor Role

The use of the consultative process for decision making enabled early, open dialogue with the regulators on cleanup plans, building trust and taking paper processes off the critical path.

Although not a signatory to RFCA, K-H played an essential role in shaping the relationship with Rocky Flats regulators and in implementing the consultative process. The RFCA parties and K-H each designated a project coordinator to act as the agency or company representative during frequent project meetings. The project coordinators also had the responsibility of coordinating RFCA issues throughout their own organizations resulting in overall alignment of regulatory and Site priorities.

The broad objectives of the 2000 Closure Contract[33] and RFCA were substantially aligned. However, the day-to-day and week-to-week implementation of projects and conduct of work presented some challenges. Even though agency goals were aligned, authorities and priorities were often in conflict at the working level of K-H, RFFO, CDPHE and EPA. K-H was very effective at demonstrating the need to place greater priority on putting the workforce to work on planned and approved projects. With workforce issues so dynamic and workplace conditions so uncertain, K-H needed greater flexibility in its planning and execution of work if the closure project was going to be successful. The

RFFO and regulators provided greater flexibility to the contractor to make decisions. In exchange, K-H provided nearly unlimited regulatory access to its planning documents, internal meetings and decision-making processes.

Aligning Regulatory Efforts to the Closure Project Baseline

The effective implementation of RFCA required continual focus on aligning the regulatory approach with the overall closure project mission. The path of accelerated closure was defined by the project's lifecycle baseline, with detailed work activities and project milestones identified. The DOE 2000 Closure Contract with K-H (a fixed term, incentive fee-based closure contract) requires compliance with RFCA.

Milestone Structure

Under RFCA, enforceable milestones[34] were established for a 3-year rolling period with no more than 12 being established per fiscal year. Milestones were designed to:

1. Provide accountability for key commitments;
2. Ensure adequate progress at the Site;
3. Provide adequate scope drivers; and
4. Facilitate budget planning and execution.

Also, each year the parties are required to review the previous year's milestones and non-enforceable target activities and either re-establish or revise them. Failure to meet enforceable milestones can result in the regulators imposing stipulated penalties of up to $20,000 per week.

Under RFCA, enforceable milestones were established for a 3-year rolling period with no more than 12 being established per fiscal year.

In 2000 RFFO proposed to CDPHE and EPA the concept of measuring regulatory milestone performance using earned value derived from the PWA (Predetermined Work Activities) list which was required per the Closure Contract. The underlying premise of the proposal was to maximize the flexibility for the Site to plan and implement closure project work (and thereby minimize changes in work priorities to satisfy regulatory milestone commitments) in exchange for expanded regulatory oversight over the closure project as a whole. The regulatory earned value framework was approved and implemented beginning with Fiscal Year 2001 work scope. The framework utilized the 3-year rolling milestone provision in RFCA. Simply put, the framework called for the Site to achieve at least 50% of the scheduled earned value derived from the PWA list in each RFCA-regulated category (decontamination & decommissioning, low level waste shipments, transuranic waste (TRU) shipments, and environmental remediation) in each year. In addition to the earned value milestones, outyear milestones (three years out and beyond) were established to anchor certain decontamination and decommissioning and environmental remediation activities in the future. The approach was so successful in advancing regulator awareness and understanding of project progress, that the regulators eliminated their review of the milestones in 2004 and beyond.

Clarity on the End State

When RFCA was signed in 1996, a path was set for cleanup and closure of Rocky Flats. The preamble to RFCA set objectives including the removal of all SNM (Special Nuclear Material) and TRU waste by 2015, with final cleanup being completed between 2008 - 2021. Future land use was described as open space in the Buffer Zone and open space or industrial uses in the existing Industrial Area.

During 1996 the Assistant Secretary for DOE's Environmental Management, looked within the DOE-EM program for opportunities for Sites to achieve accelerated closure. Rocky Flats was viewed as a Site capable of achieving closure and was chosen as the second of two accelerated closure projects (the first being the Fernald Site in Ohio). This decision was reinforced several years later with the signing of the accelerated closure contract between the DOE and K-H, which targeted Site closure in 2006.

What remained relatively undefined was the period beyond 2006 – post closure. The Future Site Use Working Group, comprised of representatives from local governments, citizens, EPA, CDPHE and DOE issued a report and recommendations in 1995.[5] This included a recommendation for open space use in the Buffer Zone for environmental research, natural and cultural resource management, industrial use in the Industrial Area to support development and implementation of remediation technologies, and a long-term goal of complete radiological cleanup to background. In 1996, RFCA adopted the open space and light industrial recommendations, although specific uses within that designation were not elaborated. Myriad community interests existed regarding the specific implementation of open space, each with implications regarding cleanup standards and remedy protectiveness. Open space uses could range from golf courses, to picnic grounds, to undisturbed, inaccessible prairie. This range of interests could have affected the ability to define cleanup standards and appropriate remedies.

Myriad community interests existed regarding the specific implementation of open space, each affecting the ability to define cleanup standards and appropriate remedies.

During the 1999 - 2001 timeframe congressional members sought to bring greater clarity to the end use and created a bipartisan effort to define future use of the Site. In December 2001, the Rocky Flats National Wildlife Refuge Act, co-sponsored by Sen. Allard and Rep. Udall, was enacted into law. The Act provided clarity to the regulators, the community and the DOE on a specific application of the open space designation identified in the RFCA. With this greater refinement of post-closure land use, realistic land use scenarios were developed and sophisticated modeling employed to aid in setting cleanup standards and in evaluating remedy alternatives.

Provisions of the Rocky Flats National Wildlife Refuge Act

As a result of most of the Site land remaining relatively undisturbed since 1951, preservation and diversity of plants and animals at the Site is unique in this area of the Front Range. The Site provides habitat for many wildlife species, including the Preble's meadow jumping mouse, which is federally protected as a threatened species, and several rare plant communities.

The Rocky Flats National Wildlife Refuge Act of 2001 (Public Law 107-107, Subtitle F, 16 U.S.C. 668dd) (Refuge Act) provides that future ownership and management of the Site shall be retained by the United States. Under the Refuge Act, upon completion of cleanup and closure of the Site, the Secretary of Energy shall transfer administrative jurisdiction over certain Site lands to the Secretary of the Interior for the purposes of establishing the Rocky Flats National Wildlife Refuge (Refuge). The U.S. Fish and Wildlife Service (USFWS), is the Department of Interior agency responsible for Wildlife Refuge management. Under the Refuge Act, the Secretary of Energy will retain administrative jurisdiction over those engineered structures used for carrying out a response action and any lands or facilities related to a response action or other actions to be carried out by the Secretary of Energy at the Site. The final delineation of lands to be transferred to the Secretary of the Interior will be identified in the CAD/ROD.

A Final Comprehensive Conservation Plan and Environmental Impact Statement (CCP/EIS)[35] related to the establishment of the Refuge was prepared by USFWS and published in 2004, in consultation with the public and the local communities as required by the Refuge Act. The Refuge Act also requires the Secretary of the Interior to provide a report to Congress on the impact of any existing property rights, including any mineral rights, on management of the Refuge, and identify strategies for resolving and mitigating the impacts. The CCP/EIS contains extensive information regarding the attributes and the plant and animal resources of the approximately 6,240-acre property in relation to its designation as a National Wildlife Refuge.

Environmental Covenants

On July 12, 2001, Colorado Senate Bill 01-145 became effective. This legislation creates authority for the Colorado Department of Public Health and the Environment to enter into enforceable environmental covenants for properties on which residual contamination exists following cleanup. Covenants could be required in cases where residual contamination precluded some uses of the land, or where engineered structures remained which required maintenance or protection from damage to remain effective. The covenants are enforceable, and run with the land; that is, they are enforceable against subsequent property owners.

As part of the negotiations on the post-closure agreement to supersede RFCA, CDPHE made it known that they wanted DOE to grant an environmental covenant for those portions of Rocky Flats that would be subject to institutional controls following closure. Although DOE had some reservations regarding the covenant, principally that it was unnecessary given that Federal ownership had been prescribed in the Refuge Act, it agreed to comply with the State's covenant law. In return, the State agreed not to require a post-closure permit for closed RCRA units that were covered under a covenant.

DOE agreed to comply with the State's covenant law. In return, the State agreed not to require a post-closure permit for closed RCRA units that were covered under a covenant.

The first area of Rocky Flats to be covered by an environmental covenant was the Present Landfill, which had been closed as a RCRA hazardous waste unit (the Present Landfill had accepted small quantities of hazardous waste during its operating life). The RFCA Parties anticipate that a more comprehensive environmental covenant, covering additional areas of the site, would be granted by DOE concurrent with the signing of the final Record of Decision for Rocky Flats.

Post-Closure Regulatory Framework

The post-closure regulatory framework at Rocky Flats will be governed by three major documents: the Corrective Action Decision/Record of Decision (CAD/ROD), the post-closure agreement, and the final site environmental covenant. The CAD/ROD is expected to select the final site remedy from among the three alternatives being considered in the Feasibility Study. These include:

1. no action (but including prescribed monitoring and maintenance actions);
2. the addition of institutional controls to alternative 1; and,
3. the addition of soil removal in the 903 Lip Area to further reduce residual risk to the wildlife refuge worker.

These alternatives will be described in detail in the Proposed Plan for Rocky Flats, due to be released for public comment in June 2006. The CAD/ROD will describe the selected alternative in some detail, including the actions to be taken by DOE, and the rationale for selecting the alternative. The DOE, CDPHE, and EPA anticipate signing the CAD/ROD in the fall of 2006.

The original Rocky Flats Cleanup Agreement continues to govern Rocky Flats activities, and will do so until it is replaced by a post-closure agreement. The post-closure agreement will implement the requirements of the CAD/ROD, and will likely prescribe DOE's obligations relating to environmental monitoring, site maintenance, reporting, information management, and actions to be taken if adverse environmental conditions are discovered in the future. The RFCA Parties (DOE, CDPHE, and EPA) began discussing the framework for the post-closure agreement in 2004. Although not yet signed (and in fact, portions of the post-closure agreement cannot be finalized until the requirements of the CAD/ROD are known), the draft agreement as of early 2006 contained the following elements:

- a reliance on both CERCLA and RCRA/Colorado Hazardous Waste Act as the underlying authorities for the agreement;
- a commitment to continue the consultative process begun under RFCA;
- clear designation of the LRA, likely to be CDPHE for most, if not all, site activities; and,
- the use of enforceable attachments to specify requirements, and non-enforceable appendices to provide information relevant to the execution of the agreement.

The RFCA Parties anticipate that the post-closure agreement will be much smaller than RFCA, the body of which (excluding attachments and appendices) is 85 pages long. The post-closure agreement is expected to be signed concurrent with the CAD/ROD.

The final site covenant will contain the institutional controls that will be included in the CAD/ROD. The geographic extent of the covenant has not been determined, but may include all those lands retained by DOE for remedy-related purposes. As mentioned earlier, the final environmental covenant for Rocky Flats will likely be granted concurrent with the signing of the CAD/ROD.

KEY SUCCESS FACTORS

1. It was essential that each of the principal parties involved in the cleanup of the Rocky Flats Site (EPA, CDPHE, DOE and K-H) had a vested interest in and commitment to achieving closure in 2006. One key to establishing this at Rocky Flats was the site Vision that was incorporated into RFCA. The Vision gave senior managers from all parties the chance to agree on top-level goals, while allowing staff to resolve issues within a general framework.

2. The ongoing clarification of the Rocky Flats end state, from the work done by citizens' groups in the early 1990's to the passage of the Refuge Act in 2001, was very helpful on a number of fronts, from defining cleanup levels to ensuring that key stakeholders were comfortable with the project's end results.[36]

3. The evolution of the regulatory framework for Rocky Flats from the IAG to the successful negotiation and implementation of RFCA was a critical aspect of achieving accelerated Site closure. It provided the regulatory flexibility necessary to implement accelerated closure with a bias for action. A key development in the alignment of regulatory milestones with earned value derived from the project baseline. This ensured the regulators, the contractor, and the DOE were all working toward the same baseline and milestones, not "project" milestones and "regulatory" milestones, which has been more the norm in the DOE.

4. The use of the consultative process for decision making encouraged and enabled early, open dialogue with the regulators on cleanup plans, building trust and taking paper processes off the critical path. A key component of this was to provide the regulators with early, complete access to Site operations and documents. This allowed for alignment with the regulators on cleanup issues, which in turn translated to greater support from the regulators when engaging stakeholders and stakeholder groups on controversial cleanup issues.

5. The process of developing the action levels, standard operating procedures, and other documents was the important effort. Much detail is presented above, but it was the discussion, dialogue, and understanding that was developed that was really the most important. The lesson is to use the process, not the specific procedures or results.

6. Certain key issues at Rocky Flats, e.g., future land use and cleanup levels, requird strong stakeholder consensus for project success. For some closely-held issues, basing project approaches on community consensus (within fiscal and time constraints) may be more effective than seeking community buy-in on a pre-determined project approach.

7. When dealing with regulatory issues, openness and honesty is paramount. The heart of the consultative process was sharing information, good or bad, early and often. In return, the parties had to learn to use the information fairly and not for manipulation or advantage. This behavior took several years to institutionalize, with considerable senior management coaching, but ultimately became a powerful tool that significantly enabled the early and under budget completion of the closure.

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Rocky Flats Closure Legacy

Contract Approach

The concept of projectizing the closure was evident in the contract, the baseline, and through consistent internal and external communications, such as this sign at the west entrance to the Site.

CONTRACT APPROACH

INTRODUCTION

The Rocky Flats Closure Contract[33] between DOE and Kaiser-Hill LLC (K-H) was signed in January of 2000. It had the singular focus of completing the cleanup and closure of the Rocky Flats Environmental Technology Site (Site) in the safest, most cost effective manner with a target completion date of December 15, 2006. The terms and conditions of the contract reflect an important evolution in the approach to contract development at Rocky Flats over a number of years. This section will outline key changes in contracting policy within the Department of Energy at the Headquarters level and the resultant application of these policies specifically at the Rocky Flats Site. The experiences gained by both DOE and the K-H between the first contract awarded in 1995 and the final 2000 Closure Contract were significant. The following is the story of that journey and the refinement of the contract driving the successful cleanup and closure of the Site.

DISCUSSION

Contract Reform

Contract reform and transition to performance-based incentives was essential to the accelerated closure concept.

Traditionally, DOE Management and Operating (M&O) contracts were cost reimbursable for operating Sites with a defined production mission and did not provide well-defined performance criteria or expectations for environmental cleanup and closure work. M&O contractors were relieved of most financial risk for poor environmental cleanup and closure efforts, creating few drivers for contractor accountability. Performance expectations were not clearly specified, contractors may not have been sufficiently incentivized to accomplish work, and performance measurement was typically subjective.

The DOE’s 1994 Contract Reform Initiative[2] grew out of a number of efforts for the government as a whole to operate in a more business-like, fiscally sound and results oriented manner. Major elements of the initiative included emphasis on the use of performance-based contracting techniques and competition for the Department's major contracts. The initiative also stressed the adoption of commercial practices. The contract reform report issued in 1994, identified the upcoming Rocky Flats contract (expiring in 1995) as a target for implementing the recommendations included with the Report.

A New Contractor for a New Mission.

In late 1993 and early 1994, the Rocky Flats Field Office (RFFO) began developing its contract strategy, adopting and implementing the Contract Reform Report's recommendations. Since the change in the Rocky Flats mission from production to environmental clean-up, DOE had recognized that it would benefit from contracting with an environmental firm, a company that could bring innovations based upon expertise in environmental work, as opposed to a weapons production specialist. RFFO issued its Request for Proposal for the Performance Based Integrating Management Contract at a Vendors Conference it hosted in July 1994.

Selecting a contractor with environmental remediation and commercial project management expertise, while in hindsight was not profound, marked a significant departure from past contracting practices.

Contractor Strategy to Compete

The joint venture company of Kaiser-Hill LLC was formed specifically in 1994 to bid on the five year Integrating Management Contract at Rocky Flats Environmental Technology Site. This contract was known as the 1995 Performance Based Integrating Management Contract (PBIMC).[37] In competing for the contract, K-H's strategy was to align its expertise in environmental remediation and the execution of major projects from its parent companies to successfully achieve cleanup of the Site. Along with an emphasis on this expertise, K-H presented a unique commercial approach to integrating their subcontractors, as well as incentivizing employee performance through significant financial rewards. K-H made the corporate commitment to share 20% of their profits with employees to incentivize behavior. K-H's proposed incentive system was a radical departure from contemporary DOE contractor practices and strongly influenced DOE's subsequent choice on awarding the contract.

Contractor Selection Process

The Rocky Flats Source Evaluation Board (SEB) decided, as part of its evaluation of proposals, to visit active project sites and schedule time to interview union officials involved with the project, as well as regulators overseeing the work. Once these discussions were complete, the SEB conducted its traditional question-and-answer session with key management personnel. The emphasis in this process was to verify how well the contractor was able to manage similar projects and send the message that DOE was committed to working effectively with a variety of relevant stakeholders.

Final Selection of K-H

As the final selection of the contractor for the 1995 PBIMC approached, the competition between K-H and Parsons was intense. Both proposed strong teams of prime contractors, subcontractors and key managers with significant, relevant experience. Both bidders improved their best and final offers. K-H's proposed performance measures were viewed as more challenging, and their incentive plans for both subcontractors and employees were viewed as more comprehensive and focused. K-H proposed an innovative labor-leasing approach, where steelworkers would remain K-H employees and be leased to subcontractors for work covered by the collective bargaining agreement. In this way, K-H avoided the anticipated problems associated with the disparate treatment of organized labor by various employers.

PERFORMANCE BASED INTEGRATING MANAGEMENT CONTRACT - 1995

The PBIMC was the first to fully incorporate the DOE's Contract Reform initiatives.

Departure from an M&O Contract

The 1995 Performance Based Integrating Management Contract (PBIMC) was a significant, intentional departure from the M&O contract format prevalent within DOE at the time. Other contracts had taken initial steps, but this contract was the first to fully incorporate the DOE's Contract Reform initiatives. The PBIMC abandoned the cost-plus-award-fee approach. Eighty-five percent of the PBIMC's fee was linked to the achievement of specific, objective performance measures. The remaining fifteen percent of the total fee was a fixed, base fee. M&O contracts provided advance payments to the contractors, through special bank accounts. The PBIMC required the contractor to finance its own performance and then submit traditional invoices for payment.

Reduction in Risk Indemnification for Contractor

M&O contracts indemnified contractors for a wide variety of risks, some even going so far as to reimburse contractors for the cost of environmental fines and penalties. One of the major criticisms concerning this practice came to light following the 1989 FBI raid of Rocky Flats and the subsequent Grand Jury investigation. The contractor for the Rocky Flats Site at the time pleaded guilty to charges of environmental misconduct and as a condition of the plea bargain, was forced to pay the fine itself. The M&O contract at the time actually required DOE to reimburse Rockwell for the cost of the fine, yet this was overridden by the court ruling. The 1995 PBIMC eliminated any such indemnifications, although the indemnification afforded through the Price-Anderson Act for nuclear accidents continued to apply. Finally, the fees for the PBIMC were derived from Federal Acquisition Regulations (FAR) fee policies, to reflect the nature of the increased performance risk being undertaken, rather than the less generous DOE M&O fee principles.

Innovations in Outcome Based Performance Measures

The 1995 PBIMC invoked the utilization of discrete "performance measures" defining specific outcomes or deliverables that the contractor was required to complete in order to earn fee. A process for development, negotiation, administration and verification of completion of performance measures was established. During the early stages of the 1995 PBIMC, various functional area managers within RFFO and the contractor's organization had begun to develop performance measures. This process lacked the overall mission focus on Site cleanup and closure and created inconsistencies across functions and programs. Additionally, there were over 60 individual active performance measures at any one time, diluting the incentive for completion of mission critical activities. The process eventually became more structured.

Final evolution to simplified, objective performance measures focused on overall Site closure led to consensus on the "Critical Few" performance measures, and eventually to end-state criteria.

Unintended Consequences of Performance Measures

Early experiences with these performance measures included unintended consequences as a result of the lack of focus on the more important closure mission activities. In many cases performance measures were poorly defined or misinterpreted, and RFFO often found itself in the position of having to clarify these measures. In one instance, RFFO set a performance measure to recycle cafeteria waste (plastics, glass, and aluminum cans). In response, the contractor assigned trashcan monitors to assure that recyclable waste was placed into the right receptacle. In another instance a performance measure was established for the removal of several old trailers from Site. The contractor moved the trailers off the Rocky Flats Site to a U-store-it lot adjacent to the Site. As a result of focusing on these specific measures, the contractor applied far too many resources under a cost-plus contract than appropriate for recycling sanitary waste and did not really accomplish the result RFFO intended with respect to the trailers (i.e., remove the trailers and sell the asset). These were lessons for both parties to refocus performance measures on more critical activities and keep the overall project goals in mind.

Impact of Incentivizing Performance

DOE initially failed to realize the power the 1995 PBIMC held in driving contractor performance as a result of its incentivizing processes, and occasionally incentivized the wrong things. As illustrated above, the contractor focus on meeting performance goals was intense. Much of this energy derived from K-H's incentive systems, which were based on the employees' abilities to meet performance objectives. With twenty percent of the contractor's fee reinvested into employee incentive programs, the achievement of specific performance objectives gained much greater importance for individual managers.

Refinement of Performance Measures

The early experience with performance measures and their impact on incentives was also a frustration to the contractor. They often worked hard to do what RFFO defined in the performance measure, only to have difficulty getting credit when time for payment came because overall closure results may not have been as expected. These problems generally came from loose definitions of completion or complex wording that did not clearly define what was to be delivered. In one instance the contractor was required to dispose of all waste chemicals from a specific building. They completed the task for all known chemicals, and then found one additional, minor waste chemical just before the end of the performance period. They were not given credit for achieving the overall performance measure. As time progressed RFFO and K-H improved their processes for defining the outcomes and deliverables, strictly limiting the use of terms like "all" and utilizing pre-agreed inventories. Both parties learned to better define the intent of deliverables in contractual terms, avoiding confusion and loopholes such as the trailer disposal incident (K-H benefit) or the waste chemical incident (DOE benefit).

Incentives for safety were transformed to penalties for poor performance; safety was an expected part of performance attached to all work and not a separate performance measure.

"The Critical Few"

Another important facet of the learning process that occurred during the performance measure development was to reduce the number of performance measures to a "critical few" and to place significant fees on those to assure timely completion. The development of the closure project baseline made the job of selecting performance measures vastly easier and improved the linkages to the Site's mission. The number of annual performance measures was reduced from 60 in 1995[12] to less than 15 by the end of the contract in 1999.[13] Performance measures were only applied to direct mission accomplishments, such as the processing and stabilization of plutonium and deactivation of nuclear facilities. Support activities such as infrastructure operations, maintenance and business operations were typically not incentivized under the rationale that successful management of these activities "enabled" the achievement of the mission-direct performance measures. Incentives for safety, originally handled through a complex indexing protocol, were transformed to penalties for poor performance. In other words, safety became an expected part of performance attached to all work and not a separate performance measure to be incentivized.

The Inspector General's Review of Incentives

Under the original 1995 PBIMC, DOE had a provision for the contractor to earn fees for cost savings. This program, known as the Cost Reduction Proposal (CRP) Program, was derived from value engineering principles. While good in concept, it became very difficult to administer and had the potential to be abused. Since there was no independent body of cost data for the type of work being performed at Rocky Flats, or a firm baseline for comparison, it became virtually impossible to validate most cost savings claims. The Project Lifecycle Baseline was simply too immature at this point to provide reliable information. Compounding this weakness in the CRP program was the fact that K-H had committed to share a significant percentage of its CRP earnings with employees. This intention to incentivize employee innovation was greatly undermined by the failures inherent in the CRP.

In 1997, DOE's Office of the Inspector General (IG) released a report highly critical of the fee incentives in the 1995 PBIMC.[38] The IG report specifically criticized the CRP program and, with the release of the report and subsequent media attention, much scrutiny was placed on the CRP's. Although RFFO and K-H disagreed with the details of the report and defended the program as worthwhile, the need to restructure fee incentives was clear. Eventually both parties accepted the fact that the CRP program was flawed and needed replacement.

SuperStretch performance measures ultimately became a better incentive to save money and get more work accomplished …because resources were immediately reinvested into additional scope.

Gateways and SuperStretch Performance Measures

Performance-based incentives evolved from single fiscal year incentives into broader project completion expectations. Gateways and SuperStretches were two manifestations of this. The CRP Program evolved into a system known as the Gateway performance measures. Gateways carried forward the scope, but not the fee, for work scheduled but not completed in the previous year. This incentivized the contractor to complete all prior year work as quickly as possible; once this was complete they were allowed to achieve fee for current year activities. Ultimately the SuperStretch performance measure process supplemented the Gateways. The SuperStretch process provided incentive for the contractor to do more work than was originally planned and budgeted. SuperStretch performance measures included fees for specific mission critical work that were budgeted for out-years. In order to meet a SuperStretch performance measure and earn associated fees, the contractor first had to perform current-year baseline work for less than budgeted cost,

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then redeploy those excess funds to other critical mission work and get that work completed. SuperStretch performance measures ultimately became a better incentive to save money and get more work accomplished than the CRP Program did because resources were immediately reinvested into additional scope. The cost-plus-incentive fee contract to come later in 2000 would encourage this kind of behavior across the totality of the project scope.

“Manage the Contract, not the Contractor”

An important paradigm shift for RFFO in changing from award fee contracting to incentive-based contracting was learning a different role in the business relationship associated with an incentive-based contract. Under the award fee relationship, RFFO provided incremental direction, sometimes on a day-to-day basis, and the contractor was rewarded for how well they responded to RFFO's direction. Unfortunately, there was no formal mechanism that illustrated the cost of various courses of action to RFFO, and often RFFO lacked clear strategic goals leading to poorly defined plans. The business model reinforced under the award fee process led to scope growth and aversion to risk. DOE grew a large and bureaucratic management structure with many individual, functional “stovepipes” often sending the contractor in different directions. RFFO personnel at fairly low levels were allowed to direct the contractor's activities and the contractor's performance was measured using a very subjective process.

A paradigm shift for DOE to “Manage the Contract, not the Contractor,” allowed the contractor maximum flexibility to complete the project in the safest and most cost-effective manner.

The 1995 PBIMC contract was a step change from previous arrangements. Early in the 1995 contract, the RFFO Manager rescinded the authority of low and mid-level DOE personnel in directing the contractor and implemented the Contracting Officer's Representative designation for selected high-level management officials. This change limited the flow of conflicting and detailed direction from RFFO to the contractor and enabled better integration of the direction that was provided to the contractor. Additionally, the business arrangement between RFFO and the contractor provided better visibility of the cost of incremental RFFO direction for “nice-to-haves” and exceeding minimum contractual requirements.

A very central concept in the 1995 PBIMC was for RFFO to establish project direction and expectations in the contract clauses and allow the contractor to determine how work would be completed. RFFO direction and expectations for performance were clearly established in the contract clauses, rather than in day-to-day interface. Over the course of the 1995 contract, the contractor was allowed greater and greater flexibility to perform the contract and to be more efficient and effective. Once RFFO became better at setting the contract outcomes and deliverables (i.e., project closure), stepping back and letting the contractor perform within the terms and conditions of the contract became easier. The systems to allow the contractor flexibility of completing project work did not exist as fully in the early stages of the 1995 PBIMC contracting period and were to evolve and change significantly over the ensuing five years.

CLOSURE CONTRACT - 2000

Setting the Stage for the 2000 Closure Contract

In 1997, RFFO managers began reviewing their business strategy for the follow-on contract. First, they determined that this should be the last contract at Rocky Flats and planned for a contract to complete the closure project. Second, they needed a set of performance measures to overwhelmingly drive the Site to closure. As the performance measure process evolved through the 1995 PBIMC contract term, the limitations of an annual planning cycle became apparent. The final set of performance measures under the 1995 PBIMC encompassed two fiscal years, allowing RFFO to provide incentives tied to more important project milestones rather than to interim milestones. It was clear even at this point that the performance measure system needed a radical change. Finally, DOE RFFO wanted to incorporate provisions that incentivized the contractor to continually improve safety for workers and the public. Developing a contract to incorporate these objectives, RFFO settled on a cost-plus-incentive-fee contract with both a cost and schedule incentive.

Sole Source Justification for awarding K-H the 2000 Closure Contract enabled valuable DOE and contractor resources to remain engaged with the closure mission.

Single Source Justification

The 1995 PBIMC was scheduled to conclude June 30, 2000. Throughout the duration of the 1995 PBIMC, K-H had made unexpected progress on the contract, and the Department had adopted the accelerated closure strategy. Concurrently, K-H was developing and RFFO was analyzing the early versions of a Closure Project Baseline. Looking at this, RFFO recognized that the year 2000 would likely be critical to the success of accelerated closure. A competitive procurement ordinarily requires at least a year of concentrated effort on the part of both DOE and any interested bidders. The individuals who would participate in such a procurement process, on both the DOE side and the contractor side, would be diverted from the closure effort, and such a distraction threatened to derail the accelerated closure schedule momentum.

Competing its major procurements was a critical objective of the Contract Reform initiative, and RFFO recognized that a sole source follow-on contract would require approval at the top of the agency. RFFO put its case together, and carried the recommendation to DOE Headquarters. RFFO emphasized that K-H was performing well, even reaching the point where the company had submitted a credible and achievable closure project baseline, and that the accelerated closure schedule could not tolerate the disruptive impacts of a contract competition. In July 1999, Secretary Bill Richardson approved the sole source justification. By law, the Department was required to forward the decision to Congress for their information. In addition, DOE announced its decision publicly. Surprisingly, the announcement generated no significant negative responses, either from Congress or the public.

Structuring the Negotiation Team for the 2000 Closure Contract

Once Secretary Richardson had approved sole source negotiations, DOE RFFO began putting together a team to develop and negotiate the new closure contract. The RFFO Manager designated team members from appropriate functional areas: Contracting, Legal, Project Management and Safety. In an unanticipated decision, the RFFO Manager requested that DOE-EM HQ assign Principal Deputy Assistant Secretary for EM as lead negotiator for the team. The intention was to show that DOE commitment to closure was a Department-wide effort, not simply a local Rocky Flats initiative. The parties strengthened this commitment with the negotiation of innovative provisions establishing firm requirements for Government Furnished Services and Items.

Closure Contract

The DOE applied standard Project Management Measures to monitor project performance. Subjectivity was minimized.

On January 24, 2000 the Rocky Flats Closure Contract between K-H and the Department of Energy was signed. The terms and conditions of the contract were a result of the experience of the parties over the previous 1995 PBIMC. The structure of performance measures, incentives and planning cycles had all transitioned to the Cost-Plus-Incentive-Fee contract format. An important aspect of the 2000 Closure Contract was its authorization of all project completion work at the time the contract was signed. The need to move from an annual planning cycle to a project completion focus was clear. Through the 2000 Closure Contract this concept was applied to all aspects of the project. The Closure Project Baseline[39] became recognized as the project plan and was used as the basis for the development of annual work plans. The 2000 Closure Contract included simplified terms and conditions to allow the closure project to be completed in an accelerated, efficient and cost effective manner.

Standard Project Management Measures

The 2000 Closure Contract provided a few simple mechanisms to measure performance derived from standard project management earned value measures. Cost variance was used to determine cost performance to date against planned cost, and schedule performance was calculated through a modified earned value process. Since there were a large number of level-of-effort support activities on the Rocky Flats closure project, RFFO and K-H agreed to evaluate schedule performance on discrete mission activities such as facilities demolished, cubic meters of waste shipped, etc.[40] About twenty-five percent of the total project was selected as Predetermined Work Activities,[41,42] for schedule variance calculation to determine provisional fee payments. This significantly streamlined the quarterly provisional fee payment process as compared to the performance measure process on the last contract.

High Change Control Thresholds

The 2000 Closure Contract allowed the contractor even more flexibility to perform work with high thresholds for requiring DOE approval for work sequences or process changes. Under the 1995 PBIMC, the contractor submitted several hundred baseline change proposals per year and had to wait for RFFO's approval for each change to move resources. Under the 2000 Closure Contract, only a handful of change requests required RFFO approval. With the 2000 Closure Contract, the cost of any DOE directed change was very visible as it resulted in a request for Equitable Adjustment (REA) with definite cost and/or schedule impacts. DOE viewed the increased potential for REAs as one of the largest risks of this new contract type. The REA experience is discussed later in this document.

Incentive Processes

Employee Incentive Systems were used which truly rewarded high performing individuals.

Incentive practices for the contractor changed significantly to a project completion focus through the development of the 2000 Closure Contract. The employee incentive programs included in the 2000 Closure Contract involved both hourly and salaried employees and tied the payout into the overall closure project completion. The program structure provided for the payout of a smaller percentage of cash bonuses immediately with the remainder deferred until project completion. The profitability of the final project, controlled by cost and schedule performance, determined the actual value of the deferred payout. This program structure was designed to strongly motivate employees and align the entire workforce to "a relentless drive for closing the Site."

Risk Sharing

Risk sharing between the contractor and DOE drove true accountability for project performance. Not meeting project commitments for either party had significant and readily apparent consequences to the success of accelerated closure.

The Rocky Flats 2000 Closure Contract contained a much greater level of risk for both parties than previous contracts. The contractor assumed more business risk for unknown conditions than any previous DOE contractor and the DOE assumed much greater contractual risk through its commitments to provide Government Furnished Services and Items (GFS&I).[43] Under the terms of the contract, the contractor could not claim changed conditions for any differing Site conditions including the level of contamination or other unknowns in Rocky Flats facilities. It was assumed that the contractor had ample time to perform due diligence during its previous years at Rocky Flats. The exception involved the waste impact of undetermined contamination levels in subsurface soils. K-H accepted responsibility for the additional waste above the estimated values up to a specified total waste quantity for the entire project, with DOE accepting the responsibility for greater volumes. Conversely, the DOE assumed the responsibility to provide receiver Sites for the nuclear materials and waste generated during the project. The risk to both parties was captured through the 70/30 (government/contractor) cost-sharing ratio for cost underruns and overruns.[44] The cost sharing provision was a standard feature of a Cost-Plus-Incentive-Fee contract.

A key feature of the Rocky Flats 2000 Closure Contract was the level of commitment made by DOE. For the first time, the DOE made specific commitments about what it would provide and when it would be provided. The most critical items provided by DOE were the receiver Sites for Special Nuclear Material and radioactive waste. DOE also provided transportation services, shipping containers, utilities, records repositories, safety document reviews and approvals, and other miscellaneous items. The contract spelled out specific quantities and dates for delivery of the GFS&I. A process for the contractor to make specific requests for GFS&I and the DOE to provide a response as to what it could and could not provide was established. Finally, under Contract C.5, Statements of Commitment, the government was committed to support K-H in finding ways to streamline the process and eliminate non-value added requirements,[45] recognizing that the 70/30 cost sharing made such actions clearly in the government's best interest despite the increased contractor fee.

DOE was fairly successful in delivering GFS&I. Being able to provide receiver Sites for radioactive waste and nuclear materials was significantly influenced by forces outside of the DOE (i.e., the public/regulatory process) and proved to be an ongoing challenge for the DOE. Being accountable for specific commitments has galvanized the department into action. Failure to deliver GFS&I would have had quantifiable contract implications, resulting in REAs by the contractor. Fortunately, the DOE has been able to use the cost impacts of not providing GFS&I to stimulate action.

REA Experience

The possibility of REAs was a great concern to DOE. The Closure Contract incorporated strong commitments by DOE to provide GFS&I, along with standard FAR contract provisions that protected the Contractor from unforeseen conditions. Early on, however, both parties recognized that significant increases in the contract's targets for cost and schedule would benefit neither side. DOE and K-H management agreed that, to the extent practicable, a better approach to equitable adjustments would be to revise non-financial contract terms rather than to merely increase the target cost or extend the target schedule. Also, both parties worked together to tightly control both DOE's issuance of contract direction and the K-H response to such direction. Whenever DOE direction had the potential to increase cost or extend schedule, K-H implemented change accounting practices to estimate and control the impacts. Both parties met regularly to monitor the potential changes. Through these techniques, the number and impact of REAs were held to reasonable levels. Upon physical completion, the impact on target cost and schedule was minimal. Six contract modifications were issued to incorporate equitable adjustments, increasing the target cost by a total of $23.7 million or 0.6% of the original target cost. No extension of the target schedule was incorporated.

DOE proposed…to extend the range of incentive effectiveness and provide adequate profit motive for K-H to achieve all possible cost and schedule incentives.

Fee Restructuring Modification

By late 2002 and early 2003, DOE's analysis of K-H's cost and schedule projections, based upon monthly progress reports submitted by the Contractor and confirmed by RFFO subject matter experts, indicated that K-H might be capable of achieving the maximum cost and schedule incentives in the Contract. Some RFFO subject matter experts believed that the Contractor could achieve significantly greater cost and schedule efficiencies. However, the existing Contract fee structure would provide no additional profit motive for such efficiencies. DOE proposed the negotiation of a Contract modification to extend the range of incentive effectiveness and provide adequate profit motive for K-H to achieve all possible cost and schedule incentives, while ensuring safe closure of the Rocky Flats Site.[46] After substantial discussions, Headquarters approved the request and Contract Modification M116 resulted. The original Contract fee arrangement included a cost-sharing arrangement that extended from a cost of $3.563 Billion to $4.796 Billion. Contract Modification M116 revised this to provide cost-sharing from a cost of

$3.122 Billion up to $4.859 Billion. In return for the opportunity to earn higher maximum fees, K-H agreed to forego its rights to higher target fees on 14 REAs. Contract Modification M116 made no changes to the Contract's target cost or target schedule. RFFO also selectively used non-fee bearing contract funding to access K-H resources in specific areas.[47] The variable payout of fee based on quarterly earned value, initially viewed as an incentive to potentially improve contractor cash flow turned out to cause problems within the DOE funding process and provided little increased incentive.[48]

Project Inspection and Acceptance of Physical Completion

While the Closure Contract was clear in its description of physical completion, it was not explicit in how the Contractor was to go about documenting the physical completion.

More than a year before project completion, RFFO and K-H staff began discussing the imminent declaration of physical completion under the Contract. It was apparent that while the Closure Contract was clear in its description of physical completion, it was not explicit in how the Contractor was to go about documenting the physical completion. In addition, there was a need for interpretation of some technical requirements, as mentioned in Contract Clause H.2, Technical Direction. Most importantly, DOE needed to provide direction regarding what structures (roads, utilities, buildings, etc.) the Contractor was expected to leave in place at physical completion.

RFFO and K-H began discussing these issues, going through each of the seven criteria of physical completion set forth in the Closure Contract, Section C.1.2, Mission and Physical Completion of the Contract. For each criterion, the parties discussed and agreed upon the documentation needed to demonstrate physical completion, the processes by which RFFO would confirm completion and provide response to K-H. In addition, the parties discussed certain other Contract requirements that did not necessarily fall into one of the criteria for physical completion. For example, Contract Section C, Technical Exhibit A, Detailed Description of Scope and Services, Paragraph IV, Environmental Remediation, required: "The Contractor shall prepare the necessary decision documents supporting accelerated actions, consistent with RFCA, and a draft RI/FS, including a draft comprehensive risk assessment and complete all actions required by the approved decision documents to remediate soil, surface water, ground water, and other contaminated media." The draft RI/FS was an important Contract deliverable, so the parties identified its format and a review/acceptance process.

These discussions evolved into an Omnibus Agreement[210] outlining the Contractor's documentation of physical completion, and the Government's acceptance process. As the discussions proceeded, and the Omnibus Agreement was being drafted, an important factor became the Omnibus

Agreement itself. The RFFO Manager, RFFO Chief Counsel, and RFFO Contracting Officer made it clear time and again that the Omnibus Agreement was *not* a Contract modification, and that if there were any conflicts between the two documents, the Contract would prevail. Eventually, statements to this effect were included both in the cover memorandum for the Omnibus Agreement, and in the second paragraph of the Omnibus Agreement itself.

The Fernald Closure Contract required development of a contract completion and transition document.

An interesting reflection of lessons learned is how the same topic was treated in the closure contract for the Fernald facility. Negotiated about six months after the Rocky Flats Closure Contract, it required development of a contract completion and transition document. This was a clear improvement for Fernald, and a case where the development of the Omnibus Agreement for Rocky Flats had to be developed as an ad hoc initiative under the "Statement of Commitment" clause, where at Fernald it was called out as a clear contract requirement.

With the Omnibus Agreement in place, K-H achieved the seven elements of physical completion, submitting the required documentation as work proceeded. This process enabled DOE to monitor K-H activities very closely with greater attention to those items that would ultimately require DOE verification. This focus also allowed the RFFO staff which were continuing to reduce in number, to focus their oversight in a manner that would enable the DOE to complete its confirmation of physical completion in a timely manner. K-H declared physical completion on October 13, 2005. Due to the continuing verification and oversight processes defined by the Omnibus, the DOE completed its inspection well within the contractual requirements, and accepted the project as complete on December 7, 2005. In hindsight, the Omnibus Agreement, which had been initially viewed as a good planning practice, was absolutely essential for the DOE to meet its contractual deadlines. The pace of activities requiring oversight and verification by the RFFO during the last few months of the project, and at declaration of physical completion, would not have been possible to verify without the structure, processes, and advance efforts developed in the Omnibus.

The Omnibus Agreement allowed the RFFO staff which were continuing to reduce in number, to focus their oversight [to] enable the DOE to complete its confirmation of physical completion in a timely manner.

KEY SUCCESS FACTORS

The evolution of the Contract Approach process at Rocky Flats resulted in its final form as the 2000 Closure Contract and was enabled by numerous events from 1994 onward. Analyzing which key factors drove the success of the effort revealed the following to be important:

CONTRACT APPROACH

1. DOE Contract Reform and transition to performance-based contracting techniques was essential to the success of the accelerated closure concept.

2. Selecting a contractor with environmental remediation and commercial project management expertise, while in hindsight was not profound, marked a significant departure from past contracting practices.

3. Final evolution to simplified, objective performance measures focused on overall Site closure led to consensus on the "Critical Few" performance measures, and eventually to end-state criteria.

4. A paradigm shift for DOE to "Manage the Contract, not the Contractor," allowed the contractor maximum flexibility to complete the project in the safest and most cost-effective manner.[49]

5. The DOE applied standard Project Management Measures to monitor project performance. Subjectivity was minimized. This could only be done with a robust, trusted baseline; otherwise it would have been an invitation for contractors to game the system.

6. Employee Incentive Systems were used which truly rewarded high performing individuals and created positive drive for safe and successful project completion throughout the contractor organization.

7. Sole Source Justification for awarding K-H the 2000 Closure Contract enabled valuable DOE and contractor resources to remain engaged with the closure mission.

8. Risk sharing between the contractor and DOE drove true accountability for project performance. Not meeting project commitments for either party had significant and readily apparent consequences to the success of accelerated closure.

9. Requests for Equitable Adjustment (REAs) can be controlled and minimized by continual attention and control by DOE and the contractor on the actions and conditions that give rise to REAs. This goes beyond change control, to understanding and controlling aspects of the site systems that cause the REAs.

10. A cost-plus-incentive-fee (CPIF) contract is not static and may need to be adjusted. The fundamental reason for a CPIF contract is to provide a balance of positive and negative incentives. If conditions change to the point where the incentive no longer functions as intended by the contract structure, the incentive range may need to be adjusted.

11. Contract verification and acceptance by the DOE is a difficult and complicated process with many tasks. Early advance planning to structure and organize the inspection process is vital to allow the DOE to meet its contractual obligations in a timely manner.

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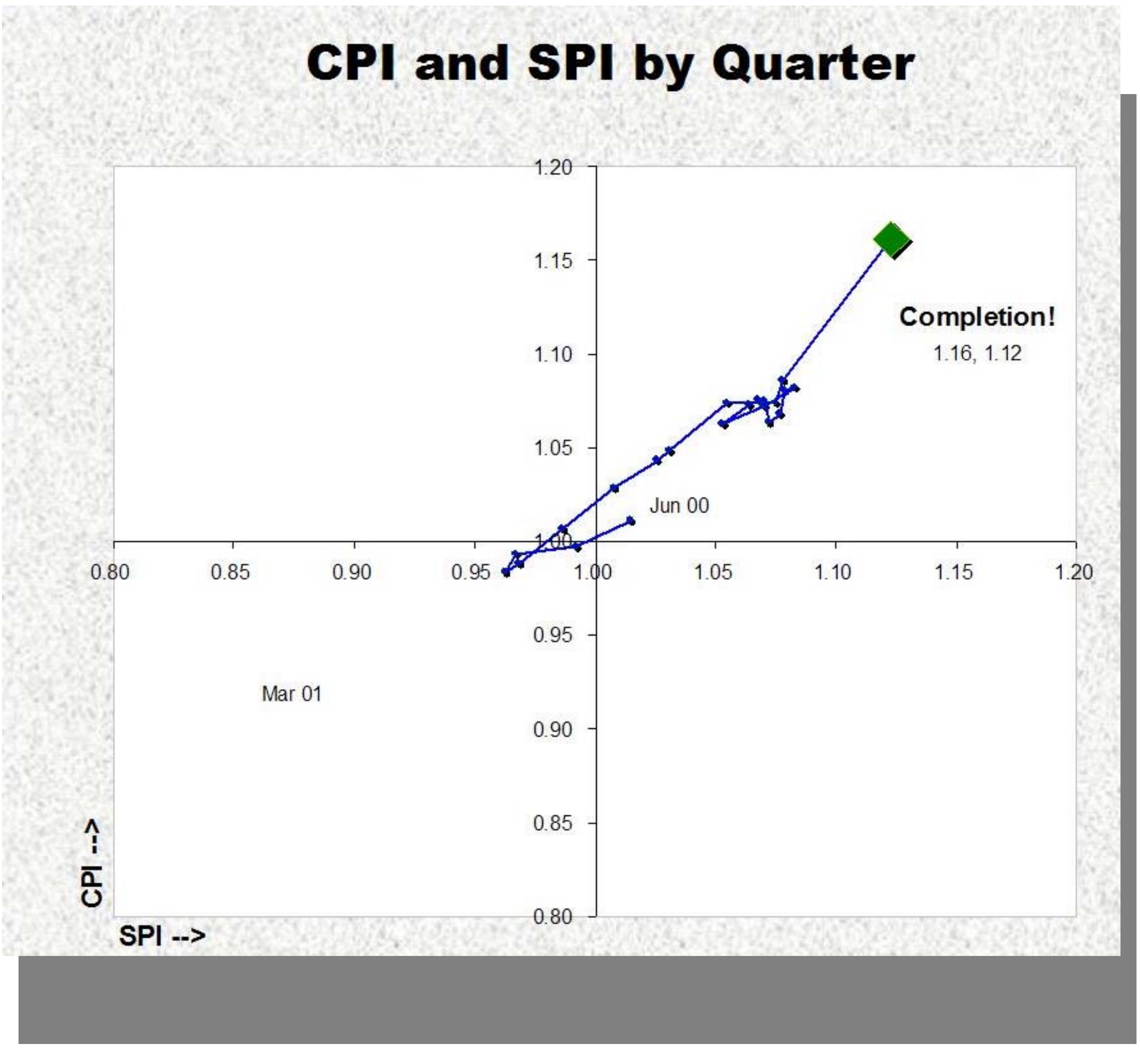
ROCKY FLATS CLOSURE LEGACY

CREATING AND IMPLEMENTING A CLOSURE PROJECT



THE CLOSURE PROJECT WAS MANAGED WITH PROJECT MANAGEMENT PRINCIPLES. COST AND SCHEDULE VARIANCE WERE MONITORED AND REPORTED MONTHLY; THE CRITICAL PATH WAS EVALUATED CONTINUOUSLY; TECHNICAL DIRECTION WAS PROVIDED SPARINGLY; AND REQUESTS FOR EQUITABLE ADJUSTMENT WERE INFREQUENT.

CREATING AND IMPLEMENTING A CLOSURE PROJECT

INTRODUCTION

Successfully pursuing accelerated closure at Rocky Flats required the creation and implementation of a closure "project." That is, the approach for cleanup and closure of Rocky Flats needed to be described with a clearly defined start and end date, with specific project milestones, budget plans and performance criteria. Accelerated closure also required transitioning the culture of the workforce, both DOE and contractor, from production/operations to closure. Implementing the Closure Project became possible with the development and validation of an accelerated closure vision ("Proof of Concept") and an effective Closure Project Baseline.[39] That baseline was work-activity based and established a schedule for activity completion as well as estimating project costs. The Baseline defined the plan to execute the accelerated closure project and allowed progress to be measured. In addition, the Closure Project milestones and endpoints outlined remained fixed throughout the life of the project.

The aggressive vision and relentless commitment to closure formed the foundation for an achievable project made possible by the application of project planning tools. Creating a project plan that challenged the workforce (with a previously unclear operating mission to one firmly committed to accelerate closure) required tremendous leadership and focus. Applying, and in some cases creating, the systems to accelerate closure in parallel with making organizational changes made the closure of Rocky Flats in 2005 an attainable goal. This section describes the actions and approaches to "creating and getting people to believe" in the possibility of a Rocky Flats closure project and to "delivering and making real" the closure project plan and baseline. It also addresses actions taken in executing the project to achieve the closure objectives under budget and ahead of schedule.

A strong vision and a relentless commitment to closure by senior level management were vital to creating the closure project.

DISCUSSION

Early Planning Efforts

Several key leaders within both DOE and the contractor, Kaiser-Hill (K-H), had a tremendous impact on the development of an accelerated closure project at Rocky Flats. In 1994 and early 1995 DOE's Rocky Flats Field Office (RFFO) Manager definitively stated the goal for site closure and effectively engaged community stakeholders through the development of the 1994 Rocky Flats Strategic Plan[1] which was issued on September 19, 1994.

The 1994 Rocky Flats Strategic Plan documented the vision, goals, objectives, and success criteria for reducing, eliminating, or mitigating existing environmental liabilities, while protecting the safety of the workers and the public. The emphasis of the Plan was reducing liabilities, eliminating inefficiencies, and minimizing unnecessary work activities. The 1994 Strategic Plan was developed with extensive input from the federal and contractor workforce, DOE HQ, regulators and stakeholders. The active involvement of these various groups helped to develop a site plan that outlined the challenges facing Rocky Flats and the scope of work needing to be accomplished. During the development of the plan, it was realized that the outreach process built trust among these diverse groups and jump-started the communications necessary for all parties to understand the significant issues that needed to be resolved.

During the development of the plan, it was realized that the outreach process built trust among these diverse groups and jump-started the communications necessary for all parties to understand the significant issues that needed to be resolved.

The 1994 Strategic Plan also accomplished other important tasks in that it was the first organized effort to communicate a change in the mission at Rocky Flats from nuclear weapons production to cleanup and closure. As the plan was drafted and revised through several iterations, it was shared with Rocky Flats federal and contractor employees through presentations at large group meetings and through supervisory chains of command. Employees participated in the comment process and their comments were dispositioned in the same way as regulator and stakeholder comments. Finally, the plan communicated the cleanup scope of work to prospective bidders when the Rocky Flats management contract was competed in 1995. The 1994 Strategic Plan was a part of the Request for Proposal sent out by DOE in its solicitation for a new operating contractor.

Liability Reduction Activity Teams

The Liability Reduction Activity Teams were composed of federal personnel and worked during late 1994 and early 1995. The purpose of these teams was to further define the scope of the liability reduction and mortgage reduction work that could be accomplished at Rocky Flats. The Site problems were still perceived in terms of reducing cost and liabilities of an ongoing site, not in terms of achieving closure. This was partially the result of the complexity and uncertainties associated with closure and partially due to the definition the Rocky Flats' DOE HQ Program Office role (EM-60, Transition). These teams defined preliminary performance metrics for the 1995 management contract solicitation. The teams concentrated in the areas of stabilizing actinide solutions, consolidating Special Nuclear Material into a single facility, shrinking the Protected Area, disposing of all waste forms, including low level and transuranic wastes, disposing of excess Special Nuclear Material and classified documents, accelerating environmental clean up, and deactivating facilities. As a result of their work, the teams expanded the understanding throughout the RFFO of the scope to be accomplished in cleaning up the site and that achieving the success criteria initiated with the 1994 Strategic Plan was possible. This set the stage for acceptance of the very aggressive closure concept details developed by the new contractor in 1995 and 1996.

Baseline Environmental Management Report

At about the same time that Rocky Flats was documenting its strategic vision for eliminating environmental liabilities, cleanup and closure of the site seemed a distant dream at DOE HQ. In March 1995, the DOE issued the results of a Complex-wide analysis of the costs and schedule necessary to cleanup the Department's aging facilities. The Baseline Environmental Management Report (BEMR I)[4] documented DOE's estimate that the cleanup of Rocky Flats would take approximately 65 years and cost over $37 billion. The BEMR was a bottoms-up analysis that accounted for all of the activities and sequences traditionally anticipated in a DOE cleanup program. Even after receiving updated information from Rocky Flats, DOE HQ projected in BEMR II (June 1996) the final cleanup and end state closure of Rocky Flats in 2055 at a cost of $17.2 billion.

The Interim End State Document and The Accelerated Site Action Project

K-H came on board as the Site contractor in the summer of 1995. They created a small team to explore the idea of accelerated closure and provided the senior leadership necessary to make this vision a viable effort. DOE was asked to include a participant to lend perspective and DOE awareness to this largely "black box" effort. The team, along with numerous other participants, supported the planning effort for accelerated closure, making the vision provided by senior leadership a reality. The following were significant events in the planning process.

K-H created a small team to explore the idea of accelerated closure and provided the senior leadership necessary to make this vision a viable effort.

In late August of 1995, K-H and RFFO embarked on an innovative process to define the end state of Rocky Flats and capture the course of action for accelerated closure. This effort, known as "Interim End State,"[7] envisioned an aggressive approach to cleanup of the Site and called for increased engagement of stakeholders. The process evolved into the "Accelerated Site Action Project" or ASAP[8] and continued to set the strategic vision of accelerated closure. The plan was developed by a small group of RFFO and K-H personnel who were instructed to take a commercial approach and to question and challenge every closure assumption. While ASAP proved critical to the process of creating the idea of accelerated closure, because of its aggressive vision it was not easily received outside of the Site. Stakeholders were surprised by accelerated closure end-state assumptions that were different than previous plans that had been discussed, and some at DOE HQ were concerned with the ability to meet the DOE commitments that were part of the plan.

By February of 1996, Phase II of the ASAP document, *Choices for Rocky Flats,*[9] provided stakeholders with alternative end-state choices and described the cost and schedule implications of each choice. One choice documented in ASAP II projected that closure could be accomplished at a cost of $10 billion with completion in 2016. Subsequent ASAP documents refined the specific activities needed to implement the strategic vision for cleanup and closure, and successive iterations of closure lifecycle baselines developed in response to that vision were critical to making closure in 2006 an achievable goal.

A key aspect of baseline development and the planning process was the aggressive "top down" approach to planning. More traditional, functional "bottoms up" information was never allowed to define or limit the project.

A key aspect of baseline development and the planning process was the aggressive "top down" approach to planning. Goals to accelerate cleanup and closure were set in each of the ASAP publications and the subsequent phases of baseline development created in response. More traditional, functional "bottoms up" information was never allowed to define or limit the project. Rather, the strategic vision of accelerated closure, further clarified through the ASAP process, set the implementation plan for closure.

<u>The "10 Year Plan"</u>

Two significant events occurred in June and July of 1996. U.S. Department of Energy Assistant Secretary for Environmental Management directed each EM site to draft a "10 Year Plan" outlining the cleanup of their site. In doing this, EM also drove DOE complex-wide support of individual site needs for accelerated closure. A joint DOE and K-H effort (ASAP III[15]) led to the Rocky Flats input to the Ten Year Plan[16] and projected closure in 2015 at a cost of $7.5 billion. Without EM HQ direction and support, particularly involving the disposition and consolidation of waste, accelerated closure at Rocky Flats would have been more difficult, if not impossible.

The second important event in July 1996 was the signing of the Rocky Flats Cleanup Agreement (RFCA)[3] (outlined in the *Regulatory Framework* section), which provided the regulatory structure for accelerated closure of the Site and agreed upon project milestones. One of the choices provided previously in ASAP II served as input to the end state agreed upon in the RFCA.

Closure Project Baseline (CPB)

Following the initial development of ASAP, K-H, partnering with DOE Rocky Flats, began to build a project baseline that eventually became the basis for negotiating and administering the Closure Contract and determining potential incentive fees. The Closure Project Baseline (CPB) embodied the overall concept of the project that fueled increasing confidence that the project could be accomplished faster and cheaper. This increased confidence was both internal to K-H and DOE RFFO as well as the stakeholder community locally and in Washington, D.C.

Development of a credible baseline was essential. To implement the baseline, Rocky Flats was dependent upon complex-wide support from DOE to allow delivery of GFS&I and completion of project milestones.

Development of the CPB occurred between 1997 and 2000. During that time, three major complete baselines were prepared and delivered to the DOE RFFO. The end objectives of each baseline were distinctly different. In each successive iteration, the end state was further clarified, the schedule was accelerated, the cost was reduced, and the level of detail was increased. Planning efforts mentioned earlier, such as the Interim End State and ASAP, were developed using a network of Subject Matter Experts from functional work areas and included people who were new to the Site (and thus brought a fresh commercial perspective). When the baselines were developed, each K-H organization provided a manager that was responsible for his or her organization's plan. These people evolved into the "Planning Managers" that reported directly to the Project Vice Presidents responsible for execution. This element was critical in establishing a clear line of accountability and increasing ownership of the baseline for each performing organization.

The first major CPB, completed in June of 1998, had a Closure Project end date of 2010 and a total cost of around $8B. The CPB consisted of an eleven-level Work Breakdown Structure (WBS) and almost thirty Project Baseline Summaries (major subprojects). In time, this proved to be an overly cumbersome system with far too much detail for lines of authority and establishing logic ties. By 1998 the K-H organization was "functionally" organized with major subcontractors assigned functional scope (i.e., nuclear operations, environmental restoration, waste management infrastructure, security) and executing assignments in numerous buildings. However, there were no clear lines of authority or accountability for overall closure efforts. This complicated planning substantially and led to a number of internal conflicts, often between subcontractors, regarding cost estimates and staffing levels. Price Waterhouse Coopers (PWC) independently reviewed the 2010 CPB. This review (and others subsequently performed) is described in more detail in the External Credibility Reviews segment of this section.

One problem that the CPB highlighted was that much of the Site budget was consumed by "landlord" costs – costs just to keep the buildings open. These included not only costs for utilities, but also costs for surveillance and maintenance, maintaining the authorization basis, and services from program or support organizations. Additional budget was consumed by costs to meet compliance requirements – Defense Board and regulatory milestones. Only a small portion of the annual budget was "discretionary." As dialogue continued with the regulators and the public, there came to be a general agreement to initially focus "discretionary" funding on the activities that would eliminate the higher nuclear risk problems at the expense of decommissioning and environmental restoration. Over the next year, in parallel with the dialogue, the Site planning and integration organization substantially increased the level of detail and number of activities, leading to finer resolution of the prioritization process.

Aligning DOE and K-H was a major element necessary to assuring success in achieving closure in 2006.

2006 Closure Goal

The CPB prepared in 1998 helped to solidify the creation of the idea that an accelerated closure project was possible. Success in development of the 2010 closure baseline led to a second more aggressive effort in 1999 focused on achieving 2006 closure. This effort was a major goal of the senior K-H and Rocky Flats Site Managers. In addition, they recognized that to make accelerated closure happen they would need to build a strong partnership between their two organizations. Aligning DOE and K-H was a major element necessary to assuring success in achieving closure in 2006. With both the government and contractor working in the same direction, the Closure Project improved its ability to refine the accelerated closure schedule and to "lock in" an achievable closure target. In addition to monitoring the development of the 2006 CPB, the senior management group devoted a substantial amount of time to resolution of major strategic issues, such as plutonium residue processing, waste disposal paths, and D&D methodology. Dealing with these issues at a high level focused the organizations on achieving 2006 project completion. As employees saw senior management focused on finding a way to achieve 2006, buy-in at the staff level began to grow.

It must be remembered that, despite the detailed planing being conducted by RFFO and K-H, at the time there was widespread skepticism that the 2006 goal of closure could be accomplished. The larger Site saw only incremental change in day-to-day activities. The General Accounting Office issued a report in 1999[51] calling the goal "laudable" but unlikely (followed by a second report in 2001[52] again suggesting that closure as soon as 2006 was unlikely).

Closure Project Baseline, Revision 3

Building on the planning efforts developed through partnership with DOE, K-H, in June of 1999, delivered the CPB Revision 3.[53] This CPB had a completion date of December 2006 and a total cost of $6.7 billion. Many of the earlier issues regarding residues, SNM packaging, and waste disposal paths had been resolved. Level-of-effort department staffing plans within the contractor organization had been dramatically cut and individual organizations felt "ownership" of both the approach and the schedule.

The Site came to consensus on the assumptions and work logic that became the "top-down" plan. Each K-H organization then developed a detailed "bottoms-up" plan that complied with the top-down work logic, cost and schedule targets. The K-H Planning Team continued to work new issues iteratively, trying in each successive attempt to reduce cost and improve schedule

The development of CPB Revision 3 solidified the management approach of earlier planning efforts into a final form. Based on the then-current CPB and the direction provided by senior management, "cases" were developed which postulated accelerated project performance (cost and schedule). These cases were based on assumptions that had surfaced during senior management strategy sessions. The K-H Planning Team, comprised of one representative from each organization, along with members of the Planning and Integration organization, came to consensus on the assumptions and work logic. That consensus result became the "top-down" plan. Each organization was then charged to develop a detailed plan that complied with and implemented the top-down work logic, cost and schedule targets. The "bottoms-up" detailed plans did not easily achieve the cost and schedule constraints of the top-down targets. The K-H Planning Team continued to work new issues iteratively, trying in each successive attempt to reduce cost and improve schedule. In hindsight, it is interesting to note that, as a result of the management leadership driving the project, the final cost of the project in 2005 proved to be closer to the "top down" case developed in 1999 than the "bottoms up" cases.

Basis of Estimate Software Tool

One major contributor to the success of the CPB effort was the development of a centralized cost estimating system known as BEST (Basis of Estimate Software Tool).[54] This system ensured that estimates were consistent from organization to organization, that they met the fundamental criteria necessary for external validation, and that all estimates "rolled-up" consistently from the lowest level to the overall plan. This system was expanded to include scope such as waste volumes by type, commodity projections, as well as craft labor and support dollars.

IMPLEMENTING THE CLOSURE PROJECT

“Level Funding Profile”

A disciplined application of project management fundamentals enabled projectization.

Following the completion of Revision 3 of the CPB, it became clear that another major revision was needed. Up until that point in time, the overall project cost profile had been developed in accordance with standard project management techniques. However, as part of the Congressionally mandated funding profile, DOE made it clear that a “level” funding profile of $657 million per year would be allocated for the Closure Project. Total project funding requirements were very close between the CPB Revision 3 and the DOE planning levels, but the level, annual funding allocation presented a new challenge that needed to be addressed in the baseline. Funding profile issues became a major part of the negotiation of the DOE Closure Contract with K-H in 2000.

Closure Contract CPB (Rev 5)

In June 2000, the Closure Contract CPB (Rev 5)[39] was developed to resolve a number of issues related to Closure Project funding and organization. This CPB was delivered to the DOE on June 30, 2000, as a requirement of the newly signed Closure Contract, and was validated early the following year.

The major features of this revised CPB included:

- Lowered cost (in line with the annual DOE funding target)
- Streamlined WBS system (Four reporting levels. Individual Execution Projects could extend the WBS to whatever levels/charge numbers necessary for their internal controls.)
- Correlation of the WBS to the Organization Breakdown Structure (OBS)
- Clearer role for subcontractors in the overall Closure Project structure
- Internal cost and schedule contingency created and reserved by K-H (working plan versus CPB)
- Earned Value Milestones that tie the CPB to fee calculations
- Incorporation of all scope and resources (such as analytical samples, commodities, and waste volumes)
- Improvements to charging practices associated with the revised WBS

Again, this baseline was produced using the “top-down, bottoms-up” iterative approach and resulted form an intense effort for several months by all organizations. During the same time period, K-H codified its project control system (as required by the contract) into a Project Control System Description (PCSD).[54]

With the experience and knowledge of the K-H planning managers now resident in the Execution Projects, the PCSD in place, and a strong partnership between the government and contractor, project performance was improved consistent with the revised schedules. In the cost arena, schedule acceleration proved to be the most powerful weapon. Enormous amounts of "level of effort" funding were deleted for each year and subsequently eliminated from the schedule. The most critical element of the entire effort, however, was the consistent, tenacious focus of the K-H CEO and Rocky Flats Manager on overall Closure Project performance. Winning over "believers" in accelerated closure came from the "trickle down" of intense senior management focus on achieving this objective.

The reorganization assigned the responsibility and authority for almost all activities necessary for execution to the Projects, and promoted the Project Managers to Vice Presidents.

Closure Project Organization

One of K-H's first post-contract award activities in 2000 was to reorganize from a "program" organization based on functions and its Performance Based Integrating Management Contract (PBIMC) subcontractors into six Execution "Projects." The Execution Projects consisted of the four plutonium buildings (771 Project, 776 Project, 707 Project, and 371 Project); another Execution Project for all other facility decommissioning, environmental restoration, and infrastructure; and a final Execution Project containing waste management, security, and plutonium stabilization. Several other support organizations were responsible for business processes, planning and project reporting, engineering and safety oversight, regulatory compliance, construction support, etc. However, the reorganization assigned the responsibility and authority for almost all activities necessary for execution to the Projects and promoted the Project Managers to Vice Presidents. It divided program organizations such as engineering, safety support, procurement, project control, and similar functions and assigned individuals to the respective Execution Project organization. With the relocation of plutonium stabilization operations so that all such non-decommissioning plutonium activities were in Building 371 (see the section on *Security Reconfiguration*), the remaining plutonium building Projects were not distracted by an operating mission and were able to completely focus on the decommissioning of their facility.

The subcontracting and staffing approaches were completely reorganized as well. All execution, previously the scope of the major subcontractors, became direct K-H scope. K-H contracted directly with most of the "third-tier" subcontractors, shortening the procurement chain and centralizing the procurement process.[55] K-H also substantially increased its staff, offering positions principally to existing employees of lower-tier subcontractors, although several key managers and staff were hired from outside the Site. The principal remaining subcontractor scope became to provide non-K-H labor. Major subcontractor business functions, previously direct contract costs, became their overhead costs. All of these changes streamlined the ability to manage resources and costs, allowed flexibility of compensation, and reallocated and reduced Site staff.

Commercial Contracting

One element of the Closure Contract management strategy involved the deployment and control of commercial contractors to support decommissioning, remediation, and construction work. Contracting was required to provide additional resources, management flexibility, and to address Davis-Bacon requirements. The initial concept was that the Site bargaining unit employees (United Steelworkers of America) comprised a limited number of skilled resources that would perform the decommissioning of the more contaminated process systems. The additional labor for accelerated closure and demolition would be provided by the construction crafts ("Building Trades") under a fixed-price subcontracting approach. The Building Trades would be deployed as early as funding became available, in some cases in the same building as Steelworkers, to support the acceleration of Projects. Additional fixed price procurements would occur for environmental restoration and other elements of defined scope. Considerable effort went into looking at ways to reduce DOE or Site-specific requirements for this less-hazardous work to make it more like normal commercial construction. One specific example was the decommissioning of Building 111, a 1950's vintage office building, that was used to pilot the use of commercial requirements on-Site.

Commercial subcontractors had problems with safety performance issues, where trends of minor accidents and incidents caused shutdowns, and subcontractor work control programs did not support the necessary corrective actions.

While the Site had some success in reducing unnecessary requirements, there were several problems with the all-fixed price approach. The first was that some activities could not be sufficiently well defined as to the existing conditions and the interaction with existing Site organizations to support a fixed-price approach. A second was the prolonged ramp-up experienced by some of the subcontractors that were used in the initial Building Trades decommissioning work. Finally, there were safety performance issues, where trends of minor accidents and incidents caused shutdowns, and subcontractor work control programs did not support the necessary corrective actions. The overall result was a drop-off of schedule performance that was remedied by modifying the subcontracting approach. Several subcontracting approaches were used, such as a "captive" construction subcontractor, a major functional subcontractor for decommissioning scope, contracting with subcontractors familiar with DOE work, and more active oversight of subcontractors by K-H. All of these remedies resulted in construction subcontractor management being more familiar with Site safety and performance expectations. Regardless of these problems, the experience in developing commercial-type statements of work for non-nuclear facilities resulted in a better ability to tailor Site requirements to the risks posed by commercial-type work.

Reporting Structures for DOE-HQ

As part of the commercial approach to the Closure Project, the Site attempted to convince DOE-HQ that the closure effort was a single DOE project and should be planned, formulated, managed, tracked and reported as a single project. Due to DOE-HQ concerns with justifying a single $600+ million annual project to Congress and, at the time, the traditional "stove-piped" program (not project) management at DOE-HQ, the Site was initially required to plan, formulate, track and report as 30 individual projects (not aligned with Site Execution Projects). Since the Site chose to manage closure as a single project (not 30 individual projects), reporting along DOE-HQ formats became a "paper chase" outside of the normal project management functions. Given the Site's focus on eliminating activities that did not directly support cleanup and closure, considerable effort was directed to obtaining relief from unnecessary reporting requirements. Over time, reporting requirements were more closely aligned to the CPB and with the Closure Project management strategy, allowing changes to be made and risks to be managed consistently while accomplishing safe closure in the fastest, most cost effective way possible.

External Credibility Reviews

External credibility reviews of the Closure Project Baselines were used to build confidence both internally and with HQ and Congress, and to provide objective recommendations for project improvement.

The flexibility provided by the Closure Contract depended upon DOE (and Congress) accepting of the validity or the Contract CPB Revision 5. DOE needed to believe that the estimate elements represent the best information available and had not been manipulated to be unachievably low or padded to assure contractor success. The fact that the CPB was credible was important to permit multi-year funding authorization and progress payment based on earned value, and in eliminating the previous method of DOE using milestones and performance measures to control K-H. Thus the DOE was able to allow K-H wide latitude to manage activity scope, approach, and schedule trusting in the robustness of the CPB to both minimize inappropriate manipulation and provide transparency for Closure Project oversight.

As the accelerated Closure Project scope was being refined and K-H was developing schedules and cost estimates, the contractor and DOE embarked on a series of external credibility reviews. Recognized experts in the field of project management and large accounting firms conducted the reviews. These reviews were intended to help the Site identify soft spots in project scope, schedule and cost in the short-term, while in the long-term to establish credibility both internally and externally to the Site. The Site approached each of these reviews in a positive manner, so that maximum benefit could be gained for the time invested in each review.

In February 1997, the U.S. Army Corps of Engineers (USACE) conducted an independent assessment of the remediation baselines at 13 DOE Environmental Management sites around the country. This assessment was performed at the request of the DOE. The assessment consisted of a review of the existing cost estimates, technical scopes, schedules and supporting data underpinning the baselines. The results of the review emphasized the need to spend more time developing quality cost estimates. Additionally, this review set the stage for Rocky Flats to continue with external reviews of proposed CPBs submitted by the contractor.

In July of 1998, Price Waterhouse Coopers (PWC) reviewed[211] the Rocky Flats CPB for compliance with the PMI Project Management Body of Knowledge and a variety of project management textbooks. Specifically this was a review of the first major baseline, completed in June of 1998, with a projected end date of 2010. K-H contracted with PWC to perform the independent validation. In September 1999, Ernst & Young, LLP (E&Y) completed a reasonableness review[212] of the cost, scope and schedule projections in the CPB Revision 3. DOE contracted with E&Y to perform the review between June 1999 and August 1999. Finally the Closure Contract Project Baseline Revision 5 was reviewed by Burns and Roe with more of an operations focus to the analysis.[213]

These credibility reviews were not performed in place of reviews by the contractor and the DOE, but supplemented the reviews conducted internally by the Site. The end result of this arduous scope, schedule, and cost development, with repeated independent reviews by recognized experts, was a willingness of the DOE and K-H to enter into a long-term closure contract with a fixed target cost and very high change control thresholds, based on the confidence in the Closure Project Baseline. In addition, the results of the reviews provided additional confidence on the part of the regulators and high level stakeholders (e.g., Congress, DOE-HQ) that the Closure Project, as planned, could succeed.

....variance tracking was accomplished on a project life cycle basis, rather than a fiscal year basis.

High Change Control Thresholds

The Rocky Flats Closure Contract signed in January 2000 defined the Site's end state, project target cost and schedule. The effective working relationship between RFFO and the contractor, and the confidence in the baseline with its project scope, schedule and costs well-defined, enabled the government to write high change control thresholds into the contract. This also represented a high level of trust on the part of DOE with the K-H planning process and the contractor ability to deliver. The change control thresholds were:

- greater than a $40 million change, DOE-HQ approval
- greater than a $20 million change, local RFFO approval
- less than a $20 million change, contractor approval

It is important to note that these were not changes to the baseline target cost and schedule, but changes that allowed flexibility in work sequencing between or within sub-elements of the total Closure Project. The benefit to the contractor of these high change thresholds was that the contractor was able, for elements of the project within the baseline, to respond to new ideas, cost savings, cost overruns, and other challenges quickly, instead of waiting 2-6 weeks for DOE approval. The advantage to the government was that the baseline was not being reset at the start of every fiscal year; variance tracking was accomplished on a project life cycle basis, rather than a fiscal year basis. Both parties benefited in that the number of change proposals being processed dropped by an order of magnitude since these high thresholds were implemented. Additionally, the CPB was being used to measure performance towards the closure goal of December 2006, at a target cost of $3.963 billion. By mutual agreement between the contractor and DOE Rocky Flats, changes to the baseline itself were only made when the scope of the contract was also changed through the equitable adjustment ("REA") requirements in the closure contract.

Project Control System

DOE direct access to the PCS also increased the level of DOE awareness and trust since DOE staff had direct and immediate access to the K-H project status and planning information.

The Project Control System (PCS) was one of only two items (along with the Predetermined Work Activities Matrix) explicitly approved by the DOE Contracting Officer upon implementing the closure contract. The contractor built the CPB, the cost estimates and the logic-tied Primavera Project Planner (P3) schedule at exactly the same activity level. The scope statements, cost estimates and P3 schedule information were contained in the contractor's PCS. The contractor submitted a description of this PCS to RFFO for approval 60 days after the contract became effective.
Some of the objectives of the PCS were to:

- Establish and maintain a project cost, schedule and technical baseline within the framework of the closure contract requirements
- Develop and publish timely project management reports that display technical, cost, schedule and funding status based on the approved CPB

- Measure actual and forecasted cost and schedule status against the CPB to determine actual and projected performance
- Maintain a concise and documented change control process for the CPB
- Plan, report, and execute all at the same level of the Work Breakdown Structure

RFFO performed a comprehensive and detailed assessment of the contractor's implementation of this Project Control System Description prior to approving the system. In July of every year K-H provided DOE with an Annual Update, in which it formally projected and documented any changes, although in practice few were made.

The contractor gave full and unfettered PCS access to the RFFO staff. This enabled the RFFO to download project information for direct analysis and left the contractor to the business of day-to-day project management. This downloaded information was used by DOE staff to directly produce monthly and quarterly project reports for use by contracting officials, stakeholders, regulators and DOE HQ, eliminating the need for additional support from the contractor. It also increased the level of DOE awareness and trust since DOE staff had direct and immediate access to the K-H project status and planning information.

Predetermined Work Activities (PWA)

The other document explicitly approved by the DOE Contracting Officer was the PWA Matrix.[41] This matrix described approximately 900 "real closure work" activities taken directly from the CPB with a value of $1.14 Billion, the completion date for each activity, and budgeted cost. The entire matrix was under change control of RFFO and any changes submitted by the contractor were subject to a high level of scrutiny with a zero change threshold. The matrix as originally approved represented the best link to the original Closure Project Baseline developed by the contractor. Maintaining this link between the PWA Matrix and the original Closure Project Baseline led to a high confidence level that the contractor's performance would meet or exceed the level originally thought necessary to achieve the goals of the closure contract.

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Quarterly, DOE Rocky Flats calculated schedule variance from the approved PWA Matrix by performing a 100% physical validation of the work reported complete by the contractor. Disagreements were avoided because the scope of each activity in the PWA Matrix was for 100% completion (unless a quantitative measure such as residues stabilized or waste disposed) before any earned value credit was given for the activity. Waste disposed from decommissioning (as opposed to legacy waste processed) turned out to be a poor project metric, because the actual waste generation was often different (and usually larger) that that originally estimated. Thus, the full earned value of the activity might be realized while additional waste remained to be generated.[56] The total PWA earned value reported compared to that scheduled to be complete provided contracting officials with valuable information as to how much progress had been made towards a 2006 closure date.

In addition to contracting officials using the PWA Matrix in determining progress towards 2006 closure, the Site's regulators used this same matrix to establish earned value milestones in the regulatory arena. For more information regarding the tie between the PWA Matrix and the regulatory milestones, see the Regulatory Framework section.

Closure Contract Project Baseline as a Useful Management Tool

The Baseline was an effective project optimization tool, providing high quality project data to support informed decisions, allowing continual optimization to take advantage of opportunities and reflecting the impact of changes in execution methods. K-H created and maintained three Primavera schedules: the contract baseline schedule, a working baseline schedule, and the "2 TO GO" schedule. The baseline schedule contained 12,786 total activities. The working and "2 TO GO" schedules, derived from baseline data and incorporating the latest activity durations and logic, were used to project impacts of activity delays and accelerations, allowing active project management, coordinating activities between Execution Projects and identifying options for closure schedule acceleration. It was also used as a communication tool between K-H and DOE, ensuring that Government Furnished Services and Items (GFS&I) activities and K-H Closure Project activities supported each other (e.g., that GFS&I trucks are available to remove packaged special nuclear material). The result was better allocation of funding to critical and near-critical activities and significant overall Closure Project acceleration.

The project schedules were used to project impacts of activity delays and accelerations, allowing active project management, coordinating activities between Execution Projects and identifying options for closure schedule acceleration.

The baseline did not include the detailed-planning level data – it provided activity scope, cost, and duration but only generally discussed how the work would be accomplished. The detailed planning resided in the work control documents and procurement documents that controlled work execution. This "rolling wave" detailed planning of near term activities avoided unnecessary complexity at the Closure Project level and unnecessary planning far in advance of the work, and allowed feedback and flexibility to adjust forecasts in the higher-level schedules.

Project Risk Management

The effort to define the baseline included the definition of project risk. Baseline activities were assigned risk values based on an assessment of parameters such as how well the work was defined and whether methods were in place to accomplish it. The risks were compiled at the Execution Project level and were managed using contingency and internal change control. The Monte Carlo simulation was used to mitigate schedule and cost risk by focusing on those activities that had substantial influence on the outcome. K-H prepared quarterly risk analyses of the contract baseline. The risk analysis generated optimistic and pessimistic cost and schedule data for each activity. The results identified the "90% confidence level" expected completion date and cost at completion. Risk Management practices were incorporated into everyday project management with Rocky Flats personnel conducting risk management activities as part of their monthly meeting and reporting. Typical reports included discussion of critical path or near critical path items and issues or potential issues that could affect Closure Project completion. Schedules were checked and updated to red-yellow-green status and corrective actions identified.[57]

The Monte Carlo simulation was used to mitigate schedule and cost risk by focusing on those activities that had substantial influence on the outcome.

Project Reporting

K-H provided monthly project reporting to the RFFO. Cumulative cost and schedule variances were identified, causes for the variances were explained, and trends and performance indices were compared to the contract schedule, the working plan, and the "2 To GO" plan. Physical accomplishments for the month were identified, and the critical path was reviewed. The status of demolition milestones was updated with trending information, external support needed to complete the Closure Project was discussed, documents submitted to RFFO for approval were identified, and a summary of issues was explained.

K-H also produced a quarterly critical analysis report for the total Closure Project and by individual Execution Project. The report addressed key accomplishments, risks, near-term objectives, performance indices, issues, and recovery items. It also included Request for Equitable Adjustment status, external project issues, critical path performance and float analysis, DOE and regulatory milestones issues, estimated cost at completion, funding status, and an analysis of the critical staffing skills.

Sunset Project

In 2002, the RFFO began developing the "Sunset Project" to document all Federal activities necessary to close the Site and to transition continuing functions to Office of Legacy Management (LM), the U.S. Fish and

Wildlife Service, or the Consolidated Business Center. (LM became the ultimate responsible DOE entity for the industrial portion of the Site and the U.S. Fish and Wildlife Service will assume management responsibility for the buffer area.) The Sunset Project recognized that K-H had a specific scope to complete under contract for site demolition and remediation, but there were many uniquely DOE tasks that needed to be accomplished to complete the overall site closure. The "Sunset Project" was supported by a Primavera schedule that outlined over 1000 activities assigned to individual Federal staff members. The schedule status was reported each month and included a 60 day look ahead for upcoming activities. GFS&I were tracked by the responsible DOE individual and by the headquarters point of contact when identified. Spreadsheets were generated with upcoming GFS&I identified by quarter and included notations as to whether dates need to be moved forward or back based on the contractor's updated schedule.

The primary value of the Sunset Project was to maintain the focus of the DOE on completion of the total mission and to ensure that hundreds of seemingly minor tasks did not inadvertently get ignored. The Sunset Project also served to be invaluable for capturing institutional knowledge as the DOE staff went through significant downsizing and loss of personnel and to reassign responsibility when staff departed.

Projectization

It is a management axiom that a clear project scope and having responsibilities and authority vested with a single project manager are two key components for project success. The decision to divide the Closure Project organization into six Execution Projects, five of which had the scope of removing their specific facilities to ground, was extremely successful. The decision on whether a Site function or organization is required is reduced to whether or not an Execution Project Manager will pay for it. This resulted in individuals and organizations identifying ways to achieve the common goal – removing facilities. The Execution Projects were of appropriate size to allow sufficient project manager focus, with minimum "collateral" responsibilities. The area or facility-specific approach avoids the ambiguity of whether a problem is the responsibility of the "program" or the "landlord."

One result has been several organizations "re-inventing the wheel", iteratively building upon each other's innovations with positive results.

An unanticipated result of the projectization was a healthy competition between Execution Projects. There were initial concerns that splitting up previous "program" functions, such as engineering, would reduce overall Site efficiency. The actual result has been several organizations "re-inventing the wheel", iteratively building upon each other's innovations with positive results. A specific example was the decontamination of gloveboxes from transuranic to low-level waste. This method of glovebox removal was pushed aggressively by the 776 Project; as the success became apparent, other Projects incorporated the technology, and continued to refine the decontamination and removal processes. Structuring personal incentives based on a common goal – Site closure - encouraged the sharing of resources and capabilities and discouraged the Closure Project competition from becoming "unhealthy."

Encouraging management focus on actions in its area of Site closure responsibility extended to the DOE activities. The Closure Contract clearly defined DOE direct responsibilities for actions to achieve closure, including the disposition of special nuclear materials and wastes (once K-H had packaged them) and final Closure standards. Some of the disposition activities required interaction with other sites and DOE headquarters to assure timely support. RFFO was also responsible for the budget development, submittal, and interaction. This was not reviewing a budget prepared by the contractor, but development of budget documents "from scratch" based on CPB and working schedule data. This division of labor reduced contractor focus on non-execution activities. DOE reorganized its internal responsibilities to provide direct K-H interfaces within RFFO and minimize direct headquarters-to-contractor contacts. RFFO's organization facilitated the GFS&I mission by vesting responsibility for those activities in the RFFO Project office and regulatory interface in the Environment and Stewardship office. The Finance organization was responsible for budget reporting and the Safety organization was responsible for Safety compliance and the Facility Representative program.

<u>Aggressive Elimination of Unnecessary Tasks, Staff, and Costs</u>

The Closure Contract was based on the contractor's ability to significantly improve productivity from the Site conditions that existed at the beginning of 2000. One of the keys was to identify and eliminate or reduce "unneeded" tasks and specialties and the mostly labor costs associated with them. There were several ways this was accomplished.

Aligning the work scope into Execution Projects accentuated the differences between closure-critical resources and functions that were "nice to have." This scrubbing of tasks was a continual process in a project environment, since activities were always being completed and the associated resources needed to be reallocated or eliminated. The Execution Projects' staffing of their teams became somewhat of a musical chairs process that encouraged individuals to demonstrate their capabilities. In some cases the Projects selected the individuals that they wanted from the completed activities or program organizations. In other cases whole groups were initially rolled under a Project and incoming managers then evaluated their needs and laid-off staff as appropriate.

This scrubbing of tasks was a continual process in a project environment, since activities were always being completed and the associated resources needed to be reallocated or eliminated.

K-H also aggressively pressed their subcontractors to reduce their overhead rates, reducing labor rates for staff hours while ensuring the maintenance of staff salaries. K-H recognized that a subcontractor industry had grown up around the Site with many subcontractor employees having a greater affiliation with the Rocky Flats Site than for a particular subcontractor. Thus a "performance contractor" overhead rate (indicative of project management risks and/or responsibilities) was being paid for "job shop contractor" levels of responsibility (i.e., staffing functions with little risk). In some cases subcontracts were eliminated with the general result of the staff gaining employment with a subcontractor that remained. This resulted in reduced overall labor costs for the same effort and often the same workers.

Finally, there was an aggressive effort to reduce infrastructure costs, either physical (such as in heating and electricity for offices) or for required support (such as the office staff required to maintain a Site security posture). Certain activities such as moving support staff to offsite offices allowed the reduction of central heating and accelerated decommissioning of unneeded facilities. Other actions were the outsourcing of activities such as laboratory services and the off-site treatment of mixed wastes. While these actions may have appeared to have higher costs for the specific service, they made unnecessary areas of infrastructure more visible and thus easier to eliminate, saving cost and usually time at the total project level.

While these actions may appear to have higher costs for the specific service, they have made unnecessary areas of infrastructure more visible and thus easier to eliminate, saving cost and usually time at the total project level.

During the initial Closure Project stages it was recognized that as closure activities progressed there would be a lessening of support costs; e.g. after a building had been emptied of special nuclear material, the security costs would greatly decrease. These cost reductions were almost always the result of both the direct cost reductions due to the completion of a mission activity and a conscious effort to eliminate or reallocate the staff and other resources that supported the mission activity. At the beginning of the Closure Project the overall schedule was funding constrained. This led to an active review of activities that could be accelerated to achieve a long-term reduction in costs. Thus, in addition to an activity's risk, if accomplishing the activity would free budget that could be used for closure then the activity became a higher priority. The term "Money Critical Path" was applied to this concept. A specific example was the reconfiguration of the Protected Area, which allowed earlier elimination of some high cost security tasks, thus releasing the funds for other closure activities.

KEY SUCCESS FACTORS

A number of critical elements contributed to the success of projectization of accelerated closure at Rocky Flats. Looking at the leadership and management skills necessary to drive the Site to closure, as well as the application of systems enabling project implementation, reveals several key areas of focus. These success factors include:

1. A strong vision and a relentless commitment to closure by senior level management were vital to creating and implementing the closure project.

2. Rocky Flats was dependent upon complex-wide support from DOE to allow delivery of GFS&I and completion of project milestones. Defined roles and responsibilities among both DOE and contractor organizations allowed each to contribute to Closure Project success.

3. Disciplined application of project management fundamentals must be used to projectize closure, but tailored to support and align with the contract and regulatory documents. Proper tailoring can allow project control systems to become a project enabler rather than just a change control and reporting tool.

4. Creation and utilization of planning systems and controls for project implementation facilitated performance, measurement, and communication of project progress. Planning allowed a proactive regulatory and public outreach approach, and thus minimized regulatory shutdowns, e.g., for decision document approval.

5. External credibility reviews of the Closure Project Baselines were used to build credibility both internal and external to the Site and to provide objective recommendations for project improvement. A credible baseline allowed DOE control without direct involvement in Closure execution. Without a credible baseline, PWAs would not be an effective tool. (Planning and decision "maturity" in 1995 could not have supported a credible baseline.)

6. Closure Project lifecycle instead of annual funding allows multiple-year project optimization. Project control systems and change control tools must allow the contractor the flexibility to achieve the optimization.

7. Providing DOE staff direct access to contractor data, such as desktop accessibility to the baseline database, both permits and encourages the DOE staff to be more knowledgeable about the project status and

issues in real time. DOE staff had similar levels of project awareness and knowledge as their contractor counterparts, which facilitated DOE's ability to engage in productive discussions on risks and alternatives.

8. Incentives, both for the contractor management and employees, must be correctly applied to promote Closure Project acceleration.

9. A safety penalty assures the contractor is proactive. In addition to the contractual safety penalties, an additional "penalty" in a schedule-incentive contract results from the downtime and schedule slip associated with resolving safety-related issues.

10. Subcontracting has been used to manage resources, allow flexibility of compensation, and reduce costs. Subcontracting ramp-up must be evaluated for safety and schedule impacts.

11. Pilot projects were useful to get work going and accelerate decision-making on Site-wide issues. Once work starts the "what-ifs" go away.

All of these factors aligned to make the accelerated closure of Rocky Flats in 2006 a credible project. However, the process of creating the idea and implementing the project was not straightforward or easy. A visionary leadership team, combined with a progressive planning process, laid the foundation for the development of an achievable Closure Project Baseline that required considerable re-working and validation. Credibility was built between DOE, K-H and a wide variety of stakeholders as project milestones were consistently met. Creating and implementing a project for the closure of Rocky Flats and defining the schedule sequencing and resource requirements necessary to achieve closure was a critical component for successfully accomplishing accelerated Site closure by 2005.

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ROCKY FLATS CLOSURE LEGACY

SAFETY INTEGRATION

WORKING SAFELY WAS ACHIEVED IN LARGE MEASURE WHEN MEANINGFUL DIALOGUE OCCURRED BETWEEN THE WORKERS AND THEIR SUPERVISORS AND MANAGERS. MANY SAFETY IMPROVEMENTS AND PROCESS EFFICIENCIES ORIGINATED WITH THE WORKERS.

SAFETY INTEGRATION

INTRODUCTION

As the Site transitioned from weapons production through an indeterminate standby mode and finally to the decontamination and decommissioning (D&D) activities associated with closure, there was a substantial change in the type of work performed and the hazards encountered. Nuclear operations, characterized by a stable, trained group of employees following routine procedures, using equipment of a known configuration, decreased as Special Nuclear Materials (SNM) and plutonium residues were stabilized and placed in safe storage awaiting offsite transfer or disposal. Construction-type work, characterized by sometimes-different contractors doing constantly changing work under evolving conditions, replaced the routine production operations. Change was a fact of life. Facility conditions changed on a daily basis, Site traffic patterns changed routinely, and the inventory and location of SNM and waste was dynamic. It was clear that the safety infrastructure existing at Rocky Flats that had been created for the nuclear production era was not designed for the constantly changing environment associated with the cleanup mission. But it was also clear that the cleanup mission could not be successful if it were not accomplished safely.

It was clear that the safety infrastructure existing at Rocky Flats, and created for the nuclear production era, was not designed for the constantly changing environment associated with the cleanup mission.

What evolved over the course of Site Closure was a proactive safety culture embraced by the DOE and contractor management, and most importantly, the hourly workforce performing the actual hazardous work. The safety culture combined the incentivized desire to accomplish work with the discipline to identify hazards and ensure that adequate controls were in place before starting that work. This was partly due to the Site's development and implementation of a streamlined and efficient Integrated Safety Management System (ISMS) that workers understood and could utilize efficiently. A related factor was the eventual realization that unauthorized and unreviewed "shortcuts" did not accelerate work due to the fact that work stoppages were inevitable when safety was not built into the process from the beginning.

The final site safety culture did not develop either quickly or easily. The Contractor received $610,000 in penalties under the Closure Contract and additional fines under the Price-Anderson Act for various safety violations. Several events described below provide further details on these safety violations. However, over time both Contractor and DOE's Rocky Flats Field Office (RFFO) management came to understand that safety was not only a requirement but also a powerful tool to enable and improve the project performance. This final safety culture was captured in the statement "If we don't work safely, we don't work."

DISCUSSION

Rocky Flats Workforce Before the Closure Mission

The Site's path to closure required the safe accomplishment of three major types of physical closure work. The first type was similar to weapons production operations in that these activities were typically performed in gloveboxes. Initially the highest priority closure work, it involved reducing legacy risks such as draining tanks, stabilizing plutonium materials, and packaging SNM and residues for safe, long-term storage or disposal. A second major type of closure work was the decommissioning of plutonium processing equipment such as gloveboxes, tanks, and ventilation systems. The third major closure work type was the decommissioning and subsequent demolition of facilities and the remediation of environmental media. This third type of closure work involved a wide variety of activities but with much lower levels of radioactivity. Although the Site passed through phases when one type of work was predominant, the work was mostly concurrent. Support work, such as waste management and disposal, proceeded in parallel to these major types of closure work. Each of these closure work types represented different safety challenges.

When plutonium manufacturing activities were shut down in 1989 for operational and safety deficiencies, it was anticipated that those activities would be resumed within a matter of weeks. Consequently, no efforts were made to process and/or package materials for prolonged storage. As additional systematic operational and safety deficiencies were uncovered it became clear that such processing and packaging activities would require significant analysis, planning, facility controls, process development, equipment modification, and personnel training. Putting these elements in place became the goal of "Resumption." Resumption originally focused on putting the systems in place to safely and compliantly restart weapons production activities. Subsequently, when the Site's weapons mission was canceled, the resumption activities focused on resuming only those operations necessary to reduce risks and stabilize the nuclear materials in preparation for Site closure.

It was clear that safely decommissioning over 1,000 gloveboxes represented perhaps the greatest challenge for Site closure

After the 1989 shutdown, substantial efforts were made to train the workforce in the principles of Conduct of Operations and to the new procedures that were being generated as part of the resumption process. While these efforts never produced the intended products (i.e., pits), the workforce did receive valuable training and an improved physical and work control infrastructure to improve the safety and compliance of Site activities. Formality of operation and procedural rigor was substantially enhanced over the pre-shutdown condition at the Site.

Initiation of Risk Reduction Work

After the production mission was canceled, the primary Site efforts focused on the removal and stabilization of hazardous materials. One of the first activities to be undertaken was the draining of plutonium bearing liquids from process tanks and piping. This activity (and other efforts involved with stabilizing SNM and residues and improving the immediate safety posture of the facilities) had some similarities to activities that hourly workers had performed during weapons production. The work involved performing a variety of carefully controlled operations in gloveboxes, observing criticality safety limits (i.e., Criticality Safety Operational Limits and Nuclear Materials Safety Limits), maintaining material control and accountability, and working to procedures.

DOE's Rocky Flats Field Office (RFFO) also began to redirect its effort from active management of the Site to overseeing contractor performance and began to develop qualified Facility Representatives to carry that oversight into the actual work areas.

Despite its overall similarity to previous production operations the work contained significant differences. The execution of the risk reduction activities required new equipment and processes. Long term storage requirements or disposal requirements for residues and SNM differed substantially from previous practice. Residues were packaged to meet strict Waste Isolation Pilot Plant Waste Acceptance Criteria (WIPP WAC). The SNM packaging required a completely new packaging concept. The startup of these processes required the infrastructure and processes developed during resumption to be integrated with the new equipment and procedures. Readiness reviews and assessments were necessary to verify that the systems were ready to operate. The work was undertaken under the oversight of the Defense Nuclear Facility Safety Board (DNFSB), DOE HQ, and numerous internal reviewing organizations. The majority of the workers that performed these activities were the same individuals that had performed the Site's production mission and were familiar with the hazards of glovebox work and attendant procedural controls.

The workforce, although largely nuclear trained and familiar with glovebox operations, was not trained to perform deactivation and decommissioning activities.

Initiation of Closure Work

The award of the 1995 Performance Based Integrating Management Contract[37] to Kaiser-Hill LLC (K-H) initiated a change in the Site's view of safety. The new contractor focused more aggressively on closure and was incentivised to accomplish closure work and achieve safety goals. RFFO also began to redirect its effort from active management of the Site to overseeing contractor performance and began to train and deploy qualified Facility Representatives to carry that oversight into the actual work areas.

Authorization Basis Changes

In order to respond to the authorization basis problems for both residue processing and risk reduction activities, the Site developed new Authorization Basis (AB) documents for the production buildings. In some buildings these replaced the Final Safety Analysis Reports (FSARs) prepared in the late 1980's to enable production and R&D missions. The first iterations of the new ABs were two Basis for Operation (BFO) documents, one for Building 771/774 and one to support transuranic waste storage in Building 440. While the Building 771/774 BFO[58] enabled the necessary activities to proceed for draining liquids and stabilizing materials, it was not suited for full scale decommissioning activities and was cumbersome to implement. Following the BFOs were facility Basis for Interim Operations (BIOs), developed to allow residue processing, material stabilization, and facility modification activities. These documents were developed with the understanding that they would eventually be replaced by documents specifically tailored to the decommissioning mission.

The Decommissioning Challenge

While the Site's primary focus after the cancellation of the production mission was risk reduction, it was clear that safely decommissioning over 1,000 gloveboxes and the associated process equipment represented the greatest challenge for Site closure. Removing plutonium processing equipment is inherently hazardous, with workers spending long hours in personal protective equipment (PPE), working in confined conditions, and using hand-held cutting tools to dismantle equipment that may contain hundreds of grams of plutonium. With the knowledge that the plutonium equipment removal work would be such a challenge, the Site initiated pilot projects to begin to develop the physical approaches and safety controls to support the effort.

The Site was not ignoring safety but tended to view the prevention of incidents as the responsibility of the safety organization.

Decommissioning Pilot Projects

One of the challenges identified during these pilot projects was the fact that the workforce, although largely nuclear trained and familiar with glovebox operations, was not trained to perform deactivation and decommissioning activities. It was essential to ensure that the workers, regardless of their background and past experience, attained the specific training necessary to ensure a consistent understanding of Site requirements and Conduct of Operations at a nuclear facility. This was especially difficult when new employees were hired to supplement the existing workforce. The majority of construction workers hired had little-to-no familiarity with the Rocky Flats safety requirements. Additional oversight of deactivation and decommissioning activities was necessary to mitigate the lack of experience.

One pilot project in 1997 involved removing a lathe glovebox in Building 707's Module A to allow the installation of a new glovebox to be used for salt stabilization. Removal of this single glovebox took approximately five months and identified many safety issues that allowed future similar efforts to be performed more effectively. This glovebox was dismantled in place while other glovebox operations continued within Module A, presenting a significant challenge since deactivation and decommissioning activities were occurring alongside nuclear production operations. Additional gloveboxes were removed in Building 779, most of which had been used for Research & Development activities.[60] This allowed the work crews to start with uncontaminated gloveboxes and progress to more contaminated equipment. These initial activities helped develop the processes and provided the training that was later transferred to the decommissioning of the larger plutonium facilities.

Safety Impacts as Closure Progressed

With an increased level of activity on Site, there were an increasing number of safety incidents. The Site workforce was not ignoring safety but tended to view the prevention of incidents as the responsibility of the safety organizations. Also, the Site did not view safety as an inherent part of the work but rather as a list of requirements that were imposed on the work by the safety professionals. Additional problems included the need to inculcate new workers with the safety culture and devise better methods of coordinating conflicting activities within buildings where the conflict might result in unsafe conditions.

Changes to the Safety and Authorization Basis Approach During Closure

The Closure Contract awarded to K-H in 2000 initiated the final change to the safety culture at Rocky Flats. The contract contained substantial rewards for safe, compliant, and timely Site closure, but also contained unprecedented penalties for unsafe performance. The modified contract, combined with increasing expertise in safe work practices and the understanding that "If we don't work safely, we don't work" allowed the Site to dramatically accelerate its closure work. Inevitably there were still safety incidents due to the natural human tendency to become complacent over time. The Site management, DOE and contractor, had to continually reinforce the importance of a questioning attitude towards work conditions and methods and to empower workers to stop work if there was any uncertainty regarding safety or compliance.

The contract contained substantial rewards for safe, compliant, and timely Site closure, but also contained unprecedented penalties for unsafe performance.

Removal of plutonium process equipment was initially performed within the framework of existing AB documents. It quickly became apparent that these documents would be tremendous barriers to full scale decommissioning. Building on the experience of the BIOs, the Site developed the Decommissioning Basis for Interim Operations (DBIOs) to facilitate full-scale decommissioning.[61] The DBIOs incorporated increased use of administrative controls, functional system requirements in lieu of specified hardware, and criteria for "stepping out" of Technical Safety Requirements (TSRs) when pre-determined conditions, such as "Operationally Clean," were satisfied. The Site Safety Analysis Report (SAR)[62] was developed to provide the AB coverage for activities not addressed under building-specific AB documents.

Decontamination and Demolition of Structures - Safety Impacts

Initiating decommissioning and demolition of structures immediately created new safety risks for what may have been a stable safety environment. This could occur for plutonium facilities after the building's (or sometimes an area of the building) process equipment had been removed. For non-plutonium facilities or uncontaminated structures, work could begin once all classified items, accountable materials, and/or personal property had been removed. Most often the work was performed by subcontractors hired for the project to provide additional labor and a lower (competitively bid) price. This resulted in safety challenges associated with new workers and contractors that did not understand or embrace the Site's safety culture and/or did not have experience with the larger scale use of large hydraulic excavators and construction equipment.

Safety Trending and Oversight

The Site's lessons-learned program had been marginally successful at sharing lessons from one building (positive or negative) with the other building projects. Major incidents were widely publicized both on Site and throughout the DOE complex. Unfortunately, many valuable lessons were not receiving the attention deserved and were not formally promulgated. While this was somewhat mitigated by the sharing of worker resources between projects, a more proactive lessons-learned infrastructure was required across the Site to ensure faster and more comprehensive incorporation of lessons learned.

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In 2001, based on an increasing trend of safety concerns based on what it believed to be K-H's excessive focus on schedule acceleration, RFFO directed K-H to develop and implement initiatives to improve safety performance.[10] RFFO required that the K-H initiatives address overall management performance, the work control and planning process, worker and supervisor performance, lessons learned and corrective actions to prevent recurrence, and independent safety oversight.

The Safety Analysis Center (SAC) was established in 2001[63] as a fundamental tool for sharing informal lessons learned and presenting the facts for Site safety events at all levels of significance. It was intended to complement the lessons learned program - not to replace it. All events were reported to the SAC on a daily basis, from minor slips and scratches to highly significant safety events such as the Building 371 glovebox fire. Events of significance were discussed so that both DOE and those K-H projects that were not directly involved in an event could understand the nature of the event, its significance, and the path forward. The projects had the authority to pursue actions on their own if they believed an event or the response to an event could be used to create improvements in their own project. Some events, following discussion in the SAC, resulted in site-wide actions being directed by senior management. An example of this was a directed walk-down of all gloveboxes to identify combustible materials instituted after the Building 371 glovebox fire in May 2003. The SAC also provided a forum for discussing general safety issues, sharing safety improvements achieved in one project or another, and for follow-up on past items discussed in the SAC. The SAC was often criticized for its ad hoc, informal approach. It compensated for the informality by responsiveness; the ability to analyze, decide, and implement corrective actions in near real time. The aspect that made this tradeoff work was the continuous level of senior management commitment to the SAC and its functionality. The SAC started each day with the focused attention of the contractor management team on issues involving safety.

The Safety Analysis Center started each day with the focused attention of the contractor management team on issues involving safety.

SIGNIFICANT SAFETY EVENTS

- In the fall of 1994, an unauthorized tank draining evolution was performed in Building 771. The draining activity involved liquids with a much higher plutonium concentration than had been authorized and personnel subsequently tried to hide their errors, creating additional significant safety concerns. Virtually all of Building 771's risk reduction activities were shut down for nearly a year while the event was analyzed and systems were implemented to prevent reoccurrence. (EM-RFO--EGGR-771OPS-1994-0062)[64]

- A sawzall cut and uptake event during glovebox size reduction in Building 779 occurred in 1999. The worker had disabled several of the sawzall's safety features and no immediate supervision was provided during the work. The response to this event led to the Site's commitment to using an "Inner Tent Chamber" approach for size reduction in Building 771, an approach for glovebox size reduction that was eventually superceded by glovebox decontamination technology and the use of more conventional soft-sided containment systems that were more ergonomically efficient. (EM-RFO--KHLL-779OPS-1999-0006)[65]

- In 2002, a consistent pattern of safety incidents and near misses was identified by the RFFO Facility Representatives in Building 865 during the initial activities of a competitively-procured decommissioning subcontractor, resulting in the building activities being shut down and the subcontractor being terminated. The longer-term result was a tightening of procurement requirements for decommissioning subcontractors and an increase in K-H supervision of subcontractor safety practices. (EM-RFO--KHLL-NONPUOPS1-2002-0002 through -0007)[66,204,205,206,207,208]

- Plutonium uptake in Building 771 was not so much an event as it was a discovery process. In Building 771 a number of employees experienced uptakes as documented by consistently elevated plutonium bioassay levels. This was eventually determined as caused by several extremely small releases, some so small that they did not trigger a Continuous Air Monitor (CAM). This chronic, low-dose exposure to multiple workers required a reexamination in 2000 of the entire contamination control strategy for a highly contaminated building undergoing decontamination. One of the primary results from this was the decision to require decommissioning workers to wear respirators for most jobs in any area where releases could routinely occur. (EM-RFO--KHLL-771OPS-2000-0057)[67]

- In May 2003 a fire in a Building 371 glovebox occurred after a nibbler began cutting into one of the upper sides of a 20-foot tall glovebox. A significant amount of combustible material had accumulated in a marginally-accessible portion of the glovebox, some as a result of workers tossing rags from decontamination efforts on other previously-attached gloveboxes (that had since been removed) instead of bagging them out. Building and Site management response was neither sufficiently rapid nor comprehensive given the severity of the incident. The root cause was worker and supervisor complacency and negligence, despite and maybe because the crew was familiar with the area and very experienced. The immediate area was shut down while the incident was being investigated, but unrelated work continued in the building. Subsequent assessments determined that K-H resumed decommissioning activities prior to developing an adequate understanding of the causes of the event, a point reiterated by the DNFSB. (EM-RFO--KHLL-371OPS-2003-0011)[68]

The Site made numerous changes to decontamination practices as a result of further investigations into the event and extensive testing on materials used to perform decontamination. Combustible loading inspections became more rigorous and pre-job walk-downs focused on identifying the presence of combustibles and unusual conditions. The Integrated Work Control Program was revised to strengthen the planning and feedback processes. Personnel across the Site were trained to these and other safety processes. The desired response to a fire was re-evaluated, procedures updated and personnel trained accordingly. Self Assessment and Independent Assessment programs were upgraded to become more effective. Numerous other corrective actions were undertaken and are described in K-H's Comprehensive Corrective Action Plan (2003-04).[69] RFFO performed a detailed self assessment and causal analysis of its own safety oversight program (issued in January 2004) in response to a December 2003 DNFSB letter, and implemented a corrective action plan to address and document the correction of the identified deficiencies. DNFSB staff visited the Site during 2004 to verify closure of actions described in both the DOE and K-H corrective action plans.

- A fire occurred while filling the Building 991 tunnels with expansive foam that cures exothermically. While foam had been used routinely for filling smaller void spaces, the heat resulting from the quantity used to fill a larger underground tunnel caused it to spontaneously combust. This fire had no flames, released no radioactivity, and the response was deliberate and controlled showing the positive effect of the lessons learned from the Building 371 glovebox fire. However, it also identified a weakness in the control of work processes and the ability of a single subject matter expert to waive work restrictions. (EM-RFO--KHLL-D&DOPS-2004-0003)[70]

SAFETY PROCESSES

"If we don't work safely, we don't work"

After the resumption period, the Site had an extremely risk averse attitude. This resulted in a perception extending from management to hourly workers that the corporate or personal benefit derived from successfully accomplishing physical work was outweighed by the negative consequences of a potential accident or actual or perceived safety incident. This extremely risk-averse culture did not support a healthy work environment or worker mindset and would not support closure. As closure progressed and work began to accelerate, the workers and management began viewing safety processes as an impediment to actual work.

Ultimately, as management and workers learned the value of safe work practices, familiarity with the processes, and the ISMS process of examining completed work for improvement in subsequent work, the culture evolved to getting work done efficiently and safely. This was summarized by the phrase "If we don't work safely, we don't work."

Failure of Safety Performance Measures to Improve Safety

In 1995 Kaiser-Hill was awarded what became known as the 1995 Performance Based Integrating Management Contract (PBIMC). A product of the DOE Contract Reform initiative, it focused on "performance measures" to incentivize contractor performance. Although in some ways an improvement on the Management and Operating (M&O) contract model, the 1995 PBIMC contained over 60 performance measures with many relating to safety. These included quarterly safety metrics such as recordable injuries, criticality violations, and occurrence reports. These metrics flowed down through the contractor team to second and third-tier subcontractors as a basis for their share of the performance fee.

In practice, the concept of trying to incentivize safety through safety performance measures did not result in improved performance but in the contractors' gaming the system.

In practice the concept of trying to incentivize safety through performance measures resulted not in improved safety performance but in the contractors' gaming the system. Occurrences were not reported or were designated as "incidents" and thus not impacting the performance measure. Higher tiered contractors did not include adverse subcontractor metrics. The result was continued disagreement between RFFO and the contractor on whether the letter of the performance measure was met, and a perceived improvement in the process metrics with little-to-no actual improvement in safety at the working level.

Closure Contract Requirements

The Closure Contract awarded to K-H in 2000[33] contained unprecedented ability for the contractor to earn fee and equally unprecedented penalties for poor safety performance. It placed graded penalties for poor safety performance; including potential total loss of virtually all incentive fee for a major accident or incident such as a worker fatality. While cutting back on DOE's responsibility to manage daily work, it emphasized DOE's role in safety oversight and improved access for RFFO Facility Representatives and other safety oversight.

A secondary safety focus was the recognition by both RFFO and K-H that DOE's unilateral and unquestioned ability to stop work for safety would impact the contractor's ability to earn fee. Since fee is earned based on closure project earned value, if a portion of the Closure Project was stopped for recovery from a safety incident, it would result in a larger loss of performance fee than might be likely to result from contractual penalties from that safety incident.

Approach to DOE's ISMS Initiative

One of the major benefits of the DOE's ISMS initiative was that the workers were much more involved and empowered in the entire safety process. Ultimately, management and workers recognized that the only way to accelerate closure was to integrate safety into every aspect of Site operations. If the work could not be done safely then the closure would be (and many times was) delayed until safety improvements were implemented. The rigorous ISMS approach to pre-job planning and walkdowns was aggressively implemented.[71,72]

One of the major benefits of the DOE's ISMS initiative was that the workers were much more involved and empowered in the entire safety process.

DOE Facility Representative Oversight

The original Facility Representative (FR) charter envisioned the FRs as the "eyes and ears" of the RFFO Manager. The FRs were in the buildings to ensure that operations were conducted "safely and efficiently" and to "observe, evaluate, and report" to DOE management concerning the contractor's compliance with DOE orders, federal regulations, and any other applicable requirements. As the RFFO's oversight role evolved, the FR role also evolved. The most significant challenge for both DOE and the contractor was to manage to the contract, not manage the contractor. The FRs continued in their role of "observe, evaluate, and report" but they learned that their oversight must start with the contractual requirements and not specific technical direction (i.e., What, not How). When technical direction was required the FRs learned to channel that direction through a Contracting Officer or Contracting Officer's Technical Representative. The working relationships between contractor building management and DOE FRs became much more collaborative, focused on accomplishing the closure mission safely and compliantly. The FRs still retained shutdown authority consistent with their first priority: Safety. However, the best FRs learned how to improve the contractor's compliance by showing how the improvement supported the contractor's bottom line: Safe, compliant closure ahead of schedule and under budget. Other sections describe multiple examples where technical or procedural improvements made for safety also significantly improved productivity.

The most significant challenge for both DOE and the contractor was to manage to the contract, not manage the contractor.

Development of the Decommissioning BIO (DBIO)

The Authorization Basis process originally focused on operations–type activities and tended to be equipment based for ease of implementation in a relatively unchanging facility. AB documents often dictated hardware and system requirements in lieu of functional requirements (e.g., "have exhaust fans F-X1 and F-X2 running at all times" instead of "maintain a minimum differential pressure of 10 inches w.g. with respect to atmosphere"). However, during the removal of process equipment during decommissioning, there was constant change in equipment conditions and additional requirements such as using of the building ventilation system for contamination control in soft-sided containment structures. The BIOs were developed to allow residue processing, material stabilization, and facility modification activities to be performed with the understanding that they would eventually need to be replaced by documents specifically tailored to the decommissioning activities. As part of accelerated closure, decommissioning work was often initiated prior to the completion of risk reduction and waste packaging work. This work was addressed under the Unreviewed Safety Question Determination or "page change" processes. Finally, at the completion of the glovebox operations-type activities, the DBIO would be implemented to allow more efficient full-scale decommissioning.

The DBIOs incorporated increased use of administrative controls and functional system requirements in lieu of specifying hardware requirements. They included recision plans and criteria for "stepping out" of TSR requirements when pre-determined conditions were met (such as "Operationally Clean") and the follow-on controls that would apply once the TSRs were discontinued. The DBIO also shifted responsibility to the building shift manager for activity coordination and configuration control.

The 2000 Closure Contract incorporated specific review times for RFFO to review AB documents based on K-H concerns that a prolonged approval process could impact closure. In fact, RFFO became progressively more flexible in supporting the closure process and more comfortable in accepting risk as a result of less rigorous analysis, as the magnitude of those risks decreased. RFFO management, as the responsible regulator for Site nuclear activities, evaluated and approved the control strategies applied at the Site.

After a building was determined to be "Operationally Clean," the principal ongoing AB requirement was a continued screening of work control documents against the DBIO requirements.

<u>DBIO "Step Out" Criteria</u>

It was a difficult and time-consuming process to downgrade a large Nuclear Facility (with its facility-specific AB) to a Radiological Facility (which operated under the authorization of the Site SAR). This was because even after the process and ventilation equipment was removed, measurement uncertainties associated with the characterization of the walls and floors would result in substantial roll-up of material at risk at a facility level.

The DBIO was intended to authorize all decommissioning activities through the building demolition and avoided the issue of downgrading the facility by providing an appropriately graded AB approach. After the building or building area was determined by RFFO to meet easily-definable "step out" criteria the efficiency of decommissioning under the DBIO was virtually the same as for a radiological facility. For example, the "Operationally Clean" criterion was based on a visual inspection of straightforward physical conditions, not characterization or gram measurements. After a building was determined to be "Operationally Clean," the principal ongoing AB requirement was a continued screening of work control documents against the DBIO requirements.

Different Company and Subcontractor Safety Systems

An ongoing safety problem at the Site was the difference in safety culture between the Site personnel and commercial subcontractor personnel. Subcontracting the decommissioning of uncontaminated and less contaminated buildings to commercial construction subcontractors was expected to both save money and ensure that sufficient hourly workers with plutonium work experience were available for the higher-risk work in plutonium facilities. There was also the belief that DOE facilities had developed inherently inefficient work practices. This led to the corollary that having commercial subcontractors manage complete projects, as opposed to performing limited activities like asbestos abatement, would allow the Site to identify and eliminate unnecessary processes and result in an overall improvement in Site efficiency.

An ongoing safety problem at the Site was the difference in safety culture between the Site personnel and commercial contractors.

Two initial projects, the demolition of Building 111 and the decommissioning of Building 865, contaminated with asbestos and uranium/beryllium respectively, were subcontracted as complete projects to commercial subcontractors. The results identified the safety deficiencies in the subcontractors. In Building 111, the subcontractor was lax in its enforcement of normal occupational safety regulations. In Building 865, the subcontractor exhibited a consistent pattern of safety violations and a persistent lack of understanding of safety practices necessary to work in a facility with radioactive contamination. In this case, the subcontractor scope was changed to remove the responsibility to manage the project and K-H management assumed project management responsibility.

Two significant modifications were introduced to address this conflict of cultures. The first was to modify the procurement process to emphasize the need for subcontractors with nuclear experience and include more safety compliance requirements in subcontract documents. The second was to recognize the need for additional K-H staff to better oversee the subcontractors. Additionally, with the Site's overall improvement in efficiency, K-H and its team of subcontractors maintained a greater degree of management control and typically subcontracted smaller project elements, allowing better control of the safety environment.

Tracking of Building Availability

As the DBIOs became active and risk reduction work accelerated, maintaining the building infrastructure in compliance with its AB became a complex effort. It became increasingly difficult to maintain ventilation operability at all locations and manage the interacting impacts of administrative controls and compensatory measures. This resulted in the facility being outside its safety envelope and the consequent shut down of processing operations. Thus the risk reduction process availability (and hence residue and SNM stabilization throughput) was less dependent on the process activities and more dependent on the building infrastructure being compliant and available to support operations.

The contractor instituted a process to track the causes of building downtime to identify routine causes and fix both the immediate cause and, in some cases, underlying systematic issues. It invested the Configuration Control Authority (CCA) with additional authority to assure daily coordination of activities and properly evaluate impacts that might result in shutdowns and allow for better coordination. The CCA proved to be a very effective coordination approach to assure compliance with the building AB.

... maintaining the building in compliance with its AB became a complex effort. ... risk reduction (activities became) dependent on the building infrastructure being available to support operations.

Conduct of Operations Process

Following basic conduct of operations principles, the Site required that all activities occurring in a facility be authorized and coordinated with the CCA. This proved crucial in assuring that activities occurring in one portion of a facility did not cause safety problems elsewhere in the facility, particularly when work affected building ventilation systems. The importance of this is best described by two failures of the work release process. In the first, a Building 559 laboratory employee vented gas through the Building 776 ventilation system. The employee made some assumptions when performing this task and although he did check in with the Building 776 CCA he failed to disclose the details of his activities. Building personnel that had knowledge of the activity failed to exercise a questioning attitude – including the CCA. The result was fumes being circulated throughout many occupied portions of the facility. Two years later an employee not assigned to Building 707 went to collect a sample from the building's ventilation system and failed to check in with the CCA. He subsequently breached a system that was in use and caused a spread of contamination through much of the first floor of the facility. Both events involved personnel not normally assigned to a building, but familiar with it, failing to follow established Conduct of Operations principles or facility procedures for obtaining approval to work.

Resolution of Safety Incidents/Occurrences While Minimizing Shutdowns

During Resumption, systemic problems with the operations and safety infrastructure demanded that when problems or incidents occurred, all related activities needed to be shut down and examined. This typically included all activities in a given facility and possibly similar activities in other facilities. As the operations infrastructure improved, incidents and occurrences less often identified fundamental systemic deficiencies, but it was still practice to shutdown the immediate operation and often the facility until the corrective actions could be implemented.

As the Site moved towards closure this process was reexamined. This resulted in carefully evaluating the incident and shutting down only those activities that were directly related to the problem. Attempts were made to accelerate the identification and implementation of corrective actions. Often, activities were continued with compensatory measures in place until specific corrective actions could be identified and implemented. This approach had several safety benefits. First, it provided better management focus on the real safety issue. Second, workers outside the immediate affected operation didn't feel like they were being "punished" for the failings of others. Streamlining the process did not preempt the identification and implementation of safety corrective actions but, it did recognize that shutting down activities was not always necessary. RFFO always maintained oversight of the corrective action process, and could shut down any activity that was not being performed safely.

The worker at all levels of the project must feel a sense of ownership for their results and accountability for their individual contributions to the mission.

Personal, Organizational, and Corporate Accountability

As the Closure Project progressed, the Site projectized all activities. The projectization usually improved accountability for work activities within a specific project. There were some exceptions, such as SNM Operations, waste operations, and some support functions that were matrixed to the user organization. Fundamentally, the key lesson is that of "ownership." Responsibility for SNM Removal was ultimately transferred to Building 371's project manager because the Building was not focused on the SNM Removal Project when it was "owned" by another organization. The Execution Project Manager had an Execution Project-specific safety organization and had personal responsibility for the safety performance of his project.

The safety lesson is that individuals must be accountable for their actions and accountability requires empowerment. The workers at all levels of the project must feel a sense of ownership for their results and accountability for their individual contributions to the mission. This ownership, accountability, and empowerment was strengthened by the contractors' incentive program that allowed workers to reap the monetary benefits of accelerated closure and share in the monetary loss from the results of safety failures. Senior management routinely encouraged employees to have a questioning attitude and to elevate issues up the management chain if they did not feel the issue was properly addressed. Eventually this became automatic as workers believed in management's commitment to "safety first".

Safety Trend Degradation

Tracking and analysis of safety metrics is a useful tool in identifying areas for greater safety emphasis. Typically, an adverse trend is noted due to either an increase in the frequency of an event or the initial measurement and tracking of a particular type of event. Following its identification, corrective actions are developed and invariably include briefings or training for workers and procedure changes were made in an attempt to preclude future occurrences. As time passes, trends in other safety area are identified and the same process is implemented. At Rocky Flats, it was observed that certain metrics varied periodically. The specific metrics exhibiting this trend were electrical events, radiological posting violations, and powered industrial truck (PIT) activities. The periodicity for these metrics varied, but they were generally between eight to twelve months. In an attempt to interrupt these cycles, safety pauses were initiated periodically as an adverse trend was beginning an upward cycle. In the case of PIT activities the contractor held an annual "rodeo" that allowed drivers to demonstrate their proficiency while reinforcing the safety aspects of their jobs. Electrical safety was always high on the radar screen. Refresher briefings and electrical safety assessments were performed with regular frequency. Also, safety pauses were used around major holidays or other events that could cause a distraction for the workers. The approach was captured in the Site Safety Continuous Improvement Plan.[74]

In an attempt to interrupt the cyclical increase in accidents, safety pauses were initiated periodically as an adverse trend was beginning an upward cycle.

Training

The original pre-closure Rocky Flats hourly personnel were highly trained in the processing and manufacturing areas. Performing decommissioning, although related due to the presence of radionuclides, was a significantly different skill set. Additionally, the scope of closure work exceeded the existing capacity of the hourly workforce, so new personnel needed to be hired. Therefore, the training challenges were to broaden the skill set of the original workers, to provide those skills to new hires as well as to re-instill the radiological precautions that were familiar to the original workers, and to inculcate the safety process and culture into all of their daily activities.

The new staff had some training advantages because they had no preconceived work patterns that required modification. Conversely, it was also noted that training had limitations that could not match practical work experience – particularly when dealing with radioactive material in the variety of forms encountered at Rocky Flats. New hires were training rigorously to perform a variety of jobs, yet they had inherent shortcomings due to their lack of experience in working with plutonium. To remedy this problem management trained the new employees using a variety of formal courses, visual aids, and toolbox safety presentations, and also kept reinforcing the safety culture. The Site developed a hands-on course ("Safety 101") with simulated work environments where workers practiced tasks with ladders and common tools in simulated contaminated spaces. Management also had success by seeding new employees in with experienced teams.

Several incidents revealed that what was identified as process knowledge was sometimes more like "urban legend"…

Over-Reliance on Process Knowledge

Process knowledge can be useful in avoiding unnecessary characterization, but has its own risks and uncertainties. Process knowledge was a useful tool in planning the decommissioning efforts, but it was subsequently recognized as a limited data source. Process knowledge also varies significantly from operator to operator. Several incidents revealed that what was identified as process knowledge was sometimes more like "urban legend" with no individual able to give a first-person account of the condition. Planning activities relied heavily on hold-up measurement scans performed prior to initiating an activity. Inputs from the hold-up measurement team became vitally important and the team's gram estimation techniques were state-of-the-art. Utilizing the information provided by process knowledge supplemented with characterization data allowed the hazards associated with decommissioning work to be better quantified and controlled.

Process Startup

DOE Order 425 (or its predecessor 5480.31) required an Operational Readiness Review or Readiness Assessment (ORR/RA) prior to starting qualifying activities. In the post 1989 environment at Rocky Flats, the ORR/RA requirements drove project and subproject managers to create the infrastructure to perform the planned activities in a safe manner. The

ORR/RA process ensures that the appropriate equipment is available, that procedures accurately and comprehensively describe the work to be performed with the appropriate integrated safety controls, and that personnel are trained to the procedures. As more and more activities successfully passed their ORRs or RAs, more and more personnel were needed to perform the operations. Personnel who had demonstrated their ability to learn new procedures and handle the scrutiny of an ORR/RA were often moved to other "new" projects that would require an ORR/RA, and the new hires were trained and qualified to backfill the positions that were being vacated. By this time, the existing processes were generally running smoothly, as process and procedural improvements tended to occur early in the operating phase. The more skilled operators were thus allowed to bring their expertise to new and higher risk (relatively speaking, not necessarily quantified by a risk analysis) activities.

Traffic Safety Committee

By early 2004 demolition, environmental remediation, and waste shipping were becoming predominant Site activities. As more activities were being performed simultaneously across the Site it became necessary to evaluate and manage the significant increase in vehicle traffic. The Traffic Safety Committee was established to address this need. This committee consisted of representatives from each of the Site projects, the Site safety organization, security organization, communications organization, and union representatives. Traffic routes were established to separate large construction type vehicles as much as possible from smaller passenger vehicles. The committee also evaluated and established pedestrian routes. Maps of these routes were prepared and distributed to the Site population and visitors. Numerous communication mechanisms were employed to get traffic safety messages and real time status of traffic routes to personnel to include email, Site web page, worker toolbox briefings, periodic traffic safety bulletins, dedicated phone number to call for updates, broadcast messages to Site landlines, and text messages to Site cell phones. Since many of the committee members were key personnel in their organizations, committee meetings and activities tended to foster integration not just in matters of traffic safety, but across the closure project as a whole. The efforts of the members of the Traffic Safety Committee contributed significantly to safety across the Site.[75]

Traffic routes were established to separate large construction type vehicles as much as possible from smaller passenger vehicles.

Safety Improvement for Non-Closure Activities

As contractual requirements for safety improvement were implemented there was a recognition that the improvement in safety needed to extend to routine activities. A substantial percentage of Site safety incidents were associated not with construction or industrial activities but with what are commonly thought of as everyday routine activities. Examples included automobile accidents, slipping while walking in winter weather, etc. The Site emphasized safety for these routine activities by aggressively monitoring and enforcing speed limits, sanding walkways, and by focusing on specific safety topics at weekly meetings. Regardless of whether onsite incidents occurred during industrial/construction or "everyday routine" activities, they all counted against the contract safety metrics and therefore individual and company incentives.

Closeout of Fire Protection and Emergency Response

The Rocky Flats fire department had historically focused on addressing fires and emergency response in an operating environment. As the Site work became more construction-like, the fire department needed to adjust for the increased fire potential from activities such as vehicle refueling, thermal cutting, and the change in infrastructure (e.g., shutdown of sprinkler and Site domestic water systems).[76] Toward the end of the closure process the Site fire protection needs were more effectively addressed using offsite resources.[77,78]

SAFETY AS THE REAL TOP PRIORITY

Early on safety was viewed as a goal, later as a requirement, and finally as a project tool to increase worker productivity and morale.

The perspective on safety by management and workers at the Site evolved over the term of the closure project. Early on safety was viewed as a goal, later as a requirement, and finally as a project tool to increase worker productivity and morale. The Site Safety Continuous Improvement Plan that followed the Building 371 glovebox fire (referenced earlier), viewed safety from an entirely different perspective than previous corrective action plans. Worker involvement in safety issue resolution was increased, additional union representatives were added as safety inspectors, event response was skewed more toward action than analysis, and the overall focus turned toward improving the minute-by-minute safety of the worker. As an example, K-H sponsored several "Safety Fairs" where vendors demonstrated all manner and style of PPE. K-H purchased PPE best suited to the task and worker preferences without question or budget limitation. These actions demonstrated to the workforce that management was truly committed to safety and their welfare, and in turn produced greater trust and overall improvement in morale. Although difficult to quantify, anecdotal evidence suggests that this commitment to safety as the true top priority in the final years of the project, resulted in the unprecedented worker productivity and ability to complete the closure without serious worker injury.

SAFETY TECHNIQUES

Process Equipment Removal Safety

Initially, soft-sided containments were vented directly to the surrounding room through HEPA filtration, but as more tents were built they were subsequently connected to the building ventilation system (usually Zone II) via flexible ducting (i.e., elephant trunks). The construction of the soft-sided containments and their ventilation created additional safety issues since they frequently changed the airflow patterns in the rooms in which they were constructed. This required diligent planning to ensure that airflow testing was performed throughout the construction process and that continuous air monitors (CAMs) were properly relocated based upon the test results. Connecting airmovers to building ventilation systems was used to provide greater airflow; however, an airflow reversal event in Building 776 highlighted the need for careful analysis of the actual physical configuration. A damper was partially (predominantly) closed, but its broken position indicator showed it was fully open. When the airmover was connected and turned on, the partially closed damper caused the contaminated air from the soft-sided containment to be forced back out into the surrounding rooms.

Safety improvements most often occurred as incremental improvements, often initiated by the hourly workforce…

Other changes were made to soft-sided containments, including the construction of multiple rooms to aid the doffing of supplied air suits and overall contamination control. However, as the glovebox decontamination techniques improved, the need for size reduction diminished, eliminating the need for more complex soft-sided containment features.

Safety improvements most often occurred as incremental improvements, often initiated by the hourly workforce or as a collaborative process between the hourly workforce, management, and technical organizations. Two examples of high-tech processes that were justified in the name of safety, the Inner Tent Chamber for directing airflow and the Robotic Size Reduction System (ROSARS) proved to be less useable and hence of less actual safety value. The Inner Tent Chamber became the less-used process for size reduction in Building 771 as glovebox decontamination, conventional soft sided containment systems, and size reduction tooling and procedures improved. The ROSARS process was never actually completed. In each case the drive for safer performance of work and reduced accidents concurrently improved overall performance.

Electrical Safety

As old known hazards were eliminated or brought under control new hazards were identified. For example, early in the decommissioning process major safety initiatives were implemented with the goal of preventing workers from being shocked while removing installed wiring from being shocked. However, several times workers cut energized electrical lines while performing approved engineered work packages. The lines were energized due to "sneak circuits," i.e. undocumented sources of power to a panel or piece of equipment. Extensive efforts were made to train personnel to positively verify that wiring had been de-energized prior to cutting.[79] The end result was a significant reduction in this type of event. Later in the decommissioning process temporary electrical cabling was brought into facilities to power equipment still required to perform work. This created new hazards that had to be analyzed and addressed. In Building 771 a worker using a hydrolance cut into a 480-volt temporary power line. Other events occurred involving electrical cords being cut or damaged by the equipment it powered. These events required supplemental corrective actions different from the previous electrical events.

Improvements in Personal Protective Equipment (PPE) Application

Building 771 uptakes resulted in precautionary use of respirators as opposed to reliance on CAMs in work areas where contamination releases could easily occur. In the dynamic conditions encountered during process equipment removal and decontamination (as compared to an operating environment) relying solely on worker response to CAM alarms was insufficient to avoid chronic uptakes of small quantities of airborne contamination the was still sufficient to show up in routine bioassays. The wearing of respirators became mandatory in a room in which work was being conducted regardless of CAM readings.

To avoid heat stress, one of the primary lessons learned was to use the more impenetrable materials only on the parts of the body most likely to receive a skin contamination (i.e., forearms, knees)...

The selection and use of Personnel Protective Equipment (PPE) other than respirators was also an ongoing safety concern. DOE placed an emphasis on reducing the number of skin contaminations complex-wide and listed excessive skin contaminations as a specific performance measure under the closure contract. PPE is a major component in the suite of tools used to prevent skin contaminations; unfortunately, some types of PPE have several drawbacks including the inability to dissipate body heat. Consequently, heat stress concerns had to be weighed against contamination concerns. A significant amount of analysis, research and deliberation was put into developing criteria for selecting PPE. One of the primary lessons learned was to use the more impenetrable materials (such as saranex) only on the parts of the body most likely to receive a skin contamination (i.e., forearms, knees), but not on the remainder of the body.

KEY SUCCESS FACTORS

1. It all begins with safety. Efficiency improvement and project accomplishment all occur because the work is performed safely. Safety needs to be viewed as a powerful enabler for improved project performance.

2. Real progress was made when management listened and acted on workforce safety concerns. More importantly, it was necessary for the workers to believe that the DOE and K-H management were listening to their concerns. Once this climate was established, money spent on safety always had returns greater than the investment.

3. Performance-based incentives for safety are not effective for changing safety culture and making long-term improvements. Incentivizing total project performance is effective at cementing management commitment to safety and understanding its importance.

4. The safety systems at former production sites were not built for the changing environment of a closure site. There needs to be continual innovation, adjustment, and evaluation to adjust for the changing conditions. At the same time adjustments need to remain within a formal system, so that the discipline of work control is not lost to informality.

5. The DOE has expectations for safety performance that are much higher than the commercial sector. Extra caution and management attention is necessary to utilize workers or contractors unfamiliar with DOE safety expectations.

6. Safety must have strong, visible, and consistent support from the highest levels of Contractor and DOE management. Anything less is a hollow commitment that will be quickly discounted by the workforce.

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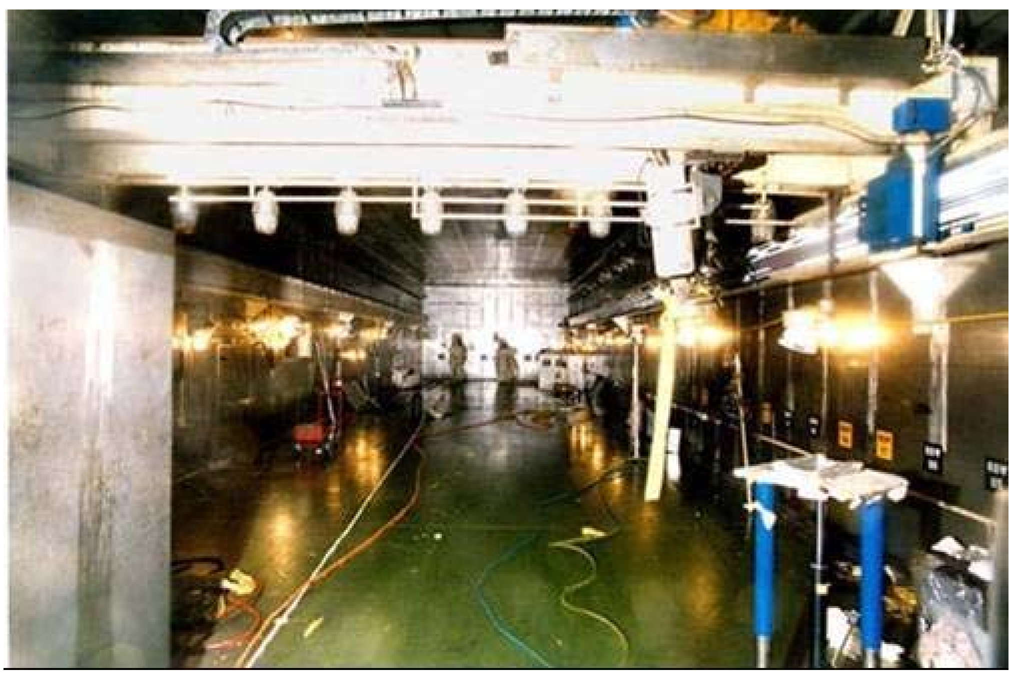
ROCKY FLATS CLOSURE LEGACY

SPECIAL NUCLEAR MATERIAL REMOVAL PROJECT



THE BUILDING 707 X-Y RETRIEVER BEFORE AND AFTER. SPECIAL NUCLEAR MATERIALS WERE SAFELY SHIPPED TO OTHER SITES, REMOVING THE HAZARD FROM METROPOLITAN DENVER.

INTRODUCTION

Special Nuclear Material Inventory

Kaiser-Hill assumed management responsibility for the Rocky Flats Environmental Technology Site (Site, Rocky Flats, or RFETS) in July, 1995. At that time, the Site had the largest plutonium (Pu) inventory of any Department of Energy facility. The Site also had a significant quantity of highly enriched uranium (HEU). These "special nuclear materials" (SNM) required characterization, stabilization, packaging for long-term storage, consolidation, repackaging/overpacking into approved shipping containers, and removal from the Site before K-H could focus on the deactivation and "decontamination and decommissioning" (D&D) of the Site's nuclear facilities.

The Department of Energy declassified the Site's SNM inventory in 1994. When Kaiser Hill started at the Site, the SNM inventory included 12.9 metric tons of Pu and 6.7 metric tons of enriched uranium. The Pu inventory included 6.6 metric tons of relatively pure Pu metals; 3.2 metric tons of Pu in approximately 6 bulk tons of Pu oxides; and 3.1 metric tons of Pu in approximately 106 bulk tons of Pu residues. The enriched uranium was in various forms. Additionally, the Site had numerous "Special Items" that required special handling due to weapons classification and nuclear safety concerns.

History of SNM at Rocky Flats

The mission of Rocky Flats was the production of nuclear weapons components (pits). Production began in 1952 and continued until 1989. The Site also disassembled retired pits to recover Pu and HEU for reuse. Supporting operations were conducted to recover Pu and uranium from retired weapons components, processing Pu scraps, and Pu residues to purify the Pu for use in weapons. In December of 1989, the Department of Energy curtailed Pu operations at Rocky Flats due to safety and environmental concerns. The DOE anticipated that plant operations would resume shortly after a new contractor had taken over the management and operation of the Site. Therefore, the Pu facilities were maintained in a production configuration with SNM in the glovebox lines ready to resume operations. Unfortunately, the "resumption" of nuclear operations was delayed due to persistent safety concerns. Before weapons production could restart, the president made the decision in 1992 to suspend nuclear weapons production, and later eliminated the Rocky Flats weapons production mission entirely. Subsequently, the Site mission evolved from a standby status through a period of improving safety and deactivating unused equipment, to the final DOE decision to accelerate the D&D of the

As a result of the evolving Rocky Flats mission from 1989 to 1993, a large inventory of Pu was left in an indeterminate storage configuration.

Site. As a result of this evolving mission a large inventory of Pu was left in an indeterminate storage configuration.

Changes in the Site Mission

The safety basis for nuclear operations assumed a certain set of conditions. The facility was in an indeterminate status after the Rocky Flats shutdown. It was imperative to understand actual storage configuration for nuclear materials during any deviation from routine

The Site mission had changed from nuclear weapons component production in the 1980s to cleanup and closure by the mid-1990's. Unfortunately, when nuclear production operations were curtailed in 1989 it was anticipated that the Site would "resume" operations within a very short period of time. The nuclear facilities shut down with SNM in the glovebox lines staged for the impending resumption of operations. It was not anticipated that this suspension of production operations would be permanent, therefore the majority of the SNM was not placed into a long-term storage configuration. In fact, at that time, the DOE had no standard for long-term storage of Pu or HEU. As it became clear that nuclear production operations would not resume at the Site, it was also recognized that the SNM should not remain in the glovebox lines indefinitely due to safety and Safeguards & Security considerations. In the early 1990s it was unclear what the final disposition of this material would be, therefore, the majority of the material was packaged in accordance with existing Site Health & Safety requirements and placed into secure storage in vaults.

In 1995 the Site's 12.9 metric tons of Pu were stored in about 27,000 packages. The majority of this Pu was packaged for short-term storage to support production operations. The DOE complex-wide concern regarding the storage conditions for Pu materials resulted in DOE developing a standard for all sites that would dictate how these materials should be packaged and stored when not in the weapons production cycle. The result was the DOE standard (DOE-STD-3013-1994) that established the criteria for stabilization, packaging, and long-term storage of Pu.

Delays in resumption ultimately resulted in safety and safeguards deficiencies, the very areas the resumption effort was trying to improve.

The "resumption" of weapons production changed to "resumption" of those nuclear operations necessary to support Site cleanup and closure. The resumption of Pu thermal stabilization operations in Building 707 was required to safely store Pu oxides at the Site. The Pu oxides could not be stabilized until Building 707 resumed nuclear operations. During this time the Site curtailed handling Pu metals and oxides that were not compliant with the Site's health and safety requirements to minimize the risk of a fire or contamination event due to unstabilized oxides on the metals or in containers awaiting stabilization. The restrictions on handling these items prevented performing proper inventories, including non-destructive assay measurements, of the affected SNM. Ironically, the delays in resumption ultimately resulted in safety and safeguards deficiencies, the very areas the "resumption" effort was trying to improve.

The Site's SNM shipping infrastructure was dramatically reduced during the 1990's as a result of the curtailment of nuclear production operations and subsequent shipping program inactivity. As the SNM Shipping Project ramped up in the late 1990's, the infrastructure did not grow accordingly and many of the remaining staff lacked historical experience. In 1998 the SNM Shipping Project was shut down by the DOE regulator due to significant procedural compliance deficiencies. The project did not resume packaging and shipping SNM for several months while significant improvements were implemented with appropriate staffing increases.

Another complicating factor in the mid-1990's was the DOE decision to place one ton of Pu at Rocky Flats under International Atomic Energy Agency (IAEA) safeguards. Although this decision was supportive of the federal policy with regard to excess fissile materials, the additional IAEA safeguards associated with placing this material under IAEA control significantly impacted the Site's ability to stabilize and repackage this material for long-term storage and eventual shipment offsite.

DISCUSSION

This section addresses specific topics that were key to understanding the Rocky Flats approach for managing and ultimately disposing of its SNM.

Rocky Flats SNM Program

The Rocky Flats Site was established with the purpose of manufacturing nuclear weapons and maintaining all of the associated processing activities necessary to providing pure Pu metal. This purpose required maintaining significant inventories of SNM, primarily plutonium. Removal of these inventories was one of the major challenges to closure of the Site and one that had to be accomplished before facility decommissioning and Site restoration could be completed. Time, costs, and schedules could only be approximated based on the technologies available. Improvement of these technologies and development of new ones had to be carried out in parallel with actual operations. Activities needed to disposition the actual nuclear materials were conceptually understood, however, performing these operations to meet the new DOE standard to prepare the material for long-term storage was something that had not been attempted.

Removal of these inventories was one of the major challenges to closure of the site and one that had to be accomplished before facility decommissioning and site restoration could be completed.

The organization of the SNM program was centered on three activities. First was the actual stabilization of the material; second was the packaging into a welded package; and third was the acquisition of a newly designed shipping container and actual shipping. During the completion of the program some lower purity oxides were packaged and shipped to the

WIPP. In the original classification of Pu oxides, these lower purity oxides were not considered residues. Disposition of large quantities of residues and contaminated wastes, associated with the Pu processing activities, was also necessary for Site closure.

SNM Consolidation

In the mid-90s the Site recognized the need to begin deactivating the nuclear buildings if there was no further need for operations. In order to deactivate these facilities it was recognized that it would be beneficial to consolidate all SNM into as few buildings as possible to support deactivation and eventual D&D of these buildings. Additionally, as a result of safety concerns related to Building 991's underground storage vaults, the DOE decided to expedite consolidating all SNM from Building 991 into Building 371. Building 371 was utilized because it was the newest and most robust of the Pu processing facilities. Building 371 required significant upgrades to satisfy security requirements and to address seismic safety concerns raised by the Defense Nuclear Facilities Safety Board (DNFSB). The safety upgrades were performed in a phased manner, the most costly and long term upgrades were scheduled to be performed ONLY if onsite storage of SNM would exceed about five years. This decision pressured the DOE to identify alternate SNM storage strategies, including building an interim storage vault onsite or accelerating offsite shipment of all SNM. These alternatives were presented and discussed publicly with a very strong preference expressed by the stakeholders for accelerated offsite shipment. Addressing the risks from the SNM became one of the most driving reasons for creation of the accelerated closure plans in 1995 and beyond.

Regulatory liabilities should be analyzed against nuclear safety liabilities when developing NEPA processes. These processes routinely experienced bureaucratic and political hurdles, resulting in unnecessary delays in SNM reconfiguration.

NEPA

The National Environmental Policy Act (NEPA) requires the government to evaluate the environmental impacts of federal decisions prior to taking any federal action. For the majority of the Site's SNM, the DOE had to complete several Environmental Impact Statements (EIS) or Environmental Assessments (EA) prior to initiating shipping SNM offsite. The most significant NEPA documents affecting SNM removal are listed below. Each of the EIS or EA documents was individually challenging, but the coordination of all the NEPA documents became a significant regulatory and public participation effort that the RFFO was initially not well prepared to address. RFFO learned that the SNM issue involved not only complex technical and safety challenges, but also substantial regulatory and compliance issues, sometimes appearing more daunting than the technical issues. The DOE public affairs and regulatory staff needed to be substantially increased to meet the SNM NEPA and regulatory coordination requirements.

- Consolidation and Interim Storage of SNM at RFETS Environmental Assessment (authorizing the Site to consolidate SNM into Building 371)[80]
- Disposition of HEU Final EIS (identified Y-12 as the primary HEU receiver site)[81]
- Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic EIS (identified Pantex as the receiver site for pits and the Savannah River Site (SRS) as a future receiver site for Pu metals and oxides)[82]
- Surplus Pu Disposition Final EIS (confirmed that SRS would receive Pu metal and oxides)[83]
- Final EIS on Management of Certain Pu Residues and Scrub Alloy Stored at the RFETS (determined that most residues would be disposed of at the Waste Isolation Pilot Plant (WIPP) but that Sand, Slag, & Crucible (SS&C) and Fluoride residues, and Scrub Alloy Pu would be sent to the SRS for recovery operations)[84]

Pu Storage Safety Concerns

In March 1994, the Secretary of Energy commissioned a comprehensive assessment to identify the vulnerabilities that might arise from the storage of Pu in an inactive configuration. This assessment was initiated because of recent ruptures of stored Pu packages and the need to safely store the large amounts of Pu-bearing materials held in aging facilities around the country. The ultimate goal of the assessment was to facilitate safe and stable interim storage of Pu materials.

The Pu and HEU solutions were identified as the most significant hazards at Rocky Flats.

Independent of the DOE assessment, the DNFSB issued Recommendation 94-1 in May 1994.[87] DNFSB Recommendation 94-1 contained several recommendations to improve the interim storage conditions resulting from the halt in production of nuclear weapons. For Rocky Flats, one of the key recommendations was for all Pu metals and oxides to be stabilized and repackaged in compliance with the DOE-STD-3013-94 standard[86] and to stabilize all Pu liquids and residues.

Both of the above assessments revealed a number of vulnerabilities. Rocky Flats Buildings 771 and 776 were identified as the most vulnerable facilities in the DOE Complex. The reason for this classification was the large quantities of plutonium-containing solutions and the large number of Pu packages that were improperly packaged.

The Pu and HEU solutions were identified as the most significant hazards at Rocky Flats. These acid solutions had been sitting idle in tanks for years and presented a leaking, corrosive, explosive, radioactive spill hazard. Also, the criticality safety risk is higher with solutions, exacerbating the risks involved with venting, draining, and processing these solutions.

DOE Approach to DNFSB-94-1 Issue Resolution

In response to DNFSB Recommendation 94-1, DOE issued an implementation plan to systematically address the recommendations in an integrated manner for all sites. The foundation for addressing the packaging and storage of Pu metals and oxides was the issuance of the DOE-3013 Standard. Under this standard all Pu metal and oxide containing greater than 30 weight percent Pu would be stabilized and packaged in 3013-type containers. In line with supporting the goal of accelerating closure of Rocky Flats, Pu materials compliant with the 3013 standard would ultimately be shipped to the SRS for long-term storage.

The Plutonium Stabilization and Packaging System (PuSPS) was developed to meet the DOE 3013 requirements for Pu metals and oxides. PuSPS was a complicated prototype that was never intended for production operations. The DOE planned to use the PuSPS to demonstrate the benefits of an automated system and then install production models at all sites including RFETS. This plan was abandoned when it was realized early on that a basic manual stabilization and welding process would be cheaper and more reliable. The prototype at RFETS was installed and nearly operational when the contractor recommended utilizing a manual system. The DOE directed the Site to use the PuSPS to failure; this decision was primarily based on the sunk cost invested into the design, testing, and installation of the PuSPS.

The PuSPS was unreliable and difficult to operate. Work-arounds were developed to provide for maintenance and engineering response on an immediate basis, 24 hours a day. The PuSPS was made to complete its mission through "brute force" effort by management and workers. Ultimately the Site was able to satisfactorily certify 1,895 3013s and ship them for storage to the SRS. Although the Site completed the SNM Removal Project one year late and significantly over its budget, in the final analysis this did not delay the accelerated closure due to creative workarounds.

At least one DOE site was directed to reweld many of their 3013s due to certification issues associated with their manual system.

It is unclear whether a manual 3013 packaging system could have been purchased, installed, and certified in time to support the Site's SNM Removal Project. The certification process was very cumbersome and at least one DOE site was directed to re-weld many of their 3013s due to certification issues associated with their manual system.

Pu and HEU Solutions

The Pu solutions were identified as high risks at the Site. In late 1994 the Site started the process of venting, draining, and processing the solutions from all Pu buildings. Some of the tanks had to be vented due to concerns about potential hydrogen buildup. The tanks were drained into bottles to reduce the criticality safety concerns associated with large volumes of Pu solutions leaking from corroded tanks and/or pipes, or spilling from a collapsed tank after a seismic event. The low concentration Pu solutions were then processed in Building 771 while the high Pu solutions were processed in Building 371. The Caustic Waste Treatment System utilized a precipitation line in Building 371 that removed the majority of the Pu from the solution. The resulting precipitate was disposed of as radioactive waste. The low-Pu solution was then processed with other low-Pu solutions in Building 771. In October 1994 the Site suspended Pu solution draining after the Building 771 crew grossly violated the draining procedure. This was a serious criticality safety violation because the workers mixed high concentration Pu solutions that were not analyzed from a criticality safety standpoint. In December several other Pu tank draining procedure violations were identified. The Site implemented vigorous corrective actions including termination of some employees for knowingly disregarding procedural requirements. The Site completed draining the Pu solutions in February 1998. A total of 31 tanks containing nearly 11,000 liters of Pu and uranium solutions were drained. The Site completed precipitating the high-level Pu solutions in July 1998.

The Site implemented vigorous corrective actions including termination of some employees for knowingly disregarding procedural requirements.

One of the highest risk vulnerabilities identified at the Site was the 2,700 liters of highly enriched uranyl nitrate (HEUN) solutions in Building 886. The scenario of concern involved a seismic event upsetting a storage tank and allowing a criticality to occur in the facility. The Site began draining the Building 886 tanks in July of 1996. The HEUN solutions were drained by October and shipped to Nuclear Fuels Services in Erwin, TN for conversion to nuclear reactor fuel. The Site obtained Nuclear Regulatory Commission (NRC) certification to ship these solutions in the FL-10. The NRC certification was quicker than the DOE certification process which was cumbersome and inefficient.

The NRC certification was quicker than the DOE certification process, which was cumbersome and inefficient.

The draining and processing of the Pu and HEU solutions significantly reduced some of the greatest hazards on Site. However, the Site still had significant quantities of Pu metals and oxides that required stabilization, repackaging, and removal from the Site.

SNM Shipping

The Site began shipping HEU parts to the Y-12 facility in Oak Ridge, Tennessee in 1996. The DOE published the "Record of Decision (ROD) for the Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement" in January 1997. This ROD authorized the Site to begin shipping pits to Pantex immediately but stipulated that Pu in other forms could not be shipped until it was stabilized and packaged in accordance with the DOE 3013 standard. Additionally, the receiver site was identified as the SRS, however, it was stipulated that no Pu would be shipped to the SRS until several conditions were met including construction of a new Actinide Packaging and Storage Facility (APSF) and a decision to locate the Pu immobilization facility at SRS.

Receiver sites for SNM must be identified, funded, and directed to provide priority to the shipping site. The infrastructure associated with SNM storage is substantial, and any disruption to SNM removal activities impacted the entire closure project.

The Storage and Disposition ROD confirmed that some pits could be sent to the National Labs (LANL and LLNL) to support R&D and National Security programs. At the time the labs were experiencing delays due to safety issues and were involved in their own "resumption" programs, preventing them from receiving SNM. Initially, the labs were unable to receive the Site's pits and other SNM parts because national DOE Weapons Program activities were a higher priority than merely supporting the de-inventory of Rocky Flats. Ironically, LANL requested that some of Rocky Flats' Pu be reserved for the Weapons Program, however, the lab did not have the ability to receive this material. The labs were eventually directed by NNSA to receive the Rocky Flats Pu in support of the Rocky Flats cleanup schedule.

The Site had a small quantity of Low-Enriched Uranium (LEU) that the Tennessee Valley Authority (TVA) was interested in obtaining. The TVA was unable to receive this LEU for several years. The Site identified an alternate disposition path for this material (disposal as Low-Level Waste (LLW) at the Nevada Test Site (NTS)) and informed the TVA that the deadline for transfer to TVA would expire in six months, after which the LEU would be disposed of as LLW. The TVA continued to demonstrate interest in the material until the Site actually shipped the LEU to NTS. The TVA could not make arrangements to receive the material in time to support the Site's closure schedule and the LEU was disposed of as waste. While this action represented a lost resource and opportunity for the TVA, it eliminated an entire category of waste from the Site and was a major step forward for the SNM program. This decision was very difficult and controversial at the time, but demonstrated the degree to which the Site and DOE HQ had aligned to the central focus of accelerated closure.

The majority of the Site's 106 tons of Pu residues were scheduled for stabilization and repackaging as transuranic (TRU) waste for disposal at the WIPP. These Pu residues contained 3.1 tons of Pu in 103 bulk tons of material or, on average, approximately 3% Pu. Historically, the DOE had planned to recover the Pu and dispose of the by-products as radioactive waste. In the mid-1990s the DOE determined that over 200 tons of fissile materials were excess to national security needs. Many of these residues across the country, but especially at Rocky Flats, had been speculatively kept for future processing to recover the Pu for weapons production. The Site recommended that the Pu residues should be disposed of in light of the fact that there was no programmatic need to recover the Pu. In August of 1998 the DOE approved an exemption to the Safeguards Termination Limits (STL)[85] to allow residues with higher Pu concentrations to be blended down with other materials, thereby making them unattractive for Pu recovery and available for disposal as waste at the WIPP. This dramatically reduced the amount of processing required to dispose of the majority of residues. A small population of the easily recoverable residues with higher concentrations of Pu (SS&C and fluorides) were originally slated for Pu recovery at the SRS canyons. Although the Site did begin shipping SS&C to the SRS, a number of technical issues affecting the shipping container delayed the shipping campaign. The fluorides were Resource Conservation Recovery Act (RCRA) regulated wastes. There were significant challenges associated with shipping RCRA-regulated waste in the DOE secure transportation system, due to the fact that the drivers were not certified to transport RCRA-regulated hazardous waste. In light of these difficulties and as a result of the STL approach, the DOE revised the ROD to send all of the SS&C and fluoride residues to the WIPP. The SS&C and fluorides were downblended to satisfy the STLs and disposed of at WIPP.

Historically the DOE had planned to recover the Pu from the residues. DOE later determined that over 200 tons of fissile materials were excess to national security needs and the Site recommended that the Pu residues should be disposed of as waste.

Shipping Containers

The Site utilized a significant variety of DOE certified Type B shipping containers during the SNM removal campaign. It was recognized early on that in order to support the aggressive shipping campaign the Site would have to use existing containers that were already approved or could be readily approved for shipping Type B quantities of SNM. No new Type B containers were considered due to the fact that the container certification process could not be accelerated to support the Site's schedule. The program to manage the container certifications, as well as the shipment of containers, was a critical aspect of the overall SNM removal.

It was recognized early on that in order to support the aggressive shipping campaign the Site would have to use existing containers that were already approved or could be readily approved.

The DOT 6M container was the first considered as the Site had considerable experience with it from weapons production use. Although the DOT 6M had been used for years to ship Pu metal throughout the weapons complex, the DOE was in the process of retiring the DOT 6M from Pu shipping. The Site did use the DOT 6M to ship some Pu metal to the labs and scrub alloy to the SRS. After completing the scrub alloy campaign the Site agreed to retire the DOT 6M and utilize a performance based package. The Site also used the 9965 and the 9968 Type B shipping containers in the early days of the shipping campaign however there were limited quantities of these containers and they could not hold a 3013 package. Ultimately the certification for these two packages was allowed to lapse as newer packages were approved (i.e., 9975, SAFKEG).

Many times documentation was difficult if not impossible to obtain yet the Site still had to provide the certifying official with sufficient technical justification to demonstrate that the pit could be safely shipped.

There was no certified container available in sufficient quantities to support the total Site SNM removal project. The 9975 and the SAFKEG were both nearing certification and the Site was willing to use either container if it could be certified to meet the Site's needs in time. The 9975 was the first to be certified for Rocky Flats Pu. The Site began procuring 9975's for shipping 3013 containers to the SRS and storing them at K-Area. The SAFKEG was the preferred shipping container because it was lighter and more containers could be shipped in a Safe Secure Transport (SST). However, the SAFKEG was not certified in time to be used at RFETS. It is unclear whether the SAFKEG could have been used for all of RFETS Pu. The SAFKEG is lighter because it has less shielding. Several of RFETS 3013's produced very high radiation readings and nearly exceeded the shipping limits (some had to be repackaged). These 3013's could not have been shipped in the SAFKEG, therefore the 9975, although heavier and, arguably, more expensive was the only Type B shipping container that was certifiable for the Site's Pu.

The Site shipped pits in the Model FL container. The majority of the pits could be packaged and shipped in full compliance with the FL Safety Analysis Report for Packagings (SARP). There was a small population of pits that did not comply with the SARP for various reasons and required special review and approval by the SARP certifying official. This process was difficult because many times documentation was difficult if not impossible to obtain, yet the Site still had to provide the certifying official with sufficient technical justification to demonstrate that the pit could be safely shipped. Although the Site could have streamlined the process by providing better information upfront, ultimately the certifying official was satisfied that all regulatory, safety, and technical requirements were satisfied and the Site was approved to ship all pits in the Model FL shipping container.

The Site requested a national security exemption (NSE)... Although the NSE was granted the DOE decided not to utilize the DT-22 for shipping these items to LLNL due to a lawsuit.

The majority of the Site's HEU metal was shipped in the Model DT-22 shipping container, utilizing a certification process similar to that used for the Model FL. A small number of large HEU items were shipped using the larger DT-23, requiring a similar certification process. The Site had a number of Pu composite items that would fit in the DT-22, however, the DT-22 was not certified for these materials. (Pu composites are Pu metal items bonded to some other substrate such as HEU, beryllium, vanadium, etc.) The Site requested a national security exemption (NSE) to authorize using the DT-22 for a one time shipment of these items to the Lawrence Livermore National Laboratory (LLNL). Although the NSE was granted, the DOE decided not to utilize the DT-22 for shipping these items to LLNL due to a lawsuit challenging the DOE's authority to exempt itself from DOT requirements. This decision required the Site to install a metal size-reduction process in Building 371 (Building 707 had already shutdown its size-reduction process) and size-reduce the parts for shipment in the 9975. Additionally, the 9975 had to be certified for the composite parts and the SRS had to prepare to process the parts instead of the LLNL.

Disposition of Highly-Enriched Uranium

In 1998 the Site purchased and installed an unproven HEU decontamination system designed to remove Pu from HEU. The HEU decontamination project assumed that this system could decontaminate every Pu contaminated HEU item to allow the HEU to be shipped to Y-12. As a result of multiple failures a detailed evaluation was performed and it was determined that the system was not designed to decontaminate many of the HEU items that the Site planned to decontaminate. The study recommended several alternative approaches such as acid leaching, machining, and oxidation, however, the DOE did not want to install or restart these systems onsite because of the cost and time involved. Ultimately the DOE decided to ship the Pu contaminated HEU items as-is to the SRS for further processing.

SNM Storage at the SRS

When EM could demonstrate that the receiver site was able to receive and that RFETS was ready to ship then NNSA provided adequate resources to support Site closure.

While the Site was stabilizing and packaging Pu into 3013's in preparation for long-term storage at the SRS, the DOE cancelled the APSF and the immobilization mission at SRS. Both of these had been established as prerequisites for shipping Rocky Flats' SNM to SRS per the earlier EIS decision. In order to support RFETS de-inventory an alternative was needed, and the DOE decided to take an existing SRS facility and retrofit it for storage of Rocky Flats' Pu. The K-Area Material Storage (KAMS) facility was a former reactor building that was modified for storing 3013 storage containers in 9975 shipping containers. The 9975 container was required due to the fact that the KAMS did not provide adequate confinement and the 9975 was therefore credited as a confinement barrier. The fact that the 9975 was used for storage at KAMS meant that the 9975 could not be reused for shipping and that many more 9975 were procured than originally planned (the Site originally planned to procure approximately 300 9975 to support its needs). The Site shipped a total of 1,895 3013s in 9975 shipping containers for storage at SRS. Additional 9975s were procured to support the residues, SS&C, and composites shipping program. Any excess 9975s were provided to other DOE sites to support their SNM shipping programs.

The governor of South Carolina sued the DOE to prevent shipping RFETS SNM to SRS until the DOE identified a disposition path for Pu stored at SRS. The federal court determined that the DOE was authorized to ship Pu to SRS and ruled in DOE's favor. The DOE began shipping Pu to the KAMS in the summer of 2002 and completed the SNM Removal Project in the summer of 2003.

Throughout the SNM Removal Project, the RFETS had to fight for Secure Transportation resources (SSTs) due to the limited resources and higher priorities of National Nuclear Security Administration (NNSA) programs such as weapons production, non-proliferation, and stockpile stewardship. Ultimately, when the Office of Environmental Management could demonstrate that the receiver site was able to receive and that RFETS was ready to ship, then NNSA directed the Secure Transportation Program to provide adequate resources to ensure that the RFETS closure was not delayed. While ultimately successful, this approach required on-going coordination and commitment from the highest levels of DOE management, and was only successful because of that level of support.

Evaluate the actual storage configuration for nuclear materials/SNM during any deviation from routine operations.

KEY SUCCESS FACTORS

1. It is imperative to evaluate the actual storage configuration for nuclear materials/SNM during any deviation from routine operations. The safety basis for nuclear operations assumed a certain set of conditions. If the facility was in an indeterminate status (such as the Rocky Flats shutdown and subsequent delays in resumption of operations) the safety basis may be inadequate to address the actual material conditions. Immediate compensatory measures would be required to mitigate the risks associated with unanalyzed, non-routine operations.

2. With SNM it is extremely important to recognize the need for training and infrastructure. The success of the SNM Shipping Project from 1998 through 2003 is largely attributed to the decision to hire, train, and retain adequate personnel to ensure that these personnel understood and complied with the SNM packaging requirements.

The success of the SNM Shipping Project from 1998 through 2003 is largely attributed to the decision to hire, train, and retain adequate personnel.

3. A NEPA ROD must be issued prior to any major federal action. The Rocky Flats SNM Removal project was delayed several times while waiting for several RODs. The DOE NEPA process was inefficient and was often delayed by political issues. Legal challenges can delay implementation of agency decisions. The DOE should carefully consider the schedule impact of additional NEPA to avoid litigation versus implementing NEPA decisions and fighting any legal battles it they materialize.

NNSA was directed to delay some national security programs to support Rocky Flats closure.

4. It is not enough to assume disposition locations. Receiver sites for SNM must be identified, funded, and directed to provide priority to the shipping site. Several times during Rocky Flats' de-inventory, receiver sites were unable to receive Rocky Flats' SNM due to lack of funding, canceled programs, conflicting priorities, lack of storage capability, or operational concerns.

5. It is not enough to assume the availability of transportation. Secure Transportation resources (SSTs) must be available to transport SNM from shipper to receiver sites. The de-inventory of an EM Site was ranked as a lower priority than NNSA national security projects such as weapons production, stockpile stewardship, and non-proliferation programs. This issue was only resolved at the highest levels of DOE when the NNSA was directed to delay some national security programs in order to support the Rocky Flats closure.

The accelerated closure of the Site made it impractical to take advantage of complex-wide studies, procurements, and certifications.

6. The accelerated closure of the Site made it impractical to take advantage of complex-wide studies, procurements, and certifications. Although the Site always participated in complex-wide, EM-wide, or multi-site/multiple user efforts, these processes rarely had the same priority as the Site Closure. Most sites/programs do not have the urgency and therefore do not have the funding priority to support outyear needs (this is inevitable with dwindling budgets because only the essential near-term needs get funded). The Site could not wait to take advantage of lower priority efforts and therefore paid more for a customized product.

The Site was ready to ship SNM, closure could be accelerated by removing SNM, and dollars and time could be saved by removing all SNM as soon as possible.

7. There were many times when the Site did not have the priority compared to the DOE Weapons Complex and was told that accelerated closure could not be supported. Rather than argue the priority question, the Site simply continued to package and prepare all SNM for offsite shipment. The important thing was demonstrating that 1) the Site was ready to ship SNM, 2) the Site closure could be accelerated by removing SNM, and 3) the bottom line, dollars and time (i.e., dollars) could be saved by removing all SNM as soon as possible. The Site's ability to consolidate SNM into Building 371, shrink the Protected Area around

Building 371, and release entire buildings for accelerated deactivation and D&D mitigated the impact of any priority delays.

8. The Site requested the National Security Exemption (NSE) to allow shipping some Pu composite items in an existing shipping package rather than size reducing the items and certifying another shipping package. Ultimately the NSE approach was abandoned and the Site size-reduced the composites and shipped them in an approved shipping container. The normal certification process should be utilized and any exceptions to that process should be considered risky at best.

The normal certification process should be utilized and any exceptions to that process should be considered risky at best

9. When dispositioning complex items such as HEU weapons parts, the Site should have make sure that disposition planning accounted for the specific characteristics of an item. Unrealistic processing assumptions (i.e., that this system could decontaminate every Pu contaminated HEU item to allow the HEU to be shipped to Y-12) resulted in unnecessary work and SNM disposition delays. If the Site had understood the characteristics of the Pu on these HEU items they may have avoided purchasing a system that met only a limited need.

10. The DOE decision to waste any SNM for which there was no programmatic need was a significant policy change that allowed the Site to stabilize and directly dispose of nearly 3 tons of Pu contained in 106 bulk tons of Pu residues, plus a significant quantity of low-concentration Pu oxides. This decision avoided unnecessary Pu recovery operations (at RFETS, SRS, and LANL) and years of storage and maintenance associated with the Pu that would have been recovered with no programmatic need.

DOE avoided unnecessary Pu recovery operations and years of storage costs for SNM with no programmatic need.

11. The following decisions greatly improved the ability of the Site to accelerate closure while packaging Pu for long-term storage: 1) Installing the PuSPS into Building 371 (instead of Building 707), 2) canceling the originally planned Building 371 3013 system and utilizing just the PuSPS for 3013 packaging, 3) discarding the automated stabilization portion of PuSPS in favor of a manually operated stabilization system.

12. Installing the PuSPS system offsite in an uncontaminated "cold" environment allowed the PuSPS to be tested and improvements identified prior to actual radioactive "hot" operations.

13. The PuSPS automated system was difficult to maintain and unreliable. Automated systems in general require more maintenance and are difficult to repair, especially in a contaminated environment. The pros and cons of automated system benefits versus manual operations simplicity and reliability should be carefully considered. The PuSPS produced detailed

The PuSPS automated system was difficult to maintain and unreliable. The most significant PuSPS lesson learned was the ***Keep It Simple*** *axiom.*

lessons-learned that were disseminated throughout the DOE Complex.[88] The most significant lesson learned was the Keep It Simple axiom.

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ROCKY FLATS CLOSURE LEGACY

DECOMMISSIONING

DUE TO THE INHALATION HAZARD OF PLUTONIUM, MUCH OF THE D&D WORK WAS PERFORMED IN BUBBLE SUITS AS SEEN ABOVE. DUE TO THE INEFFICIENCIES OF DONNING AND DOFFING PERSONAL PROTECTIVE EQUIPMENT (TWO OR THREE TIMES A DAY), SOME PROJECTS WENT TO FOUR, TEN-HOUR WORKDAYS VERSUS FIVE, EIGHT-HOUR WORKDAYS.

DECOMMISSIONING

INTRODUCTION

"Decommissioning" scope can be defined as the safe removal of all facilities after the conclusion of operations, as distinguished from operations, where a "product" is produced, and environmental restoration involving environmental media (i.e. soil and water). Successful accomplishment of decommissioning scope was critical to the success of the Rocky Flats Closure Project because it represented most of the overall project scope and much of the project critical path. Despite a clear vision of what the overall decommissioned Site would look like – no buildings standing – the path to that vision was not at all clear; many interrelated decisions had to be made and sometimes remade before most tasks could even begin.

This section is divided into three subsections. The first discusses the progression of the decommissioning scope through the closure project, emphasizing the pilot projects and role of decommissioning in the overall closure project. The second subsection addresses the success factors for Site decommissioning, including the key closure project elements, and the impact of the learning curve, technology and other important factors leading to the Closure Project decommissioning success. A final subsection summarizes the key success factors for Site decommissioning.

DISCUSSION

The Site recognized in the planning process that the plutonium facility decommissioning would be the bulk of the Closure Contract effort and key to overall Closure Project success. It implemented an organization to focus on executing that work.

Resumption of Production and Initiation of Deactivation

Active weapons production operations at the Rocky Flats Plant were curtailed in December 1989, followed by a period during which the systems and infrastructure were developed to allow production operations to resume. During this "resumption" period, the Site identified numerous conditions that presented unacceptably high nuclear safety risks, such as the potential for nuclear criticality in liquid systems, container pressurization, and neglected building infrastructures. Once it became clear from the changing world situation that further Site weapons production was unnecessary and Site closure was inevitable, the Site initially focused on remedying these nuclear safety risks. With no more than a vague notion of the closure process or how wastes or plutonium would leave the Site, the task of reducing nuclear safety risk provided a goal, consistent with a Defense Board-mandate, and generally believed to be headed in the right direction for Site closure. The Site mission became "Deactivation," or a transitional state winding down operations and preparing for decommissioning and closure, as distinct from "Decommissioning," for which the regulatory path was still uncertain.

Initial Planning and Development of Decommissioning Scope

With the implementation of the Kaiser-Hill (K-H) Performance-Based Integrating Management Contract (PBIMC)[37] in 1995, greater emphasis was placed on Site closure and the role of decommissioning in that effort. One of the initial actions was the approval of the Rocky Flats Cleanup Agreement (RFCA)[3] in 1996, which established a regulatory framework between DOE, the State of Colorado, and the Environmental Protection Agency for decommissioning as a remedial action, and outlined the major requirements. Getting this overarching principle-based agreement in place was a critical first step, but significant effort and time was still required to establish the details of responsibilities, documents, and decommissioning regulatory process. Subcontractor organizations with the responsibility for decommissioning were formed, expertise was brought in, and some detailed planning began on some immediate, relatively low-risk projects and two significant pilot projects. Additional efforts that focused on establishing activities and logic for overall Site closure are discussed in Section 1.5, Creating and Implementing a Closure Project.

Contractor Organization and Infrastructure

A part of the overall Site planning effort was to determine how to prioritize activities and use the Site facilities and infrastructure. The Site was still organized around weapons or risk reduction operations functions, not closure functions. Identifying and shutting down functions and operations no longer needed for closure was not an easy task. Often an organization's overall justification would disappear, but imbedded functions that were previously a minor focus were still needed, such as limited calibration and metrology requirements remaining despite the elimination of the need for a weapons QA organization. Multiple reorganizations left parts of operations and staff scattered across the Site. This complicated the determination of facility status; i.e. whether a facility would be used in future operations, waste management, or other activities; and if not, should the facility be decommissioned now or "mothballed" for later demolition to reduce "landlord" costs. Ultimately K-H conducted a focused management initiative to address the splintered organizational functions. The effort was successful in streamlining the organization to closure, while maintaining essential support.

Often an organization's overall justification would disappear, but imbedded functions that were previously a minor focus were still needed…Multiple reorganizations left parts of operations and staff scattered across the Site.

Initial Decommissioning Projects

Several initial decommissioning projects emphasized small or high-visibility activities such as a small, obsolete, solid radioactive waste treatment facility; large unused fuel oil storage tanks; unused guard-posts;

and additional excess buildings. This served the purpose of showing visible changes to the Site and emphasizing its future closure, while not diverting substantial resources from the overall Site focus of nuclear risk reduction. Concurrently, planning was begun to deactivate and decommission two more difficult contaminated surplus facilities: Building 123, a 1950's vintage bioassay laboratory facility, and Building 779, the Plutonium Metallurgical Laboratory.

The purpose of these two projects was to pilot the Site "decommissioning process", i.e., the combination of regulatory, management, technical, authorization basis, work control, environmental, and contractual processes necessary to initiate, plan, execute, and close a decommissioning project. At the time the organizational responsibilities for different decommissioning functions (within the DOE, the contractor, and the regulators) were unclear, the regulatory process within RFCA had never been implemented, and there was very little organizational experience in doing decommissioning work. Early estimates showed that the Site decommissioning scope would increase from a few million, to hundreds of millions of dollars a year, a ramp-up level that would be nearly impossible to sustain. While gloveboxes had been removed from buildings several at a time, there had not been large scale removal of contaminated systems in preparation for building demolition – in fact, no plutonium-contaminated building had been demolished anywhere in the DOE complex under anything approaching the rigor imposed by current regulations. The Building 123 Project was completed in September 1998 and the Building 779 Project was completed in March 2000. The implementation of these pilot projects produced several notable results.

Pilot projects were necessary early on to develop and train staff; develop procedures, methods, and estimating parameters; and to develop working relationships and processes with regulators and stakeholders.

<u>Resolution of Documentation and Regulatory Requirements</u>

The Building 123 Decommissioning Project[89] was relatively straightforward from a technical standpoint. There was substantial asbestos and modest radiological and chemical contamination, but only low levels of transuranic (alpha) contamination. There were, however, over thirty significant documents covering regulatory requirements, authorization basis, work control, characterization, waste management, etc. that were often overlapping, sometimes conflicting, and all which had to be approved and in place before different aspects of work could start. As an example, there were three somewhat overlapping safety documents (the Facility Safety Analysis, the Auditable Safety Analysis, and the Health and Safety Plan), two somewhat overlapping waste documents (the Waste Management Plan and the Unit 40 RCRA Closeout Plan), and several characterization documents, all of which slightly overlapped with the regulatory decision document (the Proposed Action Memorandum). Part of this was the result of overlapping regulations (environmental regulation safety requirements vs. DOE Orders safety requirements), and part was a result of different organizations staking claim to a future role in decommissioning. The results of the lessons learned from this project were a more defined and streamlined approval process. Most importantly, the Site recognized the need to "keep approval of documents off the project critical path," i.e., decoupling the activity (with the implicit approval of regulatory agencies) from the physical work. Once the project baseline with related scheduling tools became more mature this became an even more powerful tool. The regulators never wanted a document approval to appear on the critical path for site closure.

Guard against the complexity of the work causing inaction. Minimize studies to determine the "best" approach. Develop a credible plan with best available information, proceed with work safely, and learn by doing.

Development of Size Reduction Techniques

The Building 779 Decommission Project contained over one hundred gloveboxes ranging in contamination from virtually clean to a few very highly contaminated gloveboxes (many grams of plutonium hydride). Several approaches were used to size reduce the gloveboxes, developing techniques in cutting metal, providing waste-acceptance-criteria-compliant packaging, and training operators and foremen in decommissioning equipment with progressively increasing levels of contamination. Methods for disposing of large volumes of debris waste were also developed using cargo containers and the Surface Contaminated Object (SCO) procedure[90] for waste characterization. While used only for potentially or moderately-contaminated equipment in the Building 779 project, further refinement of this approach provided substantial improvement in safety and efficiency, as discussed in detail later in the section.

Regulators accepted less up-front detail in the regulatory decision documents, in exchange for more active participation and commitments to better detail on future buildings as the planning process improved.

Development of Overall Processes and Infrastructure

The projects developed teams able to work together to resolve problems. This included work crews developing procedures and tooling, and project management teams developing estimating, project control, and conduct of operations approaches, etc. Finally, the pilot projects began the development of the oversight and regulatory interfaces, providing examples of what work control and other documents "looked like," so that the regulators, DOE, and the contractors could begin to work out roles and responsibilities in a practical environment. This also included the development of the Building Trades subcontractor staff, and interface approaches between subcontractors. These teams were transferred virtually intact to subsequent buildings, with some selected individuals "seeded" into other projects to assist in planning.

Learning Curve Benefit

The identification of these projects as "pilot projects" was useful in several ways. The projects were executed in an expedited fashion with substantial management attention, and showed considerable cost and schedule variance from the planned ideals. Overtime was used to maintain schedule as necessary. Decisions were made to use expedited documentation that resulted in less efficient execution, such as using an authorization basis approach that authorized individual activities instead of a blanket authorization for all building decommissioning activities. Regulators accepted less up-front detail in the regulatory decision documents, in exchange for more active participation and a Site commitment to provide greater detail on future buildings as the planning process improved.

As pilot projects, they were recognized to be at the beginning of the "learning curve" i.e., the concept that work becomes more efficient over time as workers gain experience, and that it was important to develop a baseline process that could be executed and then subsequently improved. If viewed as mature projects with good estimating bases and developed execution techniques, they were less than successful – they would be some of the more costly of the Site buildings to decommission on a per square foot basis. However, viewed in hindsight in the context of the overall Site closure, the learning curve benefits far outweighed the near-term inefficiencies.

In some buildings it was impossible to decontaminate some sections of concrete to meet the free release criteria and the concrete could not be removed prior to building demolition without damaging the structural integrity of the building.

Learning Curve Example – Release of Buildings

The evolution of the building decontamination process illustrates the iterative nature of the decommissioning learning curve. The original assumption was that radiologically contaminated buildings would be decontaminated to free-release criteria so that the buildings could be demolished and disposed of as sanitary waste. After all of the gloveboxes and equipment were removed from an area then the empty rooms were surveyed to determine the location and extent of contamination. Contaminated surfaces were then decontaminated using a number of techniques (described in more detail below). Additional surveys were performed to verify that the area was successfully decontaminated and that no cross-contamination had occurred, after which the facility could be released for unrestricted demolition in terms of radiological controls and waste disposal.

This approach was used successfully in Building 779; however, the decontamination process had to be adapted in subsequent buildings to address various contamination issues. In some buildings it was impossible to decontaminate some sections of concrete to meet the free release criteria and the concrete could not be removed prior to building demolition without damaging the structural integrity of the building. Instead these sections were decontaminated to the maximum extent practical, fixative was applied to prevent cross-contamination during removal, and the area was clearly marked with paint to allow the items to be segregated during demolition for disposal as low-level waste. In the most extreme cases, the contamination was so pervasive that it was impractical to decontaminate the building or area completely and attempting to identify and segregate small sections of "clean" rubble from contaminated rubble was inefficient and greatly increased worker risks. In these situations, the building or area was decontaminated to the maximum extent practical, fixative was applied, and hot spots were clearly marked. All of the remaining parts of the building that could be released was demolished and disposed of as clean waste. The targeted areas were disposed of as low-level waste as the building was demolished. The Site utilized large-volume rail shipping when entire buildings or large areas (such as canyons or heavily contaminated equipment foundations) were demolished as radiologically contaminated waste.

Repeated use of Hydrolasing actually caused residual contamination levels to increase, believed to result from the water pressure forcing contamination deeper into the concrete.

Hydrolasing[137] involved using high-pressure water to remove contamination from the surface of concrete walls, floors, and similar surfaces. The water also reduced airborne contamination levels during the process. A wastewater collection system was used to collect, filter, and re-use the water. This technique removed surface paint and a thin layer of concrete, allowing direct surveys for alpha contamination (i.e., unimpeded by paint) to detect any contamination that might be present in the underlying concrete. Hydrolasing, however, created its own unique set of issues. While useful for decontamination of fixed surface contamination, its repeated use (more than about 3 passes) caused residual contamination levels to actually increase, believed to result from the water pressure forcing contamination deeper into the more porous concrete substrate. Also, repeated hydrolasing passes caused such deep pockets and holes in the concrete that the use of large surface monitoring equipment for the final surveys to determine building pre-demolition status became almost impossible.

Mechanical Abrasion. When the contamination extended deeper into the material alternate methods such as scabbling and concrete shaving were used. The scabbling technique involved mechanical abrasion of the concrete surface with needle-guns or pneumatic hammers, breaking up the surface of the concrete. For horizontal surfaces, concrete-shaving devices physically removed the surface of the concrete. Scabbling and shaving removed more of the surface than hydrolasing and multiple passes could remove concrete layers more efficiently than hydrolasing. Both of these techniques used water for dust suppression and to reduce airborne contamination.

Concrete Section Removal. When the contamination was localized but extended deeply into an entire concrete wall or floor section then the entire section was often removed (as long as it was not load bearing). Workers used either concrete wet saw cut techniques for floors or a diamond wire saw cutting method for walls and ceilings to cut out those specific sections into pieces that were able to be handled by the work crew for disposal as radioactive waste. Another technique that was used to break up large blocks of reinforced concrete for disposal involved core boring into the concrete and injecting expansive grout. The grout would expand and crack the concrete allowing the large item to be broken into smaller sections for disposal (this technique was used on both contaminated and clean concrete).

Controls. Water sprays were used extensively during building demolition for dust suppression. Water jets and water sprays were used to suppress the dust generated during open-air demolition of all structures (contaminated and clean). If the structure was being demolished as a contaminated facility, then the water was collected by runoff channels surrounding the facility and diverted into collection pits which were then pumped into in a holding pond, handled as radioactive waste, and treated for reuse on the facility. All such water was recycled as long as demolition was going on at the site. After all building demolition was completed then the wastewater was treated and disposed of appropriately. During demolition within buildings many areas such as roofs and interior hollow cinder block walls were soaked with water prior to demolition to reduce dust generation and airborne contamination.

Sequencing of Decommissioning by Building

The Site contained four major plutonium operations buildings: Building 771, Building 776, Building 707, and Building 371, all of which were actively engaged in reducing the risks and consequences of nuclear accidents involving residual liquids, equipment, and stored wastes. Buildings 707 and 371 additionally were the locations of "operations" to stabilize plutonium residues, oxides, and metal prior to disposition off site. Since Site closure required disposition of these materials, these two buildings were not available for immediate decommissioning. Building 776, as the storage location for much of these materials, could begin decommissioning only after these materials were either processed or relocated. The non-plutonium buildings represented a lesser risk in their current conditions, could be more easily "mothballed," and would have shorter overall project durations that would avoid their impacting the Site critical path; hence they became lower priority. Thus, although there were some smaller activities to continue risk reduction (e.g. removing enriched uranium from Building 886), the post-pilot decommissioning efforts focused on Building 771. Building 776 was anticipated to follow once its accountable material had been relocated.

Deactivation/Decommissioning Interface

Building 771 had contained the bulk of the Site's high-concentration plutonium solutions at the curtailment of weapons production, and a substantial portion of the building's subsequent nuclear risk reduction activities had been draining tanks and solidifying the plutonium-containing liquids. This provided an operating cadre available for subsequent "deactivation" activities. As the draining of the tanks was completing and efforts were turning towards the residual liquids in the piping systems, a decision was made to remove not just the liquid but the entire run of piping. This was labeled as "deactivation," and not "decommissioning," since "decommissioning" would have been a "remediation" activity covered under RFCA. Based on this decision there was no regulatory coverage for "remediation (the Decommissioning Program Plan[26] and the Building 771 Decommissioning Operations Plan (DOP)[91] were not approved) and the EPA and the State regulators were kept at a distance. Labeling the work deactivation also identified it as a "nuclear operation" and therefore within the scope of the PBIMC "nuclear" subcontractor and not the PBIMC "remediation and waste" subcontractor. Waste was managed under the provisions of the Resource Conservation and Recovery Act. Piping was removed as a means of advancing the closure process as well as preemptive action against risks from further system degradation.

... the attempt to do closure work as "deactivation" was of limited benefit. The removals engendered arguments and mistrust with the regulators, who viewed it as circumventing RFCA...The action to segregate deactivation for regulatory and management purposes was seen as a poor decision and not repeated.

In retrospect, since decommissioning was the building endpoint, the attempt to do closure work as deactivation was of limited benefit. The removals engendered arguments and mistrust with the regulators, who viewed it as circumventing RFCA. The distinction between deactivation and decommissioning caused work to be organized and executed less efficiently than if all work had been covered under RFCA and included in area-specific Sets (see below). Once the Building 771 decision document (i.e., the DOP) was approved, all of the subsequent deactivation work was performed under the RFCA (i.e., CERCLA) framework, and all waste was managed as remediation waste. The action to segregate deactivation for regulatory and management purposes was seen as a poor decision and not repeated.

Detailed Decommissioning Planning/Use of "Sets"

…The Sets were area-based… making the planning and execution easier…the Set concept was robust enough to avoid substantial replanning of the Set content, and provided the basis for project tracking and control.

Concurrently with the Building 771 Deactivation, planning and estimating for the decommissioning of the plutonium process equipment was proceeding, including the removal and size reduction of process gloveboxes, tanks, piping, and duct. This planning incorporated the methods and the cost estimating factors from the experience being gained in the (at that time) early stages of the Building 779 project. Building 771 was the first building to focus on planning the process equipment dismantlement based on "Sets" – groupings of equipment typically in the same room or portion of a room that would be worked as a unit – and defined in the Building 771 DOP. The Sets were area-based, as opposed to the deactivation activities, which removed runs of process piping that crossed several areas, making the planning and execution easier. The Sets were planned based on the methods used in Building 779, with early identification of problems for which there was no acceptable current approach to allow investigation of different technologies. Sets were initially prioritized and scheduled based on numerous criteria. These included initially performing easier work sets both to create space for logistics and waste, to allow newly forming work crews to succeed, remove gloveboxes so that support ventilation system could be removed, and clear out areas of highly-contaminated equipment so that the less experienced Building Trades subcontractors could accelerate their work. Although the sequencing changed as the Building 771 project progressed, the Set concept was robust enough to avoid substantial replanning of the Set content, and provided the basis for project tracking and control.

Decommissioning Program Development

An initial problem was too many interdependent decisions, priorities, and schedules that made it difficult to develop a baseline. Use outside experience, coupled with Site knowledge, to analyze and resolve project challenges.

In 1998 a separate K-H decommissioning program function was established to begin coordinating and refining the processes and infrastructure for the expanding decommissioning effort which had previously been the scope of the PBIMC execution subcontractors. This program evaluated the efforts to plan, estimate, and execute the Building 123 and Building 779 pilot projects. This resulted in cost modeling that would support the subsequent baselining effort, documented in the Facilities Disposition Cost Model.[196] The facilities disposition process was flowcharted and the documentation and approval process established in an attempt to resolve conflicting document requirements, streamline the planning effort, and allow decommissioning to be discussed in common terms. This process development resulted in the Facilities Disposition Program Manual.[92] The effort to create the decommissioning RFCA Standard Operating Protocols[30,31,32] was initiated to standardize and streamline the regulatory process. Site-wide facilities characterization methods and procedures were developed, and documented in the D&D

Characterization Protocol.[93] Cost modeling, additional activities to streamline the regulatory process, development of a characterization process, Site waste estimating, and planning and estimating for the decommissioning of the remaining Site facilities were begun. An ill-fated effort was initiated to develop a robotic size reduction facility that could support the remaining plutonium building decommissioning, and is discussed in a later section. Overall, the Program provided substantial support to the subsequent Closure Project Baseline[39] development and created a number of Site-wide documents that were used throughout Site closure. As the Site reorganized following the initiation of the Closure Contract, the Program functions were distributed among the resulting Projects.

Development of the Closure Project Baseline

In 2000, DOE awarded K-H a contract to complete the Rocky Flats Closure Project.[33] As part of the reorganization and rebaselining effort decommissioning efforts were divided into five distinct execution projects – the four major plutonium processing buildings and "everything else", which included one smaller plutonium laboratory, five uranium and beryllium processing facilities, and several hundred non-contaminated or lightly-contaminated structures. A sixth execution project was responsible for waste management and security. Various separate K-H site-wide organizations were responsible for planning, business processes, safety and regulatory oversight, etc. Functions necessary for successful project execution, such as procurement, engineering, and safety were projectized; i.e., each execution project had independent procurement, engineering, and safety organizations reporting to the execution project manager. The residual Site functional organizations coordinated Site policy and supported Site-level (but not project-level) execution. The execution projects were given a five-month period to complete a detailed baseline schedule and estimate through the completion of building demolition, with overall cost and schedule parameters based on the Site master schedule. This process is described in more detail in the section on Creating and Implementing a Closure Project, and the elements particularly relevant to decommissioning are discussed below.

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Status of the Closure Project Baseline Execution

Since the initiation of the Closure Project activities in July 2000, decommissioning execution proceeded essentially consistent with the planning incorporated in the Closure Project Baseline. The overall Closure Project had favorable cost and schedule variances since 2002, largely as a result of some schedule acceleration of outyear activities. Improvements in glovebox size reduction resulted in some critical path schedule improvement. This was somewhat offset by delays in shipment of accountable nuclear materials from the Site, and the potential impact on final closure of the Protected Area and removal of much of the remaining nuclear and security infrastructure. There was some reorganization to combine the management of the execution projects for improved efficiency, although having separate projects encouraged the development of slightly different approaches toward resolution of similar problems. The Site re-evaluated the extensive use of fixed-price contracting for the less-contaminated Building Trades work, based on difficulties in new contractors moving up the learning curve for doing work on Site. All tasks had acceptable methods identified and in most cases implemented. Although there was some rearrangement of activities within the individual Projects, the overall baseline structure and estimate was relatively resilient.

DECOMMISSIONING FEATURES

The following section discusses the elements that supported the Rocky Flats Closure Project success in decommissioning facilities.

Closure Project Organization

The actions taken following the approval of the Closure Contract had a profound positive effect on Site closure. The Closure Contract and subsequent rebaselining effort provided a number of key elements:

A credible baseline through the completion of the Closure Project. Previous to the rebaselining there were parts of the Closure Project that were well planned, typically near-term activities similar to ongoing work. There were also numerous unplanned parts, typically out-year work for which no organization had clear responsibility. Examples included building demolition, decommissioning of uranium-contaminated facilities, and decommissioning of large, highly-contaminated vaults. The 2000 Closure Project Baseline supported accurate planning, assessment of progress, and reporting. Emphasis on additional schedule acceleration through shortening the critical path and on planning of the end of the Closure Project would have been impossible without the level of rigor provided by the baseline. Demolition and environmental restoration activities within the building footprint were integrated through the schedule, so changes in Project schedule would be reflected in restoration planning, as appropriate. Although the Baseline provided a detailed basis for management, a more detailed level of planning (i.e. the work control documents) was conducted using the "rolling wave" approach of having work packages prepared just a few months before they were needed. This

... allowing the detailed work packages to be prepared "just in time", we were able to take advantage of the latest in technical, regulatory, and management lesson learned.

turned out to be a very successful work planning model, allowing the detailed work packages to be prepared under a "just in time" concept, and thus take advantage of the latest in technical, regulatory, and management lesson learned.

Clear scope and responsibilities, and authority vested with Project Manager to focus on and execute their scope. Under the Closure Project, all decommissioning scope became building-based with no functional management; e.g., no "D&D Program." All Projects (e.g. the 771 Project) had distinct cost and schedule baselines over which the vice-president level Project Manager had complete funding and decisionmaking authority. Functions necessary for successful project execution, such as project control, procurement, engineering, and safety were assigned to the Project, and staff in those functions were paid for and reported to the Project Manager. Although there were some residual Sitewide organizations, they were typically not in the decisionmaking chain, and generally provided support at the Project Manager's discretion. This accountability also provided an unambiguous means of identifying project personnel value and improved the ability to control costs and staffing. Cooperation and coordination between Project Managers was accomplished by leadership from the most senior contractor management and Corporate Board, rather than through an organizational structure. The contractor's most senior managers successfully managed this delicate balance between building and Site priorities, but only with continuous engagement.

Relocation of plutonium stabilization operations to Building 371. The Security Reconfiguration effort centralized all "operations" previously spread throughout the plutonium buildings into a single building, so that all such non-decommissioning plutonium activities were removed from the other three Plutonium buildings. In addition to the dramatic reduction in costs to support security compliance, the ability of the three facilities to focus on decommissioning increased, and the change in the culture resulted in improved decommissioning performance. Similar distinct divisions between operating and decommissioning were established for the non-plutonium facilities, such that buildings that had a continued waste management mission remained distinct from those either awaiting or undergoing decommissioning.

The division of the [Steelworker and Building Trades] scope during the planning process was necessary to allow contracting and proper scheduling of activities.

Division of the decommissioning scope between process systems and utilities/structural decontamination/demolition. This was an issue of distinguishing between the work that would be done by Site bargaining unit craft labor (United Steelworkers of America) and the work that would be done by construction crafts (Building Trades). There was early recognition that a construction workforce greater than that available within the current Site Steelworker ranks would be required to achieve accelerated closure. The division of the scope during the planning process was necessary to allow contracting and proper scheduling of activities.

The divisions of scope included separating the work in a given room or rooms between those removals that were highly contaminated from those that were less contaminated. Note that all of this work was considered decommissioning, not deactivation. The Site Steelworkers first removed the equipment included in their work scope. They then moved to other areas and the Building Trades removed the remaining equipment, utilities, non-load bearing walls, decontaminated structural surfaces, and (eventually) demolished the buildings. Anticipating and separating this work within the Closure Project Baseline allowed the work to be appropriately contracted, scheduled, and controlled, and would have been much more difficult after work had started.

Significant advance work was necessary to allow this separation and coordination in the work planning. Steelworkers and Building Trades do not naturally cooperate, and in fact jurisdictional issues between the two labor entities resulted in a labor strike during construction of Building 371 in the 1970's. Resolution of that strike resulted in a complex labor agreement defining strict jurisdictional boundaries. K-H had to approach both the Steelworkers and Building Trades to develop cooperative approaches that would be seen as benefiting the members of both groups. Their success in this effort enabled the efficient division of work during the decommissioning.

<u>The Learning Curve</u>

The decommissioning process at Rocky Flats can be described as surprising; surprisingly confused and inefficient at the beginning, and surprising improvement within a relatively short time. A "learning curve" effect is traditionally thought of as the result of improvement in workforce experience, which was certainly part of the process as the workers, most often former process operators, become more comfortable as D&D workers. During the initial decommissioning Sets the efficiency was low; as the understanding of the work improved, the tooling became more sophisticated, and techniques for contamination control became better. The crews also began acting more as teams, anticipating each other's actions in removing personal protective equipment, for example. K-H placed substantial emphasis on empowering its first line supervision (foremen) and in improving both training and management oversight, which resulted in improvements in crew efficiency. There was also a reduction in injuries and accident statistics, which had a collateral efficiency improvement from reduced shutdowns.

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An additional area of improvement was in work planning and procedures. Much of the early inefficiency was due to downtime caused by inadequate or incorrect work documentation. Through feedback and increased experience by the engineering and planning staff on decommissioning work, the packages became more timely and accurate, resulting in less work stoppage. Additional efficiency came from improvement in the methods of work and identifying and eliminating barriers and unnecessary activities. Examples of improved methods included the decreased reliance on size reduction resulting from improved glovebox decontamination and use of vacuum cleaners to remove raschig rings; use of plasma arc required significant efforts to overcome safety concerns. Submitting detailed facility characterization plans to allow the release of office trailers awaiting regulator approval was eliminated through increased involvement by the regulators in planning and implementation oversight. Another was consolidating facilities in a way that allowed one document to cover multiple facilities, minimizing the administrative and regulatory effort.

Impact of Pilot Projects

Two elements in particular were important in moving rapidly up the learning curve. The first was early initiation of larger-scale pilot projects discussed earlier, which allowed problems to be resolved on one project instead of having to be addressed by all projects simultaneously. Thus the inevitable delays and cost variances were not repeated, nor was the Site closure end date impacted. The other Projects all moved up the learning curve by incorporating the piloted approaches in their planning and baselines. Additionally, it allowed for development of crews, staff, and management teams, and replacement of under-performers.

Learning Curve Impacts for Subcontracted Work

The above discussion looks at the Site improvement in performance as a result of learning curve efficiencies, with the result that the Site management and workforce developed a certain level of expectations for performance and safety. However, learning curve issues also caused a rethinking of the use of fixed-price contracting for lesser-contaminated facility decommissioning. Despite attempts to make the demolition of clean facilities similar to commercial construction, there remained Site-specific requirements and expectations for safety and conduct, and personnel interactions that needed to be achieved to accomplish work. The learning curve for dismantlement, decontamination, and demolition of uranium and beryllium contaminated facilities was greater than anticipated, even for firms with experience with contaminated decommissioning elsewhere, as shutdowns in Building 865 demonstrated.

The learning curve for dismantlement, decontamination, and demolition of uranium and beryllium contaminated facilities was greater than anticipated, even for firms with experience with contaminated decommissioning elsewhere

The fixed-price subcontractor performing the dismantlement, decontamination, and demolition of a plutonium facility from which the process equipment was removed had also taken substantial time to achieve adequate productivity. The Site evaluated different methods of self-performing Building Trades work, use of cost-plus contracts, and Site Steelworkers being hired as Building Trades craftsmen to mitigate this problem.

Beryllium and Asbestos Contamination

Although the radioactive contaminants typically receive most of the attention for decommissioning, beryllium and asbestos provided significant challenges in the overall decommissioning effort. Asbestos was found in far more places than originally anticipated. Asbestos was unexpectedly ubiquitous in interior and exterior wallboard, spackling and grouting material, and floor coverings. For worker safety, asbestos-containing materials (ACM) were removed prior to demolition activities, (but generally after facility radiological decontamination) and segregated for waste disposal. The extensive ACM removal provided substantial work sequencing and control challenges, and unexpectedly appeared on the critical path for demolition of several major facilities. In the case of Building 776/777, the exterior wall panels were all determined to be ACM. An elaborate subproject replaced the complete "skin" of the building, removing ACM panels one at a time, and replacing them with a temporary non-ACM panel, so that the negative differential pressure could be maintained within the building. One positive aspect of the ACM challenge was the success of the ACM removal subcontractors. The Site focused on niche subcontractors with expertise in ACM removal. These were some of the best performing subcontractors, working safely and effectively, even considering the hazards of the asbestos.

The extensive ACM removal provided substantial work sequencing and control challenges, and unexpectedly appeared on the critical path for demolition of several major facilities....The lesson for other sites is to plan for more asbestos and beryllium contamination than would be expected based on historical knowledge or even initial sampling.

Beryllium (Be) contamination also provided unique challenges. Originally the Site anticipated that only a handful of non-nuclear production facilities would be Be-contaminated. As facilities were characterized the Site found Be contamination in nuclear facilities and even some administrative support areas. There is still no device that can provide real-time detection of Be contamination. Smear and swipe samples, lapel samplers, and other air samples collected in the field must then be analyzed in a laboratory usually with no less than a 24-hour turnaround. For their protection, workers in areas with suspected Be contamination were required to wear respiratory protection until it could be proven that Be was not present. Even this was not completely successful. Several instances occurred where a room was surveyed and found to be free of Be contamination only to have Be uncovered during the removal of a large piece of equipment. Further complicating the work planning and resource scheduling was the DOE's desire to limit the number of Be workers, since any Be worker became part of the Chronic Beryllium Disease Prevention Program, with a lifetime commitment for health screening and potential to develop Chronic Beryllium Disease. With additional training and management attention the Site worked through both the Be and ACM challenges. The lesson for other sites is to plan for more asbestos and beryllium contamination than would be expected based on historical knowledge or even initial sampling.

Influence of Technology

The decommissioning activities at the Site demonstrated the capabilities and limitations of applying technology to decommissioning problems. Several problems were resolved by the focused use of technology applied to a specific problem. The technical improvement with the biggest single impact was the ability to decontaminate plutonium process equipment such as gloveboxes and tanks from a transuranic waste form to a low-level waste, and in the process substantially reduce or eliminate the size reduction effort. This was accomplished by a combination of localized decontamination using either cerium nitrate or the EAI 3-step process, and waste characterization using "surface contaminated object" procedures as described below.

The technical improvement with the biggest single impact was the ability to decontaminate plutonium process equipment such as gloveboxes and tanks from a transuranic waste form to a low-level waste, and in the process substantially reduce or eliminate the size reduction effort.

Building 779 Size Reduction Requirements

During the Building 779 project, the only accepted way to determine plutonium levels for characterization of process equipment-generated wastes was to use non-destructive assay machinery, which could not accurately assay larger containers. Therefore, all plutonium process equipment was sprayed with fixatives to minimize plutonium airborne activity, and then manually size reduced to a size that could fit in a "Standard Waste Box," the largest container available for disposal of transuranic waste. Manual size reduction of plutonium process equipment was very labor-intensive, with several support personnel outside of a contamination control structure supporting each supplied-air plastic-suited worker using manual cutting tools inside the structure. The potential for personnel contamination and cutting injuries was high.

Conversely, non-process equipment-generated wastes, such as debris from room-air ducting and desks from process areas, could be placed into much larger cargo containers for disposal as low-level wastes at the DOE Nevada Test Site facility. The wastes could be radiologically characterized using the DOT SCO procedure. This is a straightforward process that used direct readings and smears from all surfaces of an object to determine average levels of surface contamination to give a total activity for the object. For materials at lower contamination levels it could be done with existing instrumentation. Initial evaluation showed that some, mostly laboratory, gloveboxes could be decontaminated and then characterized using existing decontamination techniques and the SCO procedure. The remaining gloveboxes would both exceed the measurement capabilities of existing equipment and could not be adequately decontaminated using existing techniques. Thus, it appeared that the majority of the Site's gloveboxes would require manual (or perhaps automated) size reduction.

Decontamination Technology Development

Three technology development efforts were pursued. First, instrumentation was developed to accurately determine contamination levels in the range of 10-100 million disintegrations per minute-alpha. Simultaneously, two approaches were evaluated for in-glovebox decontamination. One involved the adaptation of a process to dissolve plutonium oxide using cerium nitrate that had been used for tank decontamination. A second brought in a subcontractor (EAI) for application of proprietary chemicals in a multi-stage process. These methods successfully reduced the number of gloveboxes requiring manual size reduction by about 80% and resulting in a similar reduction in transuranic waste for a substantial savings in waste management costs. The decreased reliance on manual size reduction and acceleration of Closure Project schedule resulted in hundreds of millions of dollars of cost savings over the Closure Project.[94]

Problems with Robotic Size Reduction

A technology development effort that proved less successful was a project to implement a robotic size reduction facility. This facility was designed and procured based on programmatic studies of anticipated needs, not at the request of any Project (in fact before the Projects actually were organized). After spending approximately seven million dollars in development and procurement costs, the installation of this facility was halted. This was principally due to the success of the decontamination/SCO methods for glovebox dismantlement, continued improvement in manual size reduction facilities such as the use of plasma arc cutting, and improved work skills that resulted in better contamination control. Additionally, there were concerns that benefits of the robotic system, less worker exposure and faster size reduction for standard parts, would not compensate for substantial startup and debugging time and costs and the reduced flexibility for non-routine activities. Problems already being experienced with the automated Plutonium Stabilization Packaging System also influenced the decision.

Technology development was most successful when the Project initiated it to solve one of their problems and with Project buy-in and cost sharing.

Technology Development Approach

There were several factors that the Site considered when it evaluated how to approach technology development:

- Technology development was most successful when the Project initiated it to solve one of their problems and with Project buy-in and cost sharing. It was least successful during accelerated closure when initiated by a technology development organization (a solution looking for a problem).

- Evaluation of technology options must involve active participation of workers at the foreman level or below – even if a technology works, if there is no buy in from the workers, then it will not be used effectively.

- Incremental improvement, mostly with off the shelf items, yielded large benefits in increased productivity. Often one good idea leads to another – if management is open to the continual, incremental improvement.

- Employing contractors with specific expertise, such as for characterization or decontamination (perhaps with a contractual capability to transition to Site staff at some later date) is preferable to developing technology in-house.

During planning a number of "intractable" problems – activities for which there was no clear approach – were identified, such as clean-up of vaults with extremely high levels of airborne contamination. Technology development was initiated to investigate several technologies at once, using DOE Office of Technology Development funding support. The development timelines were evaluated to ensure that the candidate technologies would be available in time to be used – fortunately no completely undeveloped technology was needed.

Technology Development Practical Applications

Specific technology development activities are briefly described below and in more detail under Section 12, Technology Development. The Technology Development section contains references additional documents providing more detailed descriptions of the topics.

Plasma Arc metal cutting – Plasma arc torches were used to cut sheet metal in size reduction. Depending on the material to be cut (metal thickness, contamination level), sometimes the costs of the additional safety requirements and contamination cleanup were not worth the increase in cutting speed. Also, the plasma arc traded reduction in worker skin contamination and repetitive motion injury risks, for increased fire and contamination spread risks. Considerable effort was required to develop an adequate authorization basis to allow the system to operate. Plasma arc was used effectively to cut up massive in-glovebox equipment after addressing safety concerns.

Fogging – Fogging uses an aqueous solution of soluble materials (e.g., glycerol) that is turned into an aerosol and introduced into a stagnant contaminated room or other compartment. The aerosol absorbs and suppresses any airborne contamination, and adheres to all surfaces, mildly fixing contamination even in less exposed areas (e.g., electric motor windings). This technique is extremely useful in reducing "derived air concentration" levels and contamination spread in highly contaminated environments, although fogged contamination may adhere to clothing or booties, potentially spreading (but not significantly re-suspending) contamination. Placing a dye that is visible in ultraviolet in the fog allows support personnel to easily locate places on a worker's protective clothing that have brushed against fogging materials and may be substantially contaminated.

Strippable coatings and fixatives – These coatings are designed to fix contamination in place. Alternatively, certain latex-based coatings can be applied by spray, brush, or roller and, when dry, pulled off the surface to remove surface contamination in a stable, disposable form. The fixatives may be flame retardant to allow safe use of plasma arc cutting. Coatings may be used over fogged surfaces to decontaminate or permanently fix contamination.

Waste estimate tracking – Methods were developed to estimate waste generated during decommissioning activities based on early decommissioning pilot projects. The pilot projects were used to extrapolate waste generation for subsequent building demolition. The initial estimating technique was not very accurate. Although there were some improvements in waste estimation, the estimating process was complicated by the fact that the Site identified methods to decontaminate and dispose of significant quantities of low level waste (LLW) that were originally assumed to require disposal as transuranic waste. Additionally the volume of LLW increased tremendously when the decision was made to demolish several buildings/areas as LLW instead of the original assumption that the buildings would all be decontaminated to allow demolition and disposal as sanitary waste. In cases where the Site chose an alternative decommissioning method that generated more waste, the cost savings in decommissioning worker efficiency usually offset the

The challenge of waste estimating is recognizing when waste estimating assumptions change and adjusting the waste estimates when the project makes a decision affecting them…The more important lesson is to view waste generation and resulting disposal costs within the total project context.

additional waste cost; i.e., the overall project cost was reduced. The method also expedited critical path activities allowing closure acceleration. While not a decommissioning issue, the ER program underestimated the amount of contaminated soil that would require disposal, contributing to the quantity of LLW that required disposal in excess of that estimated. The Site's sanitary waste volumes dramatically exceeded the planning estimates.

The challenge of waste estimating is recognizing when waste estimating assumptions change and adjusting the waste estimates when the project makes a decision affecting them. At Rocky Flats, for several years these decisions to address decontamination issues or increase project efficiency were occurring at a rate and frequency that made it almost impossible for the planners to accurately estimate waste volumes; instead they were usually bounded (even then the assumptions sometimes proved wrong). Ultimately, the waste programs recognized that waste estimates were just that: "estimates" and that the Site would continue to generate and characterize waste until the Closure Project was complete. Only then would a final volume be known. Although the Rocky Flats waste estimation experience may help other sites in their waste estimating process, the variability of waste generation processes at each site limits the applicability of the Rocky Flats experience. The more important lesson is to view waste generation and resulting disposal costs within the total project context.

Property disposition per the DOE Orders, not CERCLA – A decision process was developed to support facility disposition for small facilities. In these cases, it was feasible to treat a facility (e.g., a small trailer) as property and release it for offsite reuse or sanitary disposal. This can avoid excessive characterization costs under CERCLA.

The disposition of uncontaminated real and (government-owned) personal property in compliance with CERCLA and DOE regulations can require an effort out-of-proportion to its nominal risk or overall project importance.

Disposition of personal property – The disposition of uncontaminated real and (government-owned) personal property in compliance with CERCLA and DOE regulations can require an effort out-of-proportion to its nominal risk or overall project importance. A decision process was developed to streamline the government process to dispose of real property.[95,96,200,201] It included an initial inventory that identified and verified the location and contamination status of all Site personal property. Negotiations on property disposition requirements were held with the General Services Administration. As a result, the valuation of contaminated property took into account the cost required to decontaminate it. In practice, the value of most property resulted in a net of no value – it was waste and could be taken off the books. Finally, a congressionally authorized "pilot project" allowed the revenue from the sale of government-owned personal property at Rocky Flats to be applied to cleanup effort. An aggressive program of matching high-value (typically weapons-mission) equipment with the needs of other DOE sites provided additional value to the department.

InstaCote for packaging of large equipment – A method was developed to place large pieces of contaminated equipment on metal pallets, fix and shrink-wrap the equipment, and then use a multi-coat durable spray coating to serve as a "strong, tight container" for disposition of low level waste.

Raschig Ring removal – A critically safe vacuum cleaner system was developed to allow removal of raschig rings used for criticality prevention from tanks, avoiding handling of highly contaminated glass shards.

Chipless Duct cutting – Tooling was developed to cut round process system duct using rotating blade system similar to a tube cutter. This resulted in substantially easier duct removal with reduced contamination spread.

Facility Characterization improvement – Procedures and analysis techniques were developed to conduct MARSSIM-compliant facility surveys to allow unconditional release of facilities. The processes include streamlined paperwork and sample plan development, data collection that downloads survey data directly to databases, and automatic scanning equipment for areas that require 100% scanning.

Explosive Demolition and Equipment Dismantlement – Controlled explosive charges have been used both to knock down buildings and also to create "harmonic delamination," cracking structures and substantially increasing the efficiency of conventional construction equipment in building demolition. Controlled explosives have also been used to dismantle equipment (e.g. drop ducts suspended near ceilings to the floor to avoid extended elevated work). All explosives use was in non-contaminated environments. Substantial effort was exerted to achieve public acceptance, and widespread application was limited by the additional safety and planning steps necessary to use explosives for whole building demolition.

Personnel Incentives

There was an early recognition that most of the Closure Project critical activities involved process system equipment removal, and that this would be done by Site bargaining unit staff (i.e., the Site Steelworkers) that would be retrained for that purpose. Real concern existed about the willingness of individuals to change from operators to D&D workers and to accelerate work that would result in more rapidly putting them out of a job.

The issue was addressed in a global fashion by trying to align the interests of the workers with that of K-H and the DOE… liberal use of overtime, improving the effective rate of pay for the Steelworkers… Several methods were used to provide increased compensation for D&D worker supervision, who were made directly accountable for the decommissioning activity schedule.

The issue was addressed in a global fashion by trying to align the interests of the workers with that of K-H and the DOE. This was done in three ways. First, the contract was renegotiated to delineate between Steelworker and Building Trades crafts based on level of contamination (e.g., 2,000 dpm-alpha) instead of the normal Davis-Bacon divisions. This allowed the workers best trained for higher radiological work and those best trained for construction equipment to be appropriately placed, and also ensured that the Steelworkers would move from building to building as the Closure Project progressed, ensuring their jobs as long as higher radiological hazards work remained. Second was the liberal use of overtime, improving the effective rate of pay for the Steelworkers. Third, the Steelworkers received an annual incentive bonus based on schedule performance, and there were considerable spot bonuses provided at completion of specific activities, ranging from items such as dinners to cash awards of several hundred dollars, given often. In addition to the Steelworker staff, it was recognized that the D&D worker supervision was critical to achieving the required acceleration. Several methods were used to provide increased compensation for these staff that would be directly accountable for decommissioning activity schedule.

Although not exactly a personnel incentive, the Site supported personnel outplacement as work in certain job categories decreased. In the case of the Steelworkers this included assistance in moving into Building Trades unions to do Rocky Flats decommissioning work as Steelworker work was diminishing. This program involved in excess of 150 Steelworkers and provided as much as a year of additional employment; many former Steelworkers continue to perform Building Trades craft work at other locations throughout the Denver area.

Other Factors

One consistent theme for the decommissioning Projects, as well as the Site as a whole, was the need to change the culture. While this is discussed in other sections, within the context of decommissioning it is the emphasis on the construction aspects of the work. A number of actions were taken to promote this culture change. In one case Project personnel were moved out of in-building offices into construction trailers. Part of the reason was to free up in-building space for logistics, but more important was to drive home the point that operations were over.

One consistent theme for the decommissioning Projects, as well as the Site as a whole, was the need to change the culture… Consistent with changing the culture was bringing in off-site expertise and attitudes.

Consistent with changing the culture was bringing in off-site expertise and attitudes. This involved the insertion of senior managers with outside experience at the execution project level while retaining substantial Site staff. Staff level personnel with outside expertise were also inserted. This encouraged the introduction of different approaches while taking into account unique Site considerations. Although it took time to achieve a cohesive team, having a single composite Project organization minimized the difficulties of organizational interfaces such as would occur if a number of contractor organizations were used.

The demand for small tooling for the decommissioning execution was much greater than anticipated. Examples are sawsalls, nibblers, lift tables, and engine hoists. Opening up the "supply chain" substantially reduced down time caused by a crew waiting for the right tool. Tool selection was typically a crew decision. Putting in place the procurement and tool inventory was a simple step that became a significant contributor to Project success. In one special case a needed replacement part was flown on a dedicated aircraft from halfway around the world. Although the cost was over $50,000 for what normally would have been a $100 delivery charge, delay time for normal delivery would have exceed several million dollars. This holistic view of the Project and work crew needs was repeated in less dramatic fashion on dozens of occasions, and extended to selection of personal protective equipment and other "simple" worker preference items. Getting the right tools to the workers in as quick and easy a manner as possible became part of the basic support approach that increased the efficiency and morale of the workforce.

KEY SUCCESS FACTORS

1. The Site recognized in the planning process that the plutonium facility decommissioning would be the bulk of the post-Closure Contract effort and key to overall Closure Project success. It implemented an organization to focus on executing that work.

2. Pilot projects are necessary early on to develop and train staff and facilitate development of procedures, methods, and estimating parameters, and development of working relationships and processes with regulators and stakeholders.

3. Guard against the complexity of the work causing inaction. Minimize studies to determine the "best" approach. Develop a credible plan with best available information, proceed with work safely, and learn by doing, with a bias toward continuous improvement.

4. Weed out competing priorities that are not mission-oriented.

5. Glovebox decontamination is useful because it reduces cost and increases safety due to less cutting. Other benefits, such as less cost to

manage LLW vs. TRU, are collateral benefits, not the principal drivers. Several different approaches were used to get to the goal; the ability to achieve LLW classification is dependent on historical glovebox service.

6. Manual size reduction of plutonium-contaminated equipment is dirty work with significant occupational safety risk. Its redeeming virtue is that people are very flexible in handling different material configurations (as opposed to robotic or automated processes).

7. Decisions to use in-house staff vs. fixed price contracting depend on how similar the work is to routine construction, (including Site-specific requirements like a “beryllium program”) and whether traditional construction accident rates are acceptable. As the work becomes less standard, disadvantages like supplemental training, commercial vs. Site safety practices and learning curve inefficiency may outweigh the cost benefit of competitive procurement.

8. Organize for success – projectize based on facilities or areas, not functions, to encourage management focus on closure.

9. Integrate project staff with outside decommissioning expertise and personnel with knowledge of Site processes and infrastructure.

10. An initial problem was too many interdependent decisions, priorities, and schedules that made it difficult to develop a baseline. It just takes hard work and time to get though it. Use outside experience, coupled with Site knowledge, as a template whenever possible.

11. Work the evolution – encourage incremental improvements in efficiency to yield large collective efficiency improvement.

12. Identify “intractable” problems early and begin working multiple paths toward solutions – in some cases the paths may combine.

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Rocky Flats Closure Legacy

Waste Disposition

Achieving a consistent rate of TRU waste shipments (top) was essential to the success of the program. As the project progressed, traffic safety became increasingly complex and important to proactively manage.

INTRODUCTION

During a Rocky Flats public meeting in September 1997, the Assistant Secretary for Environmental Management, Al Alm, committed to no onsite disposal of waste.[97] Although there were no mature plans for onsite disposal of waste at that time, storage scenarios and implementation of a Resource Conservation and Recovery Act (RCRA) Corrective Action Management Unit (CAMU) were on the table as project risk management options. Forecasted waste volumes were based upon incomplete building and soil characterization data, and receiver sites were not lined up for receipt of the myriad Rocky Flats waste forms.

The actual quantities of waste generated were relatively low during the production period and early 1990s and the waste management infrastructure was designed to handle those smaller quantities. There had been extended periods where no waste was shipped to disposal sites, and as a result, the Site had a substantial and growing backlog of "legacy" waste that was poorly characterized. Much of this legacy waste had been scheduled for processing to recover its plutonium during the Site's production mission and contained a much higher plutonium concentration than could be shipped. Inadequate waste storage capacity was a chronic Site issue – early performance incentives in 1996 included measures to remove waste drums that were clogging hallways in the former production facilities. As the closure project became defined in the late 1990's waste generation forecasts exceeded shipping capacity, and waste storage volumes increased even though record amounts of waste were being shipped offsite.

Meeting these challenges was well beyond the capacity of Rocky Flats to solve on its own. Waste (and materials) disposition required a DOE corporate commitment, including the support and advocacy of DOE and contractor personnel at DOE HQ, and at treatment and disposal facilities across the complex. Figure 9-1 depicts the breadth of the project in terms of support provided from other sites.

Ultimately these challenges were met and the Site achieved an unprecedented goal and mission which was given a low probability of success in the late 1990's and early 2000's. All waste was removed from the Site by October 2005, fourteen months ahead of target schedule. Waste forecasting, onsite characterization, storage and transportation, and coordination with offsite treatment and disposal facilities were essential to ensure the timely removal of all wastes. Key innovations enabled process efficiencies and cost savings. Despite the overall success the waste program also struggled with inefficiencies and problem areas throughout the closure project. The experience and lessons, positive and negative, are presented in this section. The waste disposition discussion is organized by waste form since transuranic waste (TRU), low-level waste (LLW), and sanitary waste each posed unique characterization, packaging, transportation and regulatory challenges.

Figure 9-1, Location of Principal Rocky Flats Material Disposition Sites

TRANSURANIC WASTE DISCUSSION

Rocky Flats was one of the first sites to ship waste to the Waste Isolation Pilot Plant (WIPP), and therefore did not benefit from lessons learned from other sites. Early baselines repeatedly showed TRU waste disposal as near critical path due to characterization and transportation bottlenecks, and with little capacity for acceleration either at Rocky Flats or WIPP. The TRU waste program was heavily regulated and proceduralized. Consequently, the certification process, as well as the onsite logistical issues, received senior management attention from the outset.

Whether or not WIPP would be the disposal site for TRU waste was in question prior to May 1999. The TRU waste "storage footprint" became of increasing interest since there was limited capacity for storage of TRU waste, particularly TRU-mixed waste that needed to be stored in RCRA-permitted facilities. Competing pressures included the schedule for demolition of buildings, which required further consolidation of TRU, and the generation of additional TRU from cleanup activities. WIPP was ready to receive TRU waste in May of 1999, and Rocky Flats commenced shipping TRU waste on June 15, 1999.

Generation

Decontamination of gloveboxes reduced safety hazards and TRU waste volume, and improved operational efficiency. At the beginning of the decommissioning process, gloveboxes, tanks, and other equipment had to be size-reduced in order to fit into a Standard Waste Box, a relatively small container specified by WIPP for transportation. Workers had to wear Supplied Breathing Air suits to cut the gloveboxes in a controlled environment. This was a cumbersome, slow, and potentially hazardous operation. The desire to avoid hazards that resulted from size-reduction led to the development of a revised decontamination and characterization method, which allowed most equipment to be shipped as Surface Contaminated Object (SCO) in large LLW containers.

Glovebox decontamination using cerium nitrate and application of the surface contaminated object process allowed equipment to be shipped in large low-level waste containers, obviating size reduction activities, improving worker safety and lowering project costs.

Several decontamination agents were tested. Cerium nitrate, a water-soluble acid, was selected as the preferred decontamination solution. It was liberally applied to the interior tank and glovebox surfaces in a process that transferred removable contamination to wipes, which were disposed of as TRU waste in a much smaller volume. Following neutralization and surveys, the process was repeated as necessary, and if decontamination was successful, surfaces were fixed and the component was disposed as LLW. The "SCO process" reduced the TRU waste volume to be disposed of at WIPP, and consequently increased the volume and cost of the low-level mixed waste (LLMW) disposal. The net result was that the SCO process reduced total project cost, and improved efficiency and worker safety.

Characterization

Before TRU waste could be shipped, it was essential to create and maintain an effective Quality Assurance and Self-Assessment program and to demonstrate the program's proficiency to the Carlsbad Field Office (CBFO), the Environmental Protection Agency, and the State of New Mexico Environmental Division (NMED). During the period from July 1997 through April 2005, thirty five (35) audits and surveillances were conducted by CBFO, EPA, and NMED at Rocky Flats. An additional four comprehensive audits were conducted by the Office of the Inspector General and the General Accounting Office during the same period. Characterization and record-keeping requirements were extensive.

Some characterization equipment was inadequate to sustain a high rate of TRU waste shipping, and assay of TRU waste was a logistical concern from the beginning of the project. Also, TRU characterization equipment was located in various buildings across the industrial area, resulting in multiple inter-building drum movements during the characterization process. TRU waste containers were moved out of the high-security Protected Area for real-time radiography, then transported back inside the Protected Area to be assayed, repacked, or gas sampled, then back outside to the shipping facility for final characterization prior to being shipped to WIPP.

Load management remained a challenge through the entire shipping campaign including issues of weight, wattage, and waste profile.

One substantial improvement in the characterization process was the use of Visual Verification (V2) to verify TRU container contents instead of Real Time Radiography. The V2 was only suitable for newly-generated TRU and required substantial training, certification, and discipline at the point of generation to implement. However, its use avoided substantial container movement and the scheduling, handling, and quality assurance associated with Real Time Radiography.

The Site created a TRU waste management complex, placing characterization, staging and shipping facilities within the same authorization basis and administrative boundaries, and outside of the Protected Area. This consolidated characterization equipment at the waste storage and shipping location and reduced the number of onsite drum movements. Waste characterization was prioritized and managed to support closure objectives. Readily characterized wastes were given priority. Waste characterization activities were systematically planned to ensure that an inventory of shipment-ready containers was always available to support the maximum utilization of transportation resources. Other wastes were given priority if stored in facilities slated for early closure.

The Site created a TRU waste management complex, placing characterization, staging and shipping facilities within the same authorization basis and administrative boundaries… consolidating characterization equipment at the waste storage and shipping location and reducing the number of onsite drum movements.

<u>Shipping</u>

The shipping capability was initially insufficient to meet project needs. Building 664 was the only shipping facility available and could sustain no more than seven shipments per week. Building 664 also experienced frequent down time due to equipment failure. TRU waste would end up on the project critical path if the bottleneck was not addressed. In 2001 a high bay was added to Building 440, adding two TRUPACT II container loading facilities, and enabling the number of weekly shipments to increase substantially. This new capital construction was controversial for a site undergoing accelerated closure. However, this investment paid off since it supported a sustained shipping rate of 15 shipments per week, and the TRU waste shipping campaign was completed in the spring of 2005, seven months prior to physical completion of the cleanup.

The limited availability of characterized waste meeting WIPP waste acceptance criteria was a second limiting factor to achieving the necessary shipping rate. Consolidation of characterization processes into one central area assisted with this problem, but load management remained a challenge through the entire shipping campaign, including issues of weight, wattage, and waste profile.

The TRU waste program is built for consistency, not for speed, and consequently it is important to meet project shipping goals, and difficult to make up for shipments once they are missed.

A third issue affecting the shipping campaign was the availability of a sufficient number of TRUPACT IIs. The DOE did not plan for having all generator sites ship to WIPP at the same time and WIPP planning forecasts continually showed a shortage of TRUPACT II shipping containers to meet the total EM complex need. Fortunately, the inability of other sites to meet their shipping projections made additional shipping resources available. Ensuring that there was sufficient characterized, shipment-ready inventory allowed the Site to take advantage of this availability when it occurred. For several years Rocky Flats consumed most of DOE's available TRUPACT II shipping resources to meet its GFS&I requirements under the closure contract.

Year	Shipments
1999	23
2000	53
2001	205
2002	497
2003	462
2004	638
2005	167

Figure 9-2, Transuranic Waste Shipments

Note: A total of 15,137 cubic meters of TRU waste was disposed at WIPP when the project was completed.

TRANSURANIC WASTE KEY LEARNING POINTS

1. The TRU waste program is built for consistency, not for speed, and consequently it is important to meet project shipping goals and difficult to make up for shipments once they are missed.

2. A systems approach – generation, characterization, packaging, and transportation – must be established up front to ensure maximum efficiencies are achieved.

3. Record keeping and robust quality assurance is vital for the TRU program, and requires extensive planning and active management.

4. Under the best of circumstances TRU waste disposal is extremely expensive for EM. Aggressive decontamination and packaging approaches such as SCO should be pursued to reduce the amount of TRU for disposal.

5. Closure contracts that commit corporate DOE resources should consider how to ensure the availability of those resources. Without the excess capacity that materialized when other sites were not ready to ship, DOE would have fallen short of its GFS&I commitments and likely delayed the project completion.

LOW LEVEL, MIXED, AND ORPHAN WASTE DISCUSSION

<u>Generation</u>

The original baseline LLW forecast volume was 184,475; the revised baseline was 413,000 cubic meters and the actual volume was 594,000 cubic meters. Several factors contributed to the low baseline estimate. Initial plans were for generators to provide extensive decontamination of building structures. This turned out to be inefficient and impractical, as well as a safety concern, especially for some of the older buildings. Consequently, large volumes of waste were generated later in the project from buildings that were originally expected to be decontaminated, but underwent contaminated demolition instead. In fact, about 50 percent of the total project LLW was generated and shipped in the final year.

About 50 percent of the total project LLW was generated and shipped in the final year

Another factor contributing to increased LLW volumes was bulk packaging inefficiency. The Kaiser-Hill Material Stewardship project, which managed all project-generated waste, maintained a separate budget for all disposal and treatment activities. Generators had no direct incentive to provide efficient packaging, as there were no cost ramifications to the generating project. When generated waste volumes exceeded estimated and budgeted volumes, shippable accumulations were carried over to the next fiscal year. This delayed the Site's ability to tackle certain critical path activities, such as the disposition of legacy wastes in storage areas, until late in the project.

On-site generators had no direct incentive to provide efficient packaging, as there were no cost ramifications to the generating project.

During early decommissioning projects waste was packaged into crates and drums with some of the inefficiencies described above. To address the inefficiencies the decommissioning projects began disposing of almost all of their LLW in larger containers –initially cargo containers and intermodal containers and ultimately railroad gondolas. The larger packages reduced worker risk by limiting size-reduction operations and reducing container handling and manual container movement. It also increased waste management efficiency due to fewer of packages generated, inspected, certified, marked, labeled, and shipped; and reduced waste package commodity procurement, inspection, and storage.

The use of larger packages required the successful implementation of Low Specific Activity (LSA) and SCO characterization programs (see the Technology Development section). Bulk packages would likely exceed DOT A2 limits, necessitating the need to take LSA/SCO package exceptions under DOT regulations. Implementation of LSA/SCO programs promoted waste characterization prior to packaging, placing greater emphasis on the generator's responsibility for characterizing waste.

Implementation of LSA/SCO programs promoted waste characterization prior to packaging, placing greater emphasis on the generator's responsibility for characterizing waste.

There were some disadvantages. Since the cost of waste disposal is usually based on the volume of the waste, the more material (i.e., weight) that can be packed in a container (i.e., volume), the lower the cost of disposal. The volume per unit weight increased about 25% as the Site used cargo containers instead of 4'X4'X8' waste boxes, resulting in greater disposal volume and cost. However, this increased cost was only when waste management was viewed separately. The man-hour savings from size reduction tasks that were completely avoided more than made up for the increased waste cost, so the total project cost and schedule were reduced. There was also a greater industrial safety risk due to heavy lift equipment, heavier suspended loads and a potential for injury during loading. However, the safety record for these heavy lifts was very good, and repetitive motion injuries and punctures from size reduction were avoided.

Characterization

The development of the SCO process and development of an SCO database as a waste characterization method resulted in huge characterization efficiencies. This was due to the ability to eliminate total item assay as the required method for radiological characterization. This allowed the use of larger packages, as well as a more efficient means for providing a radiological determination.

Rail Shipment

For most of the project, shipping of LLW was conducted by truck transport. This was preferable in the early phases of the decommissioning, when waste volumes were small and flexibility was important. As the project progressed to larger quantities, mainly due to the demolition of contaminated facilities and ER activities, it became clear that truck shipments involving reusable containers (e.g., intermodals) would not be efficient. Demolition of the larger facilities provided an opportunity for point-of-generation shipping that justified the expense of expanding onsite rail lines. Rail spurs were constructed beginning in 2004, extending existing lines to areas adjacent to Building 776 and Building 371. Other precursors to rail shipment were the development of Authorization Bases (ABs) that would allow open air work with bulk contaminated materials and regulatory approval (achieved through the implementation of selected RSOP).

Rail shipment removed approximately 5,000 trucks from the highway and saved about $27 million over the later phases of the Closure Project.

Rail shipment removed approximately 5,000 trucks from the highway and saved about $27 million over the later phases of the Closure Project. Each railcar can hold as much as 100 tons of waste, the equivalent to seven trucks. Also, larger containers allowed workers to spend less time size-reducing large pieces of equipment, building structural elements, and rubble with significantly less exposure to safety hazards[100].

Treatment and Disposal Sites

Rocky Flats principally used two waste disposal sites for its LLW – DOE's Nevada Test Site disposal facility (NTS) and the Envirocare of Utah (Envirocare, now called Energy Solutions) commercial disposal facility. Initial planning favored NTS for LLW disposal since it could accept wastes with activity levels greater than 10 nCi/gm (and less than 100 nCi/gm) which were above the levels acceptable under Envirocare's Waste Acceptance Criteria (WAC). Also, the disposal cost per volume was nominally less at NTS than at Envirocare.

Over time, the commercial treatment and disposal site's greater flexibility and responsiveness overcame the initial cost differential between them and the DOE-owned and DOE-operated facilities.

Over time, the commercial treatment and disposal site's greater flexibility and responsiveness overcame the initial cost differential between them and the DOE-owned and DOE-operated facilities. Rocky Flats continued to use NTS for disposal of its LLW that was packaged and greater than 10 nCi/gm. However, particularly for its lower-activity bulk waste, Envirocare's lower disposal fees for mixes of different waste materials (e.g., soil and debris), its willingness to negotiate lower fees in exchange for quantity guarantees, and its lower transportation cost (particularly by rail) resulted in a lower actual disposal cost. Additionally NTS required a rigorous set of programmatic controls to ensure waste was acceptable for disposal. Envirocare depended upon specific characterization of waste to provide evidence that WAC was met. Consequently, administrative errors caused delays in shipments to NTS, whereas this was seldom the case for Envirocare.

As the project progressed Rocky Flats also learned that NTS was less flexible in adapting their operations to accommodate Site efforts to improve disposal efficiency. For example, Rocky Flats wanted to dispose of several very large pieces of equipment without size reduction. NTS was unable to accommodate this request. NTS was also unable to accept large volume shipments of intermodal containers and rail cars. Envirocare was much more flexible and was able to accommodate both requests, saving the project substantial effort and cost.

The WAC at the TSCA Incinerator in Tennessee was very restrictive and the process for gaining acceptance of waste at TSCAI was very cumbersome, often requiring senior management intervention. The lead time for gaining TSCAI acceptance for shipment of waste was six to twelve months, partially as a result of aggressive oversight by the State of Tennessee. In contrast most commercial sites required lead time of about one month.

These orphan issues were some of the most problematic issues from a closure project perspective because they existed at the confluence of technical, regulatory, political, and administrative processes.

<u>Orphan Wastes</u>

In the mid- to late-1990s the Site identified certain mixed waste forms that had no approved treatment and/or disposal pathway. The predominant population in this category was the >10nCi/g LLMW. Neither DOE's Hanford nor NTS were able to provide a disposal path (except for about 500 55-gallon drums disposed at Hanford in the few weeks it was available). Others, predominantly the organic and mercury contaminated radioactive wastes, were "treatment orphans." Facilities permitted to treat the organic component of these wastes were not licensed to handle radioactive waste.

Early in the project, orphan wastes existed in the shadow of more pressing special nuclear material (SNM) packaging and disposition issues. But as these SNM issues were resolved, orphan waste treatment and disposal gained visibility as a critical issue. Orphan waste issues were some of the most complex from a closure project perspective, because they required the negotiation of technical, regulatory, political, and administrative processes. All orphan wastes were placed on a tracking system, regardless of the volume or number of containers. The status of treatment and disposal options was reported routinely at the DOE headquarters level to provide visibility. Because of the myriad factors affecting the disposition of orphan wastes, it was essential that actions and responsible parties be clearly identified. DOE shared responsibility with K-H for the availability of disposal sites as a Government Furnished Service/Item.

Prior to the Closure Project, nearly all LLMW waste was treated or planned to be treated with onsite facilities and processes. As the project progressed, the philosophy shifted to using offsite commercial treatment facilities to provide LLMW waste treatment. This resulted in significant cost savings as the commercial vendors enjoyed an economy of scale by treating waste from multiple DOE sites. Commercial sites also had greater flexibility to accept waste, as most have comprehensive permits and a greater ability to adapt and adjust.

As the project progressed, the philosophy shifted to using offsite commercial treatment facilities to provide LLMW waste treatment.

DOE and K-H developed several strategies to treat and dispose of the orphan waste stream consisting of >10 nCi/g radioactive mixed wastes. The Site developed an agreement with NRC-licensed Envirocare that spelled out essential and applicable requirements consistent with an anticipated revision to the NRC Branch Technical Position on Concentration Averaging[101]. DOE did not prohibit mixing greater than NRC Class A waste with NRC Class C waste. And the NRC issued a guidance interpretation that allowed mixing wastes from different classes (i.e., mixing Class A with Class C) for purposes of meeting a TSDF WAC for sites undergoing closure. As such, Envirocare could offer bulk consolidation, co-processing, and disposal of Class A and Class C LLMW. Such consolidations were arranged so that limitations of the Branch Technical Position and Envirocare's SNM exemption criteria were satisfied. This resulted in the disposal of over 1,500 m^3 of LLMW that would otherwise have become orphaned due to activity at levels greater than permitted under the WACs of Envirocare or other LLMW disposal sites.

Bulk consolidation resulted in the disposal of over 1,500 m^3 of LLMW that would otherwise have become orphaned due to activity at levels greater than permitted under the WACs of Envirocare or other LLMW disposal sites.

One particular issue that caused ongoing problems was the identification, collection, and disposal of excess chemicals. There were numerous instances of legacy chemicals, many with hazardous, oxidizer, or even explosive characteristics that continued to be discovered as Site demolition proceeded, despite a comprehensive excess chemical disposal program that began in the mid-1990s. Chemicals that were radioactive or retrieved from radiologically controlled areas, while small in volume, were extremely expensive to dispose of, one of the most extreme examples being one truckload costing over one million dollars. Two final types of material, lab returns and sources became a problem in 2005, not because they were inherently difficult to dispose of but because the waste management infrastructure was being reduced and disposal of these materials had not been properly anticipated and planned.

<u>Internal requirements</u>

The rigorous AB and Site Safety Analysis Report (SAR)[62] requirements that were established for all LLW and LLMW waste management activities conducted on the Site often led to difficulties in managing the LLW and LLMW waste population. These requirements were not consistent with the very low level of risk associated with the extremely small quantities of packaged nuclear material contained in LLW. Waste Facility ABs were not well matched to the needs of the storage and shipping operations. For example, some facilities allowed filter changes or recognized the potential for encountering a pressurized container, while others did not. These inconsistencies resulted in additional container movements to transfer wastes to facilities where these functions could be performed.

The Justification for Continuing Operation (JCO)[99] process required to remediate a single potentially pressurized container was slow and failed to deliver timely risk reduction. For example, in one case the hazard posed by a single suspect pressurized container was not remediated for three months due to the JCO process. It was fortunate that only one pressurized drum was discovered.

Adopting the requirement that onsite shipments must conform to DOT requirements placed unnecessary restrictions on certain onsite movements, with minimal benefit to safety. This requirement was a carryover from the production era when pits and special nuclear material benefited from the additional rigor of the DOT requirements. However, for LLW the efficiency of moving packages through the process of preparation for shipment was usually hindered rather than helped by the DOT requirement.

Adopting the requirement that onsite shipments must conform to DOT requirements placed unnecessary restrictions on certain onsite movements, with minimal benefit to safety.

Finally the Site criticality safety program required that items containing more than 15 grams of enriched uranium (>0.72% U-235) be managed under a criticality safety program (compared to 250 grams of plutonium). This required criticality safety operating limits, infrastructure, alarms, and procedures that were inconsistent with the risk posed by the materials.

<u>Legacy Waste Disposal</u>

At the start of the Closure Project the Site had approximately 12,000 containers of “Legacy Waste” that required disposition. This waste had been generated prior to the cleanup mission and characterized and packaged using a variety of criteria. The NTS requirements for the Site to demonstrate that a waste meets all of the rigorous NTS programmatic requirements when generated could not be met using the available data. The Site originally planned to repackage the entire population of legacy waste to ensure that every package fully conformed to the NTS programmatic requirements. As it evaluated alternatives the Site realized that the flexibility of the Envirocare WAC could allow a reduction in the repackaging of legacy wastes, since Envirocare placed greater emphasis on waste measurements and characterization rather than on production records. Although NTS waste disposal costs were nominally less, the extensive efficiency and safety improvements that resulted from the reduction in repackaging significantly streamlined and accelerated the disposition process and justified the decision to ship legacy waste to Envirocare.

LOW LEVEL, MIXED, AND ORPHAN WASTE KEY LEARNING POINTS

1. Criticality control programs need to set limits on accumulations of enriched uranium for decommissioning that are generally consistent with the DOT fissile exception requirements.

2. Hazard control criteria based on specific activities greater than 100nCi/g do reduce risks since specific activity does not contribute to risk. Controls should be based on Material at Risk mass values, consistent with DOE STD 1027.

3. Adopting DOT regulations for intra-site movement of waste packages should be closely examined for cost vs. benefit when such movement does not introduce the waste into public commerce.

4. ABs that address the progressive reduction in risk as facilities transition down in Hazard Classification 2 (non-reactor) to 3 etc., should be developed in advance.

5. Operational Readiness requirements should formally relax as facilities transition to lower Hazard Classification. As with AB documents, the life cycle of Operational Readiness Review requirements and rigor can be developed in advance.

6. Better estimate tools for predicting waste volumes are needed. In nearly every case, waste volumes produced exceeded previously estimated quantities, sometimes displaying multi-fold increase.

7. Load management techniques should be adopted in a timely manner to facilitate using WIPP for certain problematic LLMW waste types (e.g., 801s wastes). This adds a tool that increases flexibility and potentially lowers cost and risk.

8. Commercial treatment and disposal facilities were generally easier to work with, especially for innovative treatment or disposal approaches. When administrative delays and other factors were included in the cost comparison, commercial facilities could also be less expensive.

9. Larger waste packages that allow the disposal of bigger pieces of equipment and reduce size reduction can increase waste disposal volumes and costs, but can significantly decrease overall project cost and schedule, and improve safety.

SANITARY WASTE DISCUSSION

Sanitary waste disposal (which includes uncontaminated demolition debris) became a larger element of the closure project than originally anticipated. During the original waste estimating process the identification of sanitary waste quantities was an afterthought due to its relatively lower disposal cost and infrastructure (compared to radioactive waste). There was no systematic definition of exactly what materials would become waste, the ultimate scope of the effort was unclear, and much of the material was assumed to be available to recycle. Since items such as steam piping, roads, parking lots, etc. were never assigned a facility number there was no inventory from which to work. The 2000 Closure Project Baseline forecasted 66,000 tons of sanitary waste.

Sanitary waste disposal was larger than originally anticipated... sanitary waste quantities were an afterthought... There was no systematic definition of exactly what materials would become waste... there was no inventory from which to estimate.

Approximately 575,000 tons was actually disposed, nearly a factor of ten greater than the estimate. Truck shipments were increased from 5-10 per day in 2000 to an average of 130 per day in 2005, with peak days of over 300 shipments. The Site increased staff to mobilize operations, developed procedures, disposal contracts, a communication awareness program, and a tracking database.

<u>Subcontracting</u>

Initial offsite disposal was with a single landfill operator, which limited competition and was a single point failure for any landfill shutdowns.
Due to the increased volumes of sanitary waste, contracts were initiated with a second landfill, and later with a third. This resulted in a lowered disposal unit rate and a 24/7 disposal capability, which benefited some project operations. A local friable asbestos disposal capability was obtained, resulting in approximately one million dollars in savings. The third landfill was located within five miles of the Site, which cut in-half the transportation cost to the more distant landfills and also halved the daily number of trucks required. Contracts with asphalt recyclers avoided approximately two million dollars in asphalt disposal fees. Adding hauling contractors and renegotiating with existing contractors lowered sanitary waste transportation unit costs by approximately 40 percent. Using multiple contractors also improved the ability to obtain the trucks required each day.

Disposal

K-H negotiated with the landfills (and regulators) for disposal of PCB bulk product waste to include fluorescent light ballasts to greatly facilitate and make building demolition safer by avoiding manually removing light fixtures and ballasts.

A local friable asbestos disposal capability was obtained, resulting in approximately one million dollars in savings.

Onsite Requirements

The availability of an installed stationary scale was a great benefit to sanitary waste operations. The system was augmented to include an active radiological scanner and RFID system with electronically completed shipping papers for each shipment. Peak shipments of more than 300 per day would not have been possible without the automated system.

Project Management

From the start, using Conduct of Operations type controls and program management helped ensure clear communications and safe operations. A Plan-of-The-Day (POD) format was used for scheduled sanitary waste shipping work. An effective communication and employee awareness program was important early in the program as waste management changes and offsite disposal was implemented. This helped resulted in fewer incidents of unauthorized waste drop-off and incorrect waste loading. Finally, the identification of waste piles for appropriate management and disposal became more difficult as the sanitary waste loading and disposal activities increased and the Site landmarks disappeared. A GPS system “pile identification” system was implemented to assure that an appropriate level of control was provided for the effort.

SANITARY WASTE KEY LEARNING POINTS

1. As with the other waste forms, sanitary waste needs better quantity estimating tools. Sanitary waste was particularly challenging because some infrastructure sources of waste (roads, parking lots, etc) were not catalogued.

2. Continuous effort to negotiate with new haulers and disposal vendors can lower costs, expand disposal options, and improve operational flexibility.

3. Onsite supervision by trucking contractors ensures activities are completed and is useful for dealing with truck and driver issues.

4. Truck and container damage should be expected. A higher incidence of container damage was experienced in the first years of the project as loading operators were becoming familiar with the equipment.

5. For tracking onsite work (such as Davis-Bacon), establish a driver tracking matrix linked to the waste disposal database along with the shipment software (ATMS or Smart BOL). Automated systems add substantial efficiency that justifies the initial investment.

6. In the latter stages of the project, waste piles approved for disposal became difficult to identify due to loss of landmarks. A more robust tracking or identification system was warranted.

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ROCKY FLATS CLOSURE LEGACY

ENVIRONMENTAL RESTORATION

THE PRESENT LANDFILL WAS ONE OF 360 AREAS OF ENVIRONMENTAL CONTAMINATION THAT REQUIRED INVESTIGATION AND DISPOSITION. ABOVE, WORKERS INSTALL A GEOSYNTHETIC LINER AND SOIL COVER. OTHER TECHNOLOGIES USED AT THE SITE INCLUDED THERMAL DESORPTION OF VOCS IN SOILS, EXCAVATION AND REMOVAL OF SOILS, INJECTION OF HYDROGEN RELEASING COMPOUND TO ACCELERATE CONTAMINANT DEGRADATION IN-SITU, AND PASSIVE-REACTIVE GROUNDWATER TREATMENT CELLS USING ZERO-VALENT IRON FILINGS AS THE TREATMENT MEDIA.

INTRODUCTION

The Rocky Flats Site after closure was envisioned primarily as open space with minimal infrastructure, including the complete removal of the central area of nuclear weapons-manufacturing buildings. However, the path to realization of that vision was not clear. Many interrelated decisions had to be made before most closure tasks could begin. While Environmental Restoration (ER) is integral to successful Site closure, ER is different from other Site closure activities because ER projects had been underway for many years. It was also the most closely controlled scope by external regulators, and had the most public awareness and historical involvement.

The scope of the ER Program encompassed all soil, surface water and ground water remediation at the Site and included removal and remedial actions of buried waste drums, contaminated soil and other buried waste; and closure of waste storage and disposal sites such as pits, trenches, impoundments and landfills. The ER Program included the investigation, remediation and closeout of Potential Areas of Concern (PACs) and Individual Hazardous Substance Sites (IHSSs) at the Rocky Flats Site. There were over 350 PACs including over 175 IHSSs at the Site. These sites contained chemical, hazardous, toxic, radioactive and mixed wastes. Some of the sites have released contaminants to soil, ground water and surface water. Some of the PACs and IHSSs were closed as No Further Action (NFA) sites after investigation.

The historical waste sites and ER activities were regulated by both the Colorado Department of Public Health and Environment (CDPHE) and the U.S. Environmental Protection Agency (EPA), under the Department of Energy (DOE), CDPHE and EPA compliance agreement known as the Rocky Flats Cleanup Agreement (RFCA).[3] RFCA integrates RCRA and CERCLA activities at the Site.

One consistent theme for the ER Program, as well as the Site as a whole, was the need to change the culture.

Much of the success of the Rocky Flats Closure Project has come from defining and organizing the work scope, and from adjusting the organizational structure to facilitate management focus on the critical tasks. The Closure Project itself was organized into six major "Projects" and all closure activities were managed within one of the major projects. Within the Closure Project, ER management activities occurred at three levels:

- Management of the ER Program by DOE, including both the Rocky Flats Field Office (RFFO) and the Headquarters Program Office.
- Management of the Remediation, Industrial Area D&D, and Site Services (RISS) Project.
- Management of the ER Project.

During the decades of weapons component production and operations the Site had been organized and activities budgeted and funded based primarily on weapons production needs within key organizations such as Plutonium Operations and Production Operations, plus Waste Operations, Engineering, and Health, Safety and Environment (HS&E).

Development of Interim Cleanup Standards allowed other closure activities to move forward.

Prior to the mid-1980s, environmental monitoring, analysis, and compliance activities were performed within the HS&E organization. The ER Program was initiated in 1984 as the Comprehensive Environmental Assessment and Response Program (CEARP) under the auspices of HS&E. In 1986, RCRA and CERCLA functions, including the CEARP, were transferred as a separate program office to Plutonium Operations in order to provide higher visibility as part of an operating unit of the Plant. This focus was also necessary to support preparation of the required RCRA Part A and Part B permits, which still garnered the majority of the management attention. In 1988, the CEARP became the ER Program. During those years, most of the ER activities were focused on:

Limited, near-term remediation was based on interim cleanup standards and Interim Measures/Interim Remedial Actions (IM/IRAs) in order to move forward on the highest ER risks.

- Identifying historical waste sites.
- Prioritizing sites.
- Performing site characterizations and monitoring including geology, hydrology, sources and plumes.
- Preparing closure and post-closure plans for hazardous waste units to be closed.
- Conducting remedial investigations (RIs), feasibility studies (FSs), and risk assessments.
- Developing a remedial/corrective action program for the high priority sites.

The ER Program included both RCRA and CERCLA projects, and was regulated under the first compliance agreement signed in 1986 by the DOE, EPA, and CDPHE (Colorado Department of Health at that time). The agreement focused primarily on characterization and prioritization of remedial investigation. Following the EPA and FBI raid in June 1989, the Site was listed on the National Priorities List (NPL) in September 1989. This listing served as impetus for a major revision to the tri-party regulatory agreement. The new agreement built upon the information and data collected under the 1986 agreement, but attempted to better structure and organize the work. Signed in February 1991 by the same three parties, the Interagency Agreement (IAG) divided the Site into 16 Operable Units (OUs), identified 178 IHSSs and set 266 enforceable compliance deadlines stretching out over ten years. The ER Program was funded to perform the activities negotiated with the regulatory agencies.

The NPL listing and the new IAG increased the visibility and focus on environmental restoration. Funding increased substantially to support the rigorous schedule of enforceable milestones. In addition to conducting remedial investigations, feasibility studies and risk assessments, which were the primary focus of the IAG, three interim remedial actions, one each for surface water and for ground water contamination control at the 881 Hillside (OU No.1), and one for the 903 Pad Area (OU No. 2), were planned and implemented between 1989 and 1994.

This Environmental Restoration section is divided into four subsections:

1. History and Evolution of Site Closure and an Accelerated Environmental Restoration Program.
2. Key Environmental Restoration Issues, Obstacles and Resolution.
3. Environmental Restoration Success Factors and Key Innovations.
4. Environmental Restoration Key Learning Points.

Have regulatory agencies provide on-site representatives with decision-making authority during field work.

The discussion is focused on elements that address the main ER scope. Because of the integrated nature of many activities of the Closure Project there is overlap with other sections, including *Regulatory Interface*, *Future Site Use*, *End State and Stewardship*, *Stakeholder Involvement*, *Waste Disposition*, *Decommissioning*, and *Safety Integration*.

DISCUSSION

<u>Environmental Restoration Acceleration Strategy</u>

Although the 1991 IAG served to substantially increase ER activities and visibility, the effort was focused primarily on investigation and analysis. Except for the three high-priority interim actions mandated in the IAG (mentioned above), physical cleanup was almost an afterthought. This led to significant frustration from the public, Congress, and DOE Headquarters who saw tens of millions of dollars being expended for a program that "cleaned up" very little. In 1994, the ER Program developed a strategy to accelerate cleanup activities. The strategy was called "An Analysis of the Potential for Redirection of the Rocky Flats Environmental Restoration Program[194]." More commonly known as the "SPIRIT Report", it was published in draft and never finalized, but was widely shared and discussed with stakeholders and generally received favorable comments. The strategy revised the ER approach to improve cost efficiencies and accelerate scheduled projects. The revised approach included the following key features:

- Regroup OUs and IHSSs to achieve efficiency including integrating the Industrial Area (IA) OUs.

- Focus remedial actions on IHSSs rather than OUs.
- Take early remedial action to reduce risk (e.g., hot spot removals), rather than deferring action until a Record of Decision/Corrective Action Decision (ROD/CAD) is completed.
- Defer remedial actions on low risk IHSSs within the IA and integrate with Site transition and decommissioning of IA buildings.
- Perform limited field investigations to acquire sufficient data to make decisions on early remedial actions.
- Achieve waste storage flexibility by using Corrective Action Management Units (CAMUs) or regrouping of OUs.
- Combine RI/FS phases.
- Streamline National Environmental Policy Act (NEPA), Safety Analysis Reports (SARs) and Site procedures for applicability to ER activities.
- Expedite document approval through team preparation and parallel reviews.
- Have the regulatory agencies provide on-site representatives with decision-making authority during fieldwork.
- Ensure early and continuous stakeholder involvement.
- Integrate storage, disposal, potential end-state land use(s), cost, risk assessment and other systems considerations.

The new strategy pointed in the right direction. Several simple but high profile projects helped prove the validity of the principles. Most workable was a contaminated soil cleanup near the 881 Hillside that had been planned and estimated to cost over $30 million. It was completed under the new strategy in less than a week for less than $100,000. While all ER projects would not enjoy this same success, it showed that real, cost-effective cleanup was achievable. The fact that the RFFO and Contractor had voluntarily brought forth the strategy, rather than being "forced" into it by external regulatory requirements, did much to increase the DOE's credibility. The strategy and revised approach developed in 1994 became the basis for the accelerated ER Program.

The fact that the RFFO and Contractor had voluntarily brought forth the strategy, rather than being "forced" into it by external regulatory requirements, increasing DOE's credibility.

1995 Performance-Based Integrating Management Contract (PBMIC)

With the implementation of the Performance-Based Integrating Management Contract awarded to Kaiser-Hill (K-H)[37] in 1995, greater emphasis was placed on Site Closure. K-H, as the prime contractor, became the "integrating" contractor responsible for overall management and planning. Four major subcontractors with specific areas of expertise were responsible for execution within their scope boundaries: nuclear operations; waste management, environmental restoration and decommissioning; infrastructure; and security services. There were numerous lower-tier subcontractors, typically contracted through the four major subcontractors, which provided specific services or staff.

One of the initial actions after award of the PBIMC was the negotiation and approval of RFCA, which established a new regulatory framework between DOE, the State of Colorado, and the EPA Region 8. Much of what went into RFCA started from the SPIRIT Report principles and experience for what to focus on and how to conduct ER activities. RFCA also established decommissioning as a remedial action, and outlined the major requirements for decommissioning. Despite the approval of RFCA, much effort remained to establish the daily operational details of the new regulatory process, including responsibilities and decision documents. An implementing document, the Implementation Guidance Document (IGD) was prepared as an attachment to RFCA to guide the process. The IGD served as the guidebook for the daily interface between the DOE, contractor, and regulators, and was very important to translate the regulatory intent into everyday behavior.

The 2000 Closure Contract

In January 2000, DOE awarded K-H a sole-source contract to complete the Rocky Flats Closure Project. The principal purpose was to facilitate the accelerated closure of the Site, building on the planning and prerequisite activities that had taken place over the previous few years. The contract contained substantial incentives and penalties for performance, and changed a number of duties and responsibilities between DOE and K-H. A key feature of the 2000 Closure Contract[33] was the responsibility that it placed on both DOE and K-H. One element was risk sharing. While it was a cost-plus contract, K-H assumed the risk to its fee from performance – if cost or schedule targets were not made its fee was impacted, and if safety performance was unsatisfactory then all fee was at risk. DOE assumed the risk of external impacts – the burden of providing disposal or disposition sites (and sometimes transportation), the risk that final soil cleanup standards (Radioactive Soil Action Levels or RSALs) could substantially different from interim cleanup standards.

Characterization of soils under buildings was coordinated with facility decommissioning even while building characterization and decontamination was taking place; soil remediation was scheduled as soon as it was feasible.

The new contract also substantially replaced the multi-tiered contractor concept. One of the first post-contract activities was the K-H reorganization. With the pending reconfiguration of operations and the protected area and a better concept of the overall effort required for closure, it was possible to change the focus of the Site to Decommissioning, and ER and other closure support had to adjust their organizations accordingly. The scope of work was reorganized into six execution "Projects": the four plutonium buildings (771 Project, 776 Project, 707 Project, and 371 Project); RISS for all other facility decommissioning, environmental restoration, and infrastructure; and Material Stewardship, which included plutonium stabilization, waste management and security. Several other support organizations were responsible for business processes, planning and project control, engineering and safety oversight, regulatory compliance, construction support, etc. However, the reorganization placed the responsibility and authority for almost all activities necessary for execution with the Projects, and promoted the project managers to vice-presidents. It divided activities such as engineering, safety support, procurement, project control and similar functions, and redistributed individuals to Projects.

Planning for Site Closure

In the 1990's as the site regulatory and contract frameworks underwent evolution, the ER program was the one most impacted. Several concurrent, and sometimes conflicting, planning processes discussed in more detail in other sections were proceeding: RFCA, the Future Site Use Working Group, the Baseline Environmental Management Report, the Site-wide Environmental Impact Statement, the K-H Accelerated Closure Planning process, and annual Site budget planning. With the signing of RFCA in 1996, which better defined the regulatory framework of closure, the Accelerated Closure Planning process moved to the forefront.

Take early remedial action to reduce risk (e.g., hot spot removals), rather than deferring action until a CAD/ROD is completed.

Initial approaches as the Site began to try to define the path to closure focused on laying out the general activities and trying to prioritize them. As dialogue continued with the regulators and the public, there came to be a general agreement to initially focus discretionary funding on the higher risk nuclear activities, at the expense of decommissioning and environmental restoration. Part was a result of better "bounding" of uncertainties such as the ability to ship waste off-site and an "interim end-state" definition for project completion. The final part was an aggressive Site planning process that included active participation by DOE, EPA, CDPHE, interested stakeholders, and technical and management input from the execution subcontractors to continually refine the closure scope. This included uncompromising management pressure to continually reduce costs and accelerate the schedule. See the *Creating and Implementing a Closure Project*, *Regulatory Framework*, and *Accelerated Closure* sections for additional information on the Site Closure planning process.

Environmental Restoration Execution

Remediation activities began at the Site with investigations and a few accelerated removals in the 1990s. The remediation activities were initially a relatively small component of the closure work, but became a significant feature of Site activity after 2002 through final Site Closure in 2005. The Site environmental restoration program thoroughly investigated and dispositioned 421 historical IHSSs, PACs, and UBCs. Of these, 260 required remedial actions and the rest were classified as no further action. The remedial actions included approximately 100 accelerated actions.

One of the principal and highest visibility actions included the excavation of plutonium-contaminated soil caused by open-air storage of waste drums in the 1950s and 1960s. The "903 Pad", a long standing priority with the stakeholders and the surrounding communities, required the removal and offsite disposal of soil from about an acre to a depth of as much as several feet deep. Adjacent downwind "lip" areas that had become contaminated from windblown 903 Pad radioactivity required the removal of several inches of soil over an area several times as large. Use of a large, moveable tent structure was a very successful innovation for this project. Originally intended primarily to address public contamination control concerns, it served to provide a more consistent work environment for the remedial action workers. Significant improvements in safety and productivity were realized, the project being significantly isolated from the weather. This approach was shared as a lesson learned early on with both staff and managers for the Idaho Pit 9 project.

Other lower profile accelerated actions removed drums and associated uranium and chemically-contaminated soil in several relatively small drum burial sites. The majority of the liquid waste lines were characterized and allowed to remain in place based on the results of a risk analysis. Two historic sanitary (i.e., non-radioactive) waste landfills were capped to meet final closure criteria, the only waste that remains on Site.

Three contaminated groundwater plume barriers, a seep collection system, and associated passive treatment systems were installed and will continue to be operated and maintained by Legacy Management. The systems treat groundwater contaminated with nitrates, uranium, and volatile organic compounds.

The three remedial actions that involved excavation and offsite disposal of contaminated soil resulted in substantially more waste generation than had been originally estimated.

The three remedial actions that involved excavation and offsite disposal of contaminated soil resulted in substantially more waste generation than had been originally estimated. The additional waste at the 903 Pad was the result of deeper than expected excavation in the pad area and unanticipated soil removed from the "lip" area. Several "ponds" downstream of the original radiological liquid waste treatment areas, with accumulated sediments containing low concentrations of plutonium, also required deeper excavation than anticipated. Likewise, the process of "chasing" a plume of carbon tetrachloride resulted in several times the estimated waste volume.

The remedial actions mentioned above could each be their own section due to the degree of documentation. With the exception of some specific lessons-learned material prepared from the 903 Pad experience and horizontal characterization drilling, most of the experience from the dozens of remediation projects is captured in the closeout reports which are part of the administrative record.[195]

ENVIRONMENTAL RESTORATION FEATURES

Risk and ER Remedial Actions

Shortly after the PBIMC went into effect in 1995, the Site developed a revised priority list for ER projects based on risk analysis of all site risks. The risk analysis showed substantially lower environmental risks compared to the nuclear safety risks, resulting in a management decision to postpone or cancel most of the planned ER projects.

Although the regulators generally agreed that the environmental hazards presented lower risk to the public, the lack of ER projects raised both public and regulatory concerns. The concern was that the Site would use all of the money appropriated for the Rocky Flats Closure Project on the other tasks, including decommissioning and bringing down the buildings, and that everything but ER projects would be completed. The public expectation and regulatory concern was that DOE and K-H would demolish the site, then "declare victory" and walk away, and that remediation of soil and water would not get done. The public was particularly concerned about plutonium levels in the soils at and around Rocky Flats.

Remediation decisions could be made in the field using portable analytical instrumentation and mobile labs, which provided real-time analyses, characterization, and delineation of the extent of soil contamination.

Following discussions with the regulatory agencies, and as part of 1996 RFCA, some of the ER projects were rescheduled as a series of accelerated actions. These actions would demonstrate the DOE willingness and capability to see all of the ER work through to completion. The relative risk of the IHSSs was assessed and the IHSSs were prioritized for remediation based on risk. The CDPHE and EPA and the Site approved the priority list in September 1995. The interim remedial actions for priority attention included:

- Excavation, soil removal, and treatment at Ryan's Pit in 1995-1996
- Excavation, soil removal, and treatment at the Mound Site in 1997
- Excavation, soil removal, and treatment at Trenches T-3/T-4 in 1997

- Excavation, drum, soil, and debris removal at Trench T-1 in 1998
- Installation and operation of a passive ground water barrier and treatment cell at the Mound Plume in 1998
- Installation and operation of a passive ground water barrier and treatment cell at the East Trenches Plume in 1999
- Installation and operation of passive ground water barrier and treatment cell at the Solar Ponds Plume in 1999

The use of passive ground water collection and treatment systems is preferred to active systems since the Site will be closed and operation and maintenance of facilities after closure will be minimized as much as possible.

Project Document Requirements

One of the lessons learned from planning and implementation of these remedial actions was that there were an excessive number of documents utilized to plan, approve, and execute an ER project. The Decommissioning projects had the same problem. The ER documentation requirements for a project included:

- The Project Plan (either a PAM or IM/IRA Decision Document)
- Project Management Plan
- Work Plan
- Sampling and Analysis Plan
- Health and Safety Plan
- Activity Hazard Analysis
- Authorization Basis
- Auditable Safety Analysis
- Activity Control Envelope
- ALARA Job Review
- Field Implementation Plan
- Waste Management Plan
- Air Monitoring Plan
- Water Monitoring Plan
- Conduct of Operations Implementation Plan
- Integrated Work Control Program
- Integrated Safety Management Implementation
- Radiation Work Permit
- Training Plan
- Operations Orders
- Work Procedures
- Readiness Assessment

Expedite document approval by using team preparation and parallel reviews.

- Pre-Job Walkdown Checklist
- Pre-Evolution Briefing
- Technical Memoranda
- Closeout Report
- Completion Report
- Lessons Learned Report

Many of these documents were important, even critical to performing a project effectively and safely. However, many of the documents were overlapping, sometimes conflicting, and all of them had to be approved by various organizations and in place before different aspects of work could start.

The ER RSOP for Routine Soil Remediation, was developed for typical soil removal actions. This document, once approved, was used as a standard protocol without the need to repeat each of the long approval steps.

The results of the lessons learned from the ER remediation projects were streamlined project document requirements and a streamlined approval process. One decision document, the ER RSOP for Routine Soil Remediation,[24] was developed for typical soil removal actions. This document underwent public review and comment, and once approved could be used as a standard protocol without the need to repeat each of the long approval steps. Non-routine remedial actions, including ground water remediation and closure of impoundments and landfills still required project-specific decision documents. Another ER RSOP, the Asphalt and Soil Management RSOP,[25] was developed for management of asphalt, excavated and disturbed soil, sediment, debris, and investigation-derived waste. This RSOP supported the significant acceleration of the final site closure steps (removal of roads, parking lots, etc.). Each of these RSOPs incorporated Long Term Stewardship considerations (see the *Future Site Use, End State and Stewardship* section).

Two major Sampling and Analysis Plans (SAPs) were written, one for the Industrial Area and the other for the Buffer Zone. The SAPs underwent public review and comment and were approved by the regulatory agencies. Addenda to these plans were written annually. The annual addenda described specific projects scheduled for the following year. The two SAPS replaced approximately 150 project-specific SAPs.

Programmatic plans and analyses were also developed for other key documents including a Field Operations Management Implementation Plan,[102] Health and Safety Plan,[103] and Nuclear and Criticality Safety Analyses. These plans and analyses were not considered "decision documents" and therefore were not reviewed by the public nor approved by the regulatory agencies. However, they still served as unifying and integrating documentation that facilitated the overall execution of the ER program. Addenda were prepared, if necessary, for each project.

<u>RFCA Action Levels</u>

One of the key ER issues involved the setting of appropriate cleanup standards and action levels for the Site. This issue required several years of discussions because establishing appropriate cleanup standards and action levels depends on the ultimate land use. A working group from DOE, CDPHE, EPA, and K-H was formed to develop a consensus proposal for surface water, ground water, and soil standards and action levels. The proposal, called the Action Level Framework, incorporated comments from stakeholders. The Framework was developed as part of RFCA and incorporated as an attachment.

Ensure early and continuous stakeholder involvement.

The action levels are numeric standards that, when exceeded, trigger an evaluation, management action or remedial action. The RFCA Soil Action Levels (RSALs)[105] were reviewed annually until final RSALs were established and approved. RSALs were based on risk and established for the Industrial Area and the Buffer Zone. Setting interim RSALs allowed interim remedial actions to proceed rather than waiting for final standards to be in place before implementing remedial actions. This approach protected the regulators and the stakeholders since the actions were interim, and if not sufficiently protective could always be followed by a final remedial action. DOE and K-H were also aware of the potential for an additional remedial action, and therefore used a conservative approach in the interim actions to mitigate the risk of having to do a second cleanup. DOE benefited by moving ahead with the Site closure, and the stakeholders benefited by getting a more conservative cleanup than they might have been able to get with final standards.

DOE benefited [from the RSAL approach] by moving ahead with the Site closure, and the stakeholders benefited by getting a more conservative cleanup than they might have been able to get with final standards.

RSALs were established with different "tiers", Tier I and Tier II. Soils with radionuclide levels above Tier I required remediation, soils with radionuclide levels below Tier II could be put back in the ground, while the disposition of soils with radionuclide levels between Tiers I and II was handled on a case by case basis. All of the soil removal actions listed in the Risk and ER Remedial Action section above involved the implementation of different actions based on RSAL levels.

<u>Integration of Decommissioning and ER Activities</u>

Decommissioning Planning was begun to deactivate and decommission two surplus facilities: Building 123, a laboratory facility originally constructed in the 1950s; and Building 779, the Plutonium Metallurgical Laboratory. The Building 123 Project was completed in September 1998 and the Building 779 Project was completed in March 2000. The projects decommissioned the building structure leaving a decontaminated slab. All work below the slab, including any environmental medial characterization, foundation removal or disposition of under-building contamination, was "ER scope" to be left until later. At that time, there was little interaction between the ER and decommissioning projects. As time went on the integration improved significantly.

Plan D&D actions to minimize the generation of ER remediation waste, and coordinate ER waste generation activities to maximize the efficiency of waste transfer and disposal.

Following the decommissioning of Building 123, the ER Program initiated a pilot program to test the use of horizontal drilling to characterize under-building contamination. Following the decommissioning of Building 779, the ER Program (and the Site Integrated Monitoring Program) developed a ground water and building-drain monitoring plan in consultation with CDPHE, the lead regulatory agency for the building. The monitoring plan was attached to the Building 779 Closeout Report as an appendix. Although both of these ER projects were conducted as separate actions from the decommissioning projects, it was a start towards working more efficiently together. At Building 886, horizontal drilling was implemented during the decommissioning of the building.

In 2000, the K-H ER Program developed an agreement with other programs including decommissioning, Waste Management, the Integrated Monitoring Program, and the Analytical Services Division to ensure that appropriate planning and coordination would occur for the benefit of the Site mission. The ER Program assigned representatives to the other groups in order to better plan, communicate and coordinate the projects, including identifying and resolving issues in a timely manner. The agreement included the following requirements:

- Proposed decommissioning actions are consistent with the ER/decommissioning transition provisions described in the Facility Disposition RFCA Standard Operating Protocol (RSOP);[31]
- Proposed decommissioning actions are consistent with the assumptions in the ER Project Management Plan and baseline;[106]
- Proposed decommissioning actions are planned to minimize the generation of ER remediation waste;
- Proposed decommissioning actions are planned in consideration of existing IHSSs, Potential Areas of Concern (PACs), and other soil, surface water, and ground water issues;
- ER waste generation activities are coordinated with Material Stewardship to maximize the efficiency of waste transfer and disposal;
- ER activities are coordinated with the Integrated Monitoring Program to enable maximum use of air, surface water and ground water information and resources;
- ER activities are coordinated with ASD to facilitate characterization, offsite laboratory analysis and data management;
- Decommissioning/ER transition activities are implemented as planned;

- Waste generated from ER activities is shipped from point of generation directly to the offsite disposal location whenever possible; and
- ER closure activities are compliant with surface water protection standards on Site and at the Site boundary during and after final remediation activities.

Coordinate ER activities with the Deactivation and Decommissioning of buildings, and define clear demarcation lines between where D&D ends and ER starts.

Starting in 2000, it became common practice to plan decommissioning and ER work together and collect ER characterization data, including drilling through building foundations, concurrently with decommissioning activities. Planning for the use of decommissioning equipment and structures for follow-on ER remediation projects also became the norm. Developing this integrated approach to planning and communication eliminated surprises and fundamentally enabled the acceleration of closure activities that would come to fruition in the last two years of the Closure Project.

In 2001, Guidelines for the ER/decommissioning interface were finalized. Decommissioning and ER activities were coordinated in order to achieve an integrated process that minimizes risk to workers and the environment, minimizes the generation of remediation wastes, streamlines the overall remediation process and reduces costs. As part of the Guidelines, and the Facility RSOP and the ER RSOP, the demarcation lines between where decommissioning ended and ER started were clarified. Issues that were addressed included:

Emphasize utilization of passive ground water remediation systems to decrease long-term costs for operation and maintenance.

- Building foundations
- Associated structures and tanks
- Closure of RCRA units
- Building and under-building characterization
- Process waste lines
- Other underground piping and utilities
- Depth below grade for completion of decommissioning task
- Depth of soil removal
- Backfilling, site regrading, and revegetation

Despite the success of these guidelines to facilitate integration, problems still developed. Near the end of the project several high americium contamination samples were discovered in upper Walnut Creek. Some quick sampling traced the release back to the location of the former Building 771, which had been decontaminated, demolished, and the hillside regraded and replanted. Investigation later revealed that some water used in decontamination efforts had found its way into formerly clean pipes that had been abandoned underground and not adequately plugged. The water flushed some contamination through the pipe acting as a conduit for contamination to the surface, and thus to the surface water. This event highlighted again the importance of very clear and complete coordination between D&D and ER activities.

Investigation later revealed that some water used in Building 771 decontamination efforts had found its way into formerly clean pipes that had been abandoned underground and not adequately plugged. The water flushed some contamination through the pipe to the surface, and thus to the surface water.

Independent Cleanup Verification

Many of the actions described above helped the ER program to perform ahead of schedule and perform better than regulatory minimums. Despite that progress a number of issues were continuous challenges:

- The public was focused on environmental risks.
- There were differences between public perceptions of risk and results of risk modeling (in general, there was public distrust of risk modeling).
- There was continuing disagreement between competing experts on how to apply risk modeling.
- There were ongoing discussions about the relative risk from contamination in the surface soil vs. subsurface soil and buried contamination, and how to prioritize the cleanup.
- There were concerns that some unknown contamination might be left in the subsurface or that known contamination with unacceptable risk might be left behind.
- There was a long-term community distrust of Rocky Flats that needed to be overcome.

As the closure project was nearing completion the RFPO attempted to address several of these issues by arranging for independent verification of the cleanup. The independent verification effort had mixed success in addressing stakeholder concerns and is described more completely in the *Stakeholder Involvement* section. DOE Order 5400.5, Radiation Protection of the Public and the Environment, also has requirements regarding verification. The RFPO effort identified several topics within DOE Order 5400.5 that were confusing for a cleanup and closure site:

- Verification of residual contamination within authorized limits is required for land being released to the public for unrestricted use. The Rocky Flats land is staying within Federal control by transferring to the Department of Interior and with clear use restrictions as a wildlife refuge. For this circumstance the requirements were unclear.
- The degree of "independence" required for verification is not clear, whether independence relates to methodology, previous work, relationship to contractor, or relationship to the DOE, site or HQ.

- The DOE Order standard is based on limiting dose to the public, while the CERCLA cleanup approach is based on limiting risk to the public. The comparison of these approaches is neither direct nor obvious.
- Regulators were less familiar and therefore less comfortable with the DOE Order approach. They understood their cleanup approach and standards to be more conservative and thus more protective (9.8 pCi/g vs. 231 pCi/g)[209] and were resistant to additional analysis they believed would only add confusion.
- Radiation standards were very difficult for stakeholders to understand even after almost eight years of focused effort at Rocky Flats. The DOE Order approach for verification, which was different from the cleanup standard they had focused on, was not understood and led to skepticism, rather than providing the confidence an independent check should provide.
- “Hot spot” used for radiological contamination has a specific definition and meaning in environmental regulations and DOE Orders, and the definitions may differ. Adding to the confusion, “hot spot” is often misused as a generic term. The majority of the areas sampled with elevated radiological contamination were not “hot spots” by regulatory or DOE Order definition, and thus required no action.
- Land is widely variable in size, nature and extent of potential contamination, and other variables that require significant application of judgment to apply the DOE Order. DOE guidance related to the Order further directs application of judgment to design sampling and verification techniques appropriate to the situation. The broad use of judgment invites disagreement between knowledgeable experts.

From the Rocky Flats experience it is clear that additional work is needed early in the cleanup process to align the appropriate application of DOE Order 5400.5 for sites undergoing closure and releasing land. Additional guidance may be useful as indicated by the topics above, but even more importantly better advanced coordination and communication between the field, Headquarters, regulators, and stakeholders to ensure common expectations and understanding.

<u>Other Issues and Obstacles</u>

There were a number of other issues to resolve and obstacles to overcome as part of Site closure and the acceleration of ER projects:

- The ER scope was initially not well organized for execution of remediation projects and for interface with other closure work.
- Without defined final cleanup standards there were potential large investigation, remediation, and waste treatment and disposal costs.

- A large-scale, costly, and long CERCLA remedial investigation / feasibility study (RI/FS) process was being followed and some investigations involved several phases of plans and fieldwork.
- There were long review schedules and multiple revisions to ER plans and reports by regulators and their subcontractors.
- The regulatory review and approval process was long and cumbersome.
- Certain RFCA provisions could be and were interpreted differently.
- RFCA left final cleanup standards vague and there was continued community concern over cleanup standards.
- There were competing community interests (somewhat resolved with Wildlife Refuge legislation).
- Long-term advocacy groups often dominated the debate.
- The Site needed to maintain some continuity of workforce to achieve safe closure.
- Closure would require integrating commercially-trained staff into the more safety-conscious nuclear environment.

Many of these issues were not unique to the ER program or isolated to those discussions. However, the nature of the Site history and mandated public involvement for ER made the ER program the focus for many broader public and regulatory concerns. The issues were interwoven throughout the ER program and were addressed many times, often with only subtle changes, for multiple projects. The repetitive and persistent nature of some of these issues was largely due to the accelerated approach for closure. Use of interim remedial actions allowed extensive cleanup and risk reduction years earlier than would have been possible under a standard regulatory approach. However, because the actions were interim, it invited stakeholders to continue to champion their issues or agenda throughout the closure project. Resolution of some of these issues has been discussed in this section and other sections. The next paragraphs describe and summarize the resolution of issues in terms of factors and key innovations that facilitated ER success.

Use of interim remedial actions allowed extensive cleanup and risk reduction years earlier than would have been possible under a standard regulatory approach. However, because the actions were interim, it invited stakeholders to continue to champion their issues or agenda throughout the closure project.

KEY SUCCESS FACTORS

1. The Site took advantage of a change in the national regulatory climate and EPA and CDPHE priorities, both of which allowed acceleration to take place.

2. The Site hired specialists from the regulatory agencies and outside environmental groups (in some cases former opponents) to assist in negotiations and in streamlining the regulatory process. This added

credibility to the DOE effort and increased the trust between the agencies.

3. Interim Cleanup Standards[107] were developed as part of the Rocky Flats Cleanup Agreement (RFCA) to allow other closure activities to move forward (e.g., negotiation of the Closure Contract), despite some stakeholders concerns that they would now have limited input.

4. Limited, near-term remediation was based on conservative interim cleanup standards and Interim Measures/Interim Remedial Actions (IM/IRAs) in order to move forward on the highest ER risks. This allowed remediation to take place and time to work towards final cleanup standards in a more inclusive and deliberate manner.

5. The Site minimized the number of internally-required documents and streamlined the decision process (through RFCA) for all regulatory-required decision documents including Sampling and Analysis Plans (SAPs), Proposed Action Memoranda (PAMs), IM/IRAs and the ER RSOPs. The resource savings from this effort were substantial.

6. ER Decision documents evolved to include a "long-term stewardship" component, i.e., a section that identified ongoing actions that would be required after the remedial action was complete. This facilitated coordination with the US Fish and Wildlife Service, which would become more important after passage of the Wildlife Refuge Act.

7. The Site and the regulatory agencies negotiated "trade-offs" for minimal or no remediation at low-risk sites in return for more extensive soil remediation at higher-risk sites, resulting in greater overall risk reduction. This was a classic "win-win" where the regulators, stakeholders, and DOE all benefited.

8. Minimizing potential surface water impacts and achieving surface water standards became the primary water resources-protection goal, adding clarity to the development of other remedial actions.

9. Ground water and deep soil remedial actions were only implemented where there was a potential pathway to surface water.

10. Temporary structures were used to provide weather shelters to allow continued work during inclement weather. An initial justification was that they would provide contamination control for contaminated soil removal and airborne releases at remediation sites. However, as more experience was gained with approaches for contaminated work in open air environments it was determined that (for the levels of

contamination encountered) there was no need for this level of contamination control, but the safety, efficiency, and worker morale improvements more than justified their use.

11. Operable Unit and Individual Hazardous Substance Site (IHSS) characterization and remediation activities were reorganized and scheduled to maximize integration with the other Site closure activities.

12. Characterization of soils under buildings was coordinated with facility decommissioning while building characterization and decontamination was taking place; soil remediation was scheduled as soon as it was feasible. The integration between D&D and ER was vital to overall closure project success.

13. Innovative and commercially-available technologies were used as much as possible for ER projects.

14. Cost-sharing with DOE EM-50 for technology implementation enabled the ER budget to be effectively augmented. Examples include:
    - planning and conceptual design of evapotranspiration covers for closure of impoundments and landfills;
    - design, installation, and monitoring of a passive barrier and treatment system for ground water collection and control at the Mound, Solar Ponds, and Eat Trenches plume sites;
    - an enhanced natural attenuation treatability field study at the PU&D Yard, and
    - the use of "Hydrogen Release Compound.

The Site emphasized the use of passive ground water remediation systems to decrease long-term costs for operation and maintenance.

15. The Site emphasized the use of passive ground water remediation systems to decrease long-term costs for operation and maintenance.

16. Site characterization was closely coordinated with remediation activities to allow almost immediate transfer of lessons learned within the ER program.

17. The Site established a streamlined contracting process with two primary ER contractors; one for characterization and the other for remediation projects.

18. Onsite analytical chemistry and radiological laboratories and mobile analytical instrumentation were used allow real-time analyses and enable characterization and delineation of the extent of soil contamination to proceed concurrently with remediation activities.

19. The Site established a computer-based remedial action decision management system to provide contamination maps quickly and expedite remediation decisions in the field. This was an upfront investment that provided substantial benefit, especially in the final years of site closure.

20. A Site-wide water balance study supported the development of the hydrologic design basis for closure. It included modeling of how the Site-wide water balance would change from existing, operating conditions to closure conditions; predicted potential surface water impacts; and assisted in determining the final configuration of Site drainages.

21. A land configuration study was conduced to provide the engineering data required to design engineering controls and the final site configuration at closure, including consideration of soil erosion and sediment transport, actinide migration, ponds, dams, drainages, and a stable geomorphic surface. This became a very useful and powerful tool for discussions with the regulators and the contractor regarding the Site appearance after closure.

22. The Site developed a RFCA Integrating Decision Document (which later evolved into the Land Configuration Design Basis[109]) that provided the framework, strategy and decisions necessary to achieve the final Site condition. It addressed water quality and protection, the final land configuration, monitoring, long-term stewardship and a comprehensive Site risk assessment in support of the final CAD/ROD.

23. The Site implemented an "ER Documents Team" consisting of DOE-RFFO, EPA, CDPHE, K-H, and sometimes the Fish and Wildlife Service. The purpose of the team was to ensure rapid approval of ER documents such as SAP addenda, RSOP notifications, and documents closing out IHSSs (Closeout Reports or Data Summaries). The team met nominally every two weeks with a goal of achieving regulatory agency approval of documents within 20 business days. It dispositioned comments real-time with the resolution recorded in meeting minutes included in the administrative record. The approach was made possible by comprehensive "generic" decision documents (i.e., the ER RSOP and the Industrial Area and Buffer Zone Sampling and Analysis Plan[110]). These plans provided the process and framework and allowed the sampling, execution, and closeout documents for each IHSS to be very specific and relatively short which allowed a short review turnaround. Also, the onsite regulator presence ensured that they viewed the work activities on essentially a

The ER Documents Team would achieve regulatory agency approval of documents within 20 business days.

daily basis, which provided assurance in the execution process that reinforced their confidence in the expedited review process.

24. As remedial actions were completed within various predetermined sectors of the Site, those areas were placed off limits to routine access[111]. The Site implemented a personnel- and vehicle-control system where employees were required to obtain "permits" to re-enter remediated areas. This allowed the Site to confirm that the areas did not become recontaminated and provided controls for restoration and revegetation.

<u>Additional Learning Points</u>

1. Identify difficult problems early and begin working toward solutions.

2. Work closely with regulatory agency and community representatives.

3. Elevate key unresolved, regulatory issues early to Compliance Agreement Coordinators (i.e., above the working-level negotiations) in order to reach agreement and stay on schedule.

4. Negotiate interim soil and water cleanup standards, if necessary, to allow work to proceed.

5. Prioritize projects based on risk and risk reduction, but accept that some "low risk" ER work may be required to maintain good faith with the regulators and the stakeholders.

6. Closely coordinate and integrate site characterization and remediation activities.

7. Utilize portable analytical instrumentation and quick-turnaround mobile laboratories to make remediation decisions in the field.

8. Perform interim remedial actions to achieve progress toward Site closure consistent with the overall closure plan and strategy.

9. Coordinate expectations and plans for independent verification of cleanup with all interested parties well in advance of project completion. Use planning and scoping tools to get written agreements and ensure detail is adequate to eliminate misunderstanding, especially for contract scope and quality requirements.

10. Minimize the number of project documents, eliminate all unnecessary document requirements, and streamline the document approval process.

11. Organize and schedule ER projects to maximize integration with the other Site closure activities.

12. Decisions to use Site radiation/construction workers vs. fixed price contracting depend on how similar the work is to routine construction, and whether traditional construction accident rates are acceptable to the Site.

13. Staff projects with both outside ER expertise and incumbents knowledgeable of Site processes and infrastructure.

14. Bringing the Site to closure requires coordinated completion of environmental restoration as well as decommissioning of the buildings.

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ROCKY FLATS CLOSURE LEGACY

SECURITY RECONFIGURATION

SNM CONSOLIDATION AND A REDUCTION OF THE SECURITY PERIMETER IMPROVED EFFICIENCY FOR D&D WORKERS PREVIOUSLY REQUIRED TO TRANSIT SECURITY CHECKPOINTS.

SECURITY RECONFIGURATION

INTRODUCTION

Security Reconfiguration at the Rocky Flats Site (Site) is the term that has been applied to maintaining appropriate Safeguards and Security protection for Department of Energy (DOE) assets and classified matter, while at the same time reducing security-related landlord costs to facilitate the transfer of resources to closure projects. The Security Reconfiguration was a team effort involving DOE (both the Field Office and various DOE headquarters offices) in its oversight and regulation of closure activities, and Kaiser-Hill (K-H) through its closure planning and technical support.

Much of the success of the Closure Project came from identifying ways to do work more efficiently and applying savings to accelerate closure. This section describes the Security Reconfiguration approach within the Closure Project leading eventually to the elimination of all security interests, with consequent reductions in overhead costs when all nuclear materials were eliminated from the Site. It also describes other security issues and approaches that the Site addressed during closure.

Security at the Site had always been driven by the necessity for the protection of DOE assets including special nuclear materials (SNM) and classified matter. This protection was governed by a number of DOE Orders and Directives, and enforced through numerous reviews, surveys, assessment, and inspections. Therefore, the first requirement in the reconfiguration of security at the Site was to ensure that nuclear material and classified matter always remained protected in accordance with established departmental protection policy.

The ability to make proactive changes and provide operational flexibility within the context of the DOE Orders enabled accelerated progress towards Site closure.

The DOE Policies and Directives were developed and refined over decades to cover ongoing operations in a production environment. This guidance can reasonably be extended to cover conventional closure of individual facilities within an on-going Site – i.e. remove all security assets, and once the facilities are virtually clean, then downgrade the security and safeguards requirements. However, the Policies did not lend themselves readily to the decommissioning and demolition of a complete operating Site containing thousands of kilograms of SNM and hundreds of thousands of classified documents, parts, and special tooling, spread across numerous facilities.

Security reconfiguration represented an opportunity during accelerated closure, in that earlier removal of security restrictions allowed more activities to be performed concurrently, with a substantial improvement in the facility closure schedules and decommissioning productivity. Alternatively, waiting until a facility was completely empty and clean to reduce security carried an enormous cost and schedule penalty. The challenge at the Site became how to reinterpret, within the scope and intent of the directives, the methodology of compliance to DOE Orders to allow for closure with the undiminished and continuous protection of security assets.

DISCUSSION

Initial Site Focus

Active weapons productions operations at the Rocky Flats Plant were curtailed in December 1989, followed by a period during which the systems were developed to allow production operations to be resumed. Prior to curtailment of operations, the Site was organized based on the weapons production needs with "operations" such as plutonium pit production, plutonium recovery, or waste management functionally defined with activities in numerous buildings. There was one large Protected Area (PA) encompassing the north half of the Site industrial area and including all of the plutonium operations and storage. A smaller PA surrounded a single uranium facility on the south half of the Site. The workforce consisted largely of cleared personnel. Security, as a support organization, provided the guidance and direction to the Site for compliance to DOE Orders on Security as well as the Safeguards for Special Nuclear Material (SNM). This was accomplished by conducting numerous reviews, assessments, surveys, and inspections by contractor, DOE's Rocky Flats Field Office (RFFO), and DOE HQ personnel. The emphasis was on total compliance with requirements and guidance.

During the early 1990s, Security was initially focused on correcting procedural, technical basis, and training deficiencies. The ultimate goal was to "resume" nuclear operations in a safe and compliant condition, including compliance with increasingly stringent DOE Orders governing Security. Despite changes in the scope of Site operations, the Site security mission remained the protection of DOE assets, i.e., SNM and classified matter. As "resumption" progressed, numerous physical conditions were identified that presented unacceptably high nuclear safety risks. Once it became clear that the changing world situation made the weapons production mission unnecessary and Site closure inevitable, the Site focused on remedying these nuclear safety risks, and adjusted priorities to not resume general operations and to proceed to closure of the Site.

Performance Based Integrating Management Contract

The original K-H Performance-Based Integrating Management Contract (PBIMC)[37] was awarded in 1995. K-H, as the prime contractor, became the "integrating" contractor responsible for overall management and planning. Four major subcontractors with specific areas of expertise were responsible for execution within their scope boundaries: nuclear operations; waste management, environmental restoration and decommissioning; infrastructure; and security services. There were numerous lower-tier subcontractors, typically contracted through the four major subcontractors, which provided specific services or staff.

Site Conditions During the Beginning of the Integrating Contract

The Site contained four major plutonium operations buildings: Building 771, Building 776/777, Building 707, and Building 371, all of which were actively engaged in reducing the risks and potential consequences of nuclear accidents involving residual liquids, equipment, and stored wastes. Buildings 707 and 371 additionally were the locations of "operations" to stabilize plutonium residues, oxides, and metal prior to storage or eventual disposition off site (Building 707 restarted limited nuclear operations, initiating residue stabilization in 1995). While there were various other activities such as some decommissioning, environmental restoration, and waste management, the focus of the Site was on the plutonium building activities. Minor closure work was performed where there was a clear path forward. This included the disposition of some enriched and depleted uranium metal and production equipment to other DOE facilities, and the disposition and consolidation of classified items, which led to the general reduction in security interests and closure of some of the secondary limited and exclusion areas. The larger picture was that the opening of WIPP looked more certain, transuranic (TRU) waste acceptance criteria was beginning to stabilize, there was a consensus to dispose of residues as waste, and DOE Standard 3013 was being developed for long-term storage for SNM. The path forward to remove these materials from the Site was becoming clear, and it led through these plutonium buildings, especially Building 707 and Building 371.

Lack of storage space was one of the most vexing challenges... With the "gridlock" created by the storage only limited decommissioning of the most critical buildings could occur.

Lack of storage space was one of the most vexing challenges. Storage had always been a problem. The entire Site had been designed and operated as a production facility; it emphasized throughput, not storage. The FBI raid and cessation of operations in 1989 turned the Site into a "storage facility" almost overnight. Storage of both high-level plutonium materials (metal, oxide, and weapons parts) and wastes ("residues," mixed wastes, and low-level materials) contributed to overall space and logistics problems. Drums took up much of the space in the plutonium buildings, including hallways and utility areas, and shuffling drums while maintaining adequate material controls became a significant effort in itself. It was a case of "gridlock."

The majority of these materials had no location to which they could be dispositioned, and in many cases represented a security vulnerability and nuclear safety risk that required active maintenance of safety systems and operating protocols to prevent or mitigate accidents during storage or transportation. While it was clear that the Site could not achieve closure with these materials remaining on site, it was unclear when they would leave the Site and where they would go. What was clear was that only limited decommissioning of the most critical buildings could occur, and that the waste generated by the decommissioning would exacerbate the problem. Concomitantly, security requirements did not lessen, nor did perceived threat to SNM and classified matter change.

Under the PBIMC the Site was still organized around operations functions, not closure functions, many of which involved SNM and classified materials. Identifying and shutting down functions and operations no longer needed for closure was not an easy task. Often an organization's overall justification would disappear, but imbedded functions that were previously a minor focus were still needed, resulting in multiple reorganizations that left parts of operations and staff scattered across the Site. Many of these operations had security requirements, including protection of classified mater and lower-attractiveness level materials. This complicated the determination of the current and future security requirements for a facility. Understanding and then addressing these diverse security functions and organizations was a major challenge for K-H that took considerable time and effort to work through.

Closure and Security Planning

Concurrent and associated with the implementation of the PBIMC in 1995, greater emphasis was placed on Site closure and the role of planning in that effort. Several preliminary versions of the closure project baseline were produced between 1997 and 1999, each with an increased level of detail and certainty and each with a shorter schedule to completion of Site Closure.

The decision was made to reconfigure the PA to provide the necessary security for stabilization activities while allowing more open access to buildings where D&D would occur.

Initial closure planning efforts considered how best to accommodate both the plutonium and residue stabilization (prior to offsite disposition), and the decommissioning activities occurring in adjacent areas. For a variety of reasons, the decision was made to reconfigure the PA (surrounding the major plutonium buildings) to provide the necessary protection for the stabilization activities while allowing more open access to the buildings where initially the greatest decommissioning effort would occur. This decision resulted in a number of secondary activities that became a major focus of the security reconfiguration effort.

SECURITY RECONFIGURATION

As primary closure activities and sequences became better defined, the security activities and approaches necessary to achieve acceptable compliance were defined, and impacts of these activities evaluated. In cases where the impacts resulted in significant project conflicts, the Site began to investigate innovative security methodologies that deviated from existing Orders, but that nevertheless met the intent of the protection philosophy by "alternative-but-equivalent" approaches. Where equivalent security approaches were identified and accepted, variances were requested and obtained from the established DOE Orders. Where nonstandard conditions that deviated from Safeguards and Security directives existed, the protection rationale was supplemented with compensatory measures and deviations from the DOE Orders were obtained. In all instances, continuous and effective communication between all affected parties and management support facilitated the ability to manage the protection of SNM and classified matter in compliance with DOE orders, while allowing for innovative alternatives to their protection in support of closure activities.

The acceptance of a graded approach meant that the amount of security and safeguards protection could be tailored to the risk.

Security and Safeguards Considerations at the Start of Closure

Part of the success of Site closure, and accelerated closure in particular, rested on the principles of maintaining adequate security, accountability of nuclear materials, graded safeguards approach, and qualified measurement systems for the determination of the amounts of nuclear materials present. As long as the SNM remained at the Site, the requirements for its protection could not be and were not compromised. This resulted in the Site keeping largely the same levels of security protection support, e.g., guards, guns, gates, and support staff, as had existed during the days of weapons production through this period.

In 1997 over 250,000 pounds of classified parts, tooling, and scrap determined to be excess was dispositioned to non-classified configurations or shipped to other DOE sites.

Security and Safeguards Actions to Support Closure

As progress was made towards closure, and security and decommissioning needs were being reconciled, the Site initiated several key actions that facilitated the ability of Safeguards and Security to support accelerated closure. These actions are summarized below, although in many cases the relevant reference or additional narrative detail is omitted as it would be classified or have other concerns regarding release to the general public. Authorized individuals seeking more specific information are encouraged to contact the Safeguards and Security organization within EM Headquarters or at the EM Consolidated Business Center (EMCBC).

The utilization of the graded Safeguards and Security approach - The utilization of a graded approach by the separate responsible DOE and contractor organizations meant that the amount of security and safeguards protection could be tailored to the risk.

Consolidation of SNM - The consolidation of SNM into Building 371 was a prerequisite to reducing the PA, and is described later in this section.

Consolidation of classified matter - Consolidation of classified matter allowed for the elimination and/or reduction of classified storage areas. Also, the elimination of classified matter became a major effort in the reduction of security areas, e.g., in 1997 over 250,000 pounds of classified parts, tooling, and scrap was determined to be excess and was then dispositioned to non-classified configurations or shipped to other DOE sites. This allowed for the reduction of several major security areas at the Site, thus reducing costs and manpower.

The Safeguard Termination Limit variance allowed for the storage of materials outside of the PA under reduced requirements ultimately allowing the closure of that portion of the PA.

The Variance for the Site Safeguards Termination Limits (STL) of Attractiveness Level D & E materials - This variance allowed for the storage of Attractiveness Level D & E materials outside of the PA under reduced security and safeguards requirements. The ability to store materials previously in Building 371 and elsewhere in the PA under requirements that would have much lower security costs was a prerequisite to moving materials from Building 371 to make room for higher attractiveness-level materials from other buildings. This in turn allowed the removal of all SNM from Building 707, Building 776/777, and Building 771 and thus for closing that portion of the PA.

The termination on-Site of STL materials - This is described further in the *Special Nuclear Material Removal Project* section, and also supported the storage of materials previously under security and safeguards protection outside of the PA under much less stringent requirements.

Splitting of the materials accounting system into both classified and unclassified systems - The separation of the materials accounting system into both a classified and an unclassified system allowed for the reduction of total number of classified items and their consolidation to Building 371. The unclassified portion of this system could then be managed outside of the previous strict security regime.

Advancements in the measurement and accountability of hold-up materials (characterization)[198] - Advancements in the measurement capability and hold-up accountability allowed for a reduction in the total uncertainty of hold-up material present. This resulted in security and safeguards requirements being more effectively tailored to specific situations.

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Material Access Area (MAA) reductions - Material Access Area reductions was a necessary pre-step in the closure of buildings and the eventual reduction of the PA.

Limited Area (LA) reductions - A beneficial pre-step in the closure process, although not a precursor for the closure of the PA.

Protected Area (PA) reduction and reconfiguration - This was the biggest step and probably the most significant step in the security reconfiguration, especially since it was completed in July 2001, before the attack of September 11, 2001. With the reconfiguration, the PA became approximately 25% of its former size and a number of the former plutonium production buildings became more accessible outside of the PA. This allowed for uncleared workers to have better access to D&D areas, and thus led to reduced cost and higher efficiency. From the purely security point of view, the reductions in security costs were partially offset by more stringent requirements, e.g., new Orders, actions in response to the terrorist attacks of September 11th 2001, etc. However, the logistics to performing D&D activities was certainly enhanced.

The importance of these actions was that they reduced overhead costs and reduced the impact of security and safeguards requirements. The end result was that valuable resources were released to accelerate closure operations in other areas.

A Creative Security and Safeguards Approach

It was a requirement that all of these actions would be performed within the compliance framework of the DOE Orders for the control and protection of security assets and SNM. However, all parties recognized that the guidance had not considered the need to define the means for reducing safeguards and security activities to reflect diminishing security risks, while concurrently facilitating closure operations and maintaining an acceptable level of Safeguards and Security. Although it was recognized that closure would eventually reduce security requirements, with no guidance to cover many first-of-a-kind situations, like a PA that would only be required for a few years, all major closure actions needed to be considered for their security impact.

Although it was recognized that closure would eventually reduce security requirements, with no guidance to cover many first-of-a-kind situations, like a PA that would only be required for a few years, all major closure actions needed to be considered for their security impact.

Critical to this success was the creative thinking of personnel involved in the planning and execution of these activities, to recognize potential vulnerabilities, but also to identify more cost effective ways to meet the intent of the compliance requirements. Since the guidance was not always directly applicable, it became even more important to develop the necessary justification and documentation and move it through the approval process in a way that avoided hindering closure progress. This required active participation from all parties. Also, the support of upper management, both from the DOE and contractor, helped to convey the concept to the general plant population that maintenance of Safeguards and Security was a necessary component of the closure process.

The Waste Conundrum

One particular challenge as the Site culture evolved towards that of a Closure Site was the difficulty of effectively conveying the idea that Safeguards and Security must always be paramount in the decommissioning and demolition of the Site. A widespread attitude within the hourly workforce was that, "it's only waste, nobody wants it". However, what was waste to Rocky Flats was not necessarily waste to a potential adversary. Since significant residues and low level waste material remained even after all Category I & II nuclear materials had been removed, the Site had to continue to maintain adequate Safeguards and Security until all potential security targets had been removed. Communication efforts by the security organizations helped to mitigate this attitude and ease the transition from production to closure while maintaining Safeguards and Security. Perhaps a more effective effort at communicating this concept earlier in the project would have resulted in ensuring that appropriate Safeguards and Security requirements were addressed earlier in the planning process.

A widespread opinion was that "it's only waste, nobody wants it". However, what was waste to Rocky Flats was not necessarily waste to a potential adversary.

PROTECTED AREA RECONFIGURATION PROJECT FEATURES

Initial PA Configuration

Since the early 1980's, the Rocky Flats approach for protection of nuclear materials relied on a 140-acre PA covering the north portion of the industrial area. It contained almost all of the SNM handling and storage locations and the material access areas. A separate and much smaller PA located in the southeast portion of the industrial area contained one single building (Building 886, the Critical Mass Laboratory). Surrounding the primary (or larger) PA were security fences, towers, and intrusion detection devices. There were three access "portals," two of which allowed vehicle traffic. Access was restricted based on access authorizations and identification, guard force inspections, and other controls. While this was an efficient means of implementing security controls in an operating environment – an established workforce, cleared personnel, and modest vehicle traffic through the portal – it was a major source of inefficiency in a closure environment and also a symbol of the status quo operating-type environment.

Early in its closure planning the Site recognized that the majority of the decommissioning work would be done in the four plutonium buildings, and that to make an accelerated schedule the two oldest – Buildings 771 and Building 776/777 - would have to start first. The layout of the protected area was such that these two and a third, Building 707, were clustered close to each other. Several hundred yards separated these three from the fourth, Building 371. Building 371 was newest and the biggest individual building, and located in areas with little soil or groundwater contamination. If all work that involved processing of accountable quantities of material (mostly storage, packaging and shipping, and residue processing) could be relocated to Building 371, then the PA could in principle be "shrunk" to surround just that building with no loss in control. The question was whether the benefits of decommissioning the three older plutonium buildings in the "reduced security" area outside the modified PA outweigh the cost and schedule penalties of modifying the PA. An alternative, to create "bubbles" of fenced areas inside the PA where uncleared individuals could move freely, had been tried on the Building 771 and Building 779 projects. The "bubble" approach had mixed success in that it avoided the excessive use of cleared escorts and allowed sufficient manpower to be applied to the decommissioning but still severely restricted personnel and vehicle movement compared to normal construction.

There will often be "yet one more" item found in facilities that had years of classified operations – people didn't realize what they had.

Reconfiguration Pros and Cons

The initial advantages of decommissioning in a reduced-security area was obvious, including unrestricted vehicle and personnel access, a reduced number of security "lockdowns" that result in work stoppages, and reduction in clearance requirements. The disadvantages were also obvious. Before the new PA could become operational new physical barriers and detection systems would have to be designed and installed and the approval and acceptance processes would have to be completed. Before the old PA could be eliminated substantial SNM, residue, and waste activities would need to be relocated and existing material access areas would have to be sufficiently cleaned up and downgraded, sometimes while containing significant inaccessible inventory. Critical path activities such as stabilization of SNM and residues would be disrupted, a counterproductive effort. With the Closure Project completion schedule a major concern, it was clear that delay in implementation would reduce the benefit. After some preliminary analyses, the decision was made to go forward.

In retrospect perhaps the greatest justification for the PA Reconfiguration was risk mitigation for closure project circumstances that never actually occurred.

In retrospect perhaps the greatest justification for the PA Reconfiguration was risk mitigation for closure project circumstances that never actually occurred. At the time the decision was made there were significant uncertainties associated with stabilization and shipment of SNM. The Plutonium Stabilization and Processing System (PuSPS) was an automated, unproven, technologically-elegant system designed to be installed in Building 707, the DOE Standard 3013 was not final, and major roadblocks needed to be removed before the Savannah River Site could accept the SNM even if it could be stabilized. Delays in stabilizing or shipping the SNM could easily have added years to the disposition of the SNM, perhaps even requiring prolonged storage of the material onsite. The PA Reconfiguration was expected to mitigate the impact that prolonged delays in the disposition of SNM would have caused, allowing the decommissioning and environmental restoration to proceed on a largely independent track. However, since most of these SNM problems were solved through other means, the PA Reconfiguration had less impact than expected.

Impact of PA Reconfiguration on Response Times

While the planning and design for the PA reconfiguration revealed additional problems, there were also some additional advantages. Isolating Category I & II SNM within a smaller PA provided an additional security benefit. Minimizing the target areas reduced the risk of possible theft or diversion and the Protective Force personnel being concentrated within the much smaller PA reduced the average response time. The operational efficiencies that were achieved through more expedient personnel access to facilities outside the reconfigured PA were also greater than anticipated. The change allowed for a decrease in the number of personnel assigned to support roles and an increase in the number of personnel performing decommissioning and demolition. Finally, the reduction of the PA reinforced the realization of the workforce that closure was in progress.

Impact of PA Reconfiguration on the Number of Security Clearances

The reduction of the PA substantially reduced the number of Q-clearances and L-clearances required for routine access into controlled areas. However, the PA reconfiguration did not *completely* eliminate the need for clearances. The personnel security function needed to remain largely in place onsite as long as SNM was still onsite, which continued until August 2003. The reduced requirement for higher-level clearances produced little direct cost savings to the building project managers. Substantial benefits did accrue to the government due to a reduced need for security reinvestigations and lower level ("Q" vs. "L") reinvestigations. Other

The PA reconfiguration did not completely eliminate the need for clearances. The personnel security function needed to remain largely in place on site as long as SNM was still onsite.

efficiencies such as workforce management and material movement at the Site also saw some benefit, but these are difficult to quantify.

PA Reconfiguration Project Execution

The achievement of readiness for this significant change in the Site security posture required the removal and/or relocation of large quantities of classified matter and SNM throughout the Site. Specifically, the consolidation allowed for the eventual closure of security areas, and the reduction of the PA. Much of the classified matter associated with the non-nuclear production activities at the plant was either shipped off site to other DOE facilities, or was reconfigured to non-classified forms and treated as waste materials. The remainder of the more highly attractive SNM was consolidated from a high of seven MAAs (historically) to one remaining MAA within Building 371. Remaining classified matter was located within DOE Order compliant repositories.

The development of the PA Reconfiguration project began during 1995, and despite changes in scope and several redesigns, came to fruition in a November 2000 final design that the Site then implemented in July 2001. Prior to initiating implementation, the K-H Vulnerability Analysis Team was asked to establish a relative "risk value" for implementing the preliminary design for the modified intrusion detection system.

With its high visibility and the importance of its success to Site closure, the PA Reconfiguration project attracted substantial K-H management attention. The success of the project resulted in increased efficiency of conducting closure work within the former PA, and therefore supported the accelerated closure schedule. The net result was an identifiable reduction in the cost of overall Site safeguards and security compliance and a less quantifiable but very real savings resulting from increased efficiency and culture change.

Since it was an iterative process, the VAs required time to perform, and must be included reasonably early in the planning process. However, the increased efficiencies identified and eventually implemented more than compensated for the time spent on this activity.

OTHER SECURITY AND SAFEGUARDS FEATURES

Vulnerability Analyses As A Tool for Accelerating Closure

The Site Safeguards and Security Plan – Vulnerability Analysis (SSSP-VA) identifies potential targets, establishes target priorities, develops protection strategies, determines adversary paths, develops risk determinations, and recommends compensatory measures. The results of these activities were documented in the Site Safeguards and Security Plan (SSSP), updated annually.

The SSSP-VA team was comprised of representatives from the main contractors at the Site and DOE, RFFO. The SSSP-VA team had specific roles and responsibilities to:

- Conduct the modeling analyses to determine risks and consequences of the perceived threats, i.e., the DOE Design Basis Threat (DBT).
- Characterize facilities and Safeguards & Security measures and systems at the Site and evaluate the effectiveness of controls against the DBT.
- Propose probable adversary paths for neutralization modeling and performance test requirements. Incorporate results into the Vulnerability Assessment Report (VAR) as a part of the SSSP.
- Determine Probability of Neutralization of proposed scenarios.
- Assist in evaluating the creditability of scenarios and adversary paths.
- Participate in analyses to provide response data and support to scenario development.

All planned and/or proposed changes to the SSSP with respect to security areas, protective force deployment, and nuclear material movement or storage were evaluated within the framework of a Vulnerability Analysis (VA). The same analysis was used to evaluate actions that accelerated closure. Both changes as a result of PA reconfiguration and proposed changes in the security posture to achieve accelerated closure efficiencies were evaluated. Since it was an iterative process, the VAs required time to perform, evaluate the results, and rework the analysis depending on the scope and objectives of the proposed changes in the Safeguards and Security systems at the Site, and must be included reasonably early in the planning process. However, the increased efficiencies identified and eventually implemented in process operations in support of an accelerated closure schedule more than compensated for the time spent on this activity.

VAs were written for all changes in security configuration, either as formal documents or to supplement to existing VAs. Most importantly, the collected VAs became a part of the analyzed upgrade case for the yearly submittal of the Site Safeguards and Security Plan (SSSP). In 1999, the consolidation of nuclear materials and classified matter were issues addressed in the upgrade case of the SSSP. In 2000, the reconfiguration of the PA was addressed. With the validation, approval, and acceptance of these documents, approval was also received for alternate or non-standard approaches to security and safeguards issues. Examples of actions covered in the VAs were such issues as storage of Pipe Overpack Containers (POC) outside of a PA, use of limited security controls in Building 906 storage area for waste, removing residues/wastes from PA, etc. Once approved in the updated SSSPs, the changes were implemented through the subsidiary Site plans and procedures (e.g., the Material Control and Accountability Plan).

Waivers and Variances

Of the variances and waivers obtained supporting security reconfiguration, there were a few that were notable in their affect on managing security at the Site. The most important of these are listed below, and as described earlier, can only be referenced or detailed to a limited extent:

Safeguards Termination Authorization for All Attractiveness Level D Waste Derived from Plutonium Bearing Residues - This variance request (VR) allowed for the termination of safeguards controls for waste materials on Site prior to shipment. The benefit was that the protection and short term storage of these materials could be accomplished at a much-reduced cost than would be required for accountable nuclear materials.

Determination of Attractiveness Levels within Material Access Area – This VR facilitated the ability to efficiently downgrade material categorizations and consequently the MAAs leading to the eventual reconfiguration of the PA.

Use of Type III Degauser for Tape Sanitization – This VR provided a more efficient but equally acceptable method for sanitization of computer magnetic tapes leading to an overall reduction of classified matter at the Site.

While some of these deviations appear small, the ability to make proactive changes and provide operational flexibility within the context of the DOE Orders resulted in the accelerated progress towards Site closure.

Allowing Site Employees Holding Active Access Authorizations (AAs) Under a Classified Contract to Transfer Between Classified Contracts Within the Same Company Without Formally Transferring the AA – The implementation of this VR provided a mechanism for easing the burden of transferring clearance from one contract to another within the same company. With the pressure of meeting closure schedules, many employees found themselves moving to different contracts within the same company as specific tasks were completed.

Line Supervision 371 PA – This variance provided the acceptance of the line supervision (i.e., secured data system) of the redesigned and reconfigured PA.

Intrusion Detection, Portal 2, Building 372 – This VR provided approval of the detection instrumentation on the PA reconfiguration.

PA Physical Reconfiguration – This VR provided approval of the design of a "non-standard" PA physical security design.

Physical Protection of Intrusion Detection System – This waiver provided acceptance of issues dealing with the PA reconfiguration and the intrusion detection system.

Building 371 Door 333 Protective Force Post – This VR expedited building operations personnel access into the Building 371 MAA.

All of the above variances and waivers played a role in the Site's ability to effectively and efficiently manage compliance to DOE Orders for Safeguards and Security. While some of these deviations appear small, the ability to make proactive changes and provide operational flexibility within the context of the DOE Orders resulted in the accelerated progress towards Site closure. The approach was also consistent with the approach used for safety, technical, regulatory, and other issues, to seek continuous, evolutionary improvement.

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Closure Security after SNM Disposition [112]

After the completion of SNM shipments in the summer of 2003 the security requirements at the Site were substantially diminished. Appropriate surveys and audits were conducted, the requirements were downgraded to property protection status, and the PA guardposts and fences removed. The personnel security requirements were also reduced appropriately. Some level of site security continued to support TRU waste storage and shipment through April 2005. Following the last TRU shipment, Site security was reduced to standard industrial security. DOE security oversight needs also diminished, and as of January 2004 RFFO security staff was reduced to a single individual.

Security Issues for Transition

Beginning in summer 2003 the Rocky Flats Project Office (RFPO) began active coordination with the newly-created Office of Legacy Management to transition the long-term maintenance and monitoring tasks. As the planning of the transition progressed into 2004, the records management scope appeared as one of the larger and more difficult tasks. One important issue making the records function so challenging was the substantial volume of classified records and electronic databases that K-H would turn over to the DOE. Most of the classified records related to the former weapons production mission, which pre-dated K-H. As final buildings were being demolished a disposition path was needed for the records; their relocation became the critical path action to allow

As the planning of the transition progressed into 2004, the records management scope appeared as one of the larger and more difficult tasks.

demolition of B-460. To address this need the RFPO began looking for a suitable location to quickly and inexpensively prepare a classified records vault that would meet all DOE security criteria. A suitable building was identified at the Denver Federal Center (DFC), an enclave of various Federal agencies west of Denver and about 15 miles from the Site. A vault-type room was built and certified within B-55 at the DFC, and B-460 classified records were relocated to the new vault in March 2004.

Legacy Management had identified records management, including classified records, as a core mission, but did not agree to support classified records transition according to the expected K-H closure completion (by then appearing to be possible as early as October 2005). The Legacy Management decision forced EM Headquarters security staff to consider several alternatives to address the classified records. An additional complicating factor for the classified records was that a substantial number were related to the ongoing Cook litigation. Judicial rulings had mandated that the records remain in Colorado until the litigation (including appeals) was complete, potentially many years or even decades. After significant discussion and consideration of alternatives EM Headquarters selected the EMCBC to retain control of the classified records and databases. Legacy Management would take the unclassified material. The decision was influenced by the existing vault with the classified material in B-55 at the DFC. EMCBC acceptance of the classified records, kept in the B-55 vault, was a very low cost choice with minimal additional management action required. The final agreements related to the records transitions are documented in the Site Transition Plan for EM and LM approved March 2005,[162] and the Memorandum of Understanding between RFPO and EMCBC approved March 25, 2005.[193]

KEY SUCCESS FACTORS

1. Safeguards and Security compliance needs to be integral to the planning process as long as there are assets that must be protected.

2. Because a material is being dispositioned as waste doesn't automatically mean there are no security requirements – as a result of the Site's success in dispositioning higher-grade materials, some of the remaining wastes retain security controls and become a driver for security infrastructure.

3. A proactive program that applies flexibility in Safeguards and Security compliance requires incorporation of security planning in the planning process, sufficient lead time, and extraordinary cooperation of all parties.

4. Vulnerability Assessments were an effective tool in communicating compliance and implementing change, in the context of the Site Safeguards and Security Plan.

5. Waivers and variances were utilized effectively to support Site Closure and were proactively supported by EM Headquarters security personnel.

6. Significant efficiencies can be gained from shrinking security boundaries to allow workforce flexibility for non-operations activities (e.g., decommissioning and environmental restoration) and reducing inefficiencies that result from a high-security environment.

7. Completing the removal of classified tools and parts to allow building closure can be a significant activity in facilities that had years of classified operations. Individual determinations may be required for individual items – people didn't always realize what tooling was in storage. In most buildings the piecemeal downgrading was helpful, and was only a significant problem in one Rocky Flats facility. For that one facility, declassifying the whole building at once and earlier using the operating personnel would have mitigated this problem.

8. When evaluating approaches for a new perimeter intrusion and detection system (necessary for a PA reconfiguration) that employ less technology and equipment, and more labor, a site should be prepared for start-up problems and cost escalation.

9. Overhead cost savings from reducing the number of personnel clearances is not that significant as long as a significant security area and workforce is still required. Reinvestigation costs drop substantially, but the direct project gets little cost savings.

10. DOE may have substantial obligations at closure completion regarding classified records and material. Early coordination and planning are essential to address these issues.

11. A positive attitude shift toward more teaming and cooperation between Federal and contractor security staffs led to collaborative problem solving. Vulnerability assessments, deviation requests, assessments, and many other safeguards and security issues were resolved through breaking down barriers and working together to meet the need.

12. The classified and sensitive nature of security issues complicates the sharing of lessons. Interested and authorized individuals seeking more

specific information related to this section are encouraged to contact the Safeguards and Security organization within EM Headquarters or at the EMCBC.

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Rocky Flats Closure Legacy

Technology Deployment

The most suitable technology for a given technical problem was not always apparent from the outset. Plasma arc cutting and cerium nitrate cleaning were effective. PuSPS was difficult to maintain and operate. In each case, a technology was applied in response to a specific technical challenge.

INTRODUCTION

An essential part of the Rocky Flats Closure Project strategy was that productivity would improve as the project progressed. The commitment to a 2006 completion within the funding limits made in 1997 required 12% efficiency improvement per year. Executing a strategy to deliver that level of continuous improvement required identifying and deploying many innovative processes and technologies. Which technologies proved the most beneficial depended upon the project characteristics and scope. Principle characteristics of the Rocky Flats Closure Project were the types and location of the contaminants, the relatively large decommissioning component, and the need to ship all wastes offsite for disposal. Specific philosophies for the deployment of technologies included establishing the conditions that allowed the work methods to evolve, and identifying specific problems that needed resolution for the overall Closure Project to succeed. The accurate definition of the overall closure scope and development of a project baseline, including assigning project risk by activity, supported the evaluation of prospective technologies. The process used to target activities where new technologies could be effectively employed, as well as examples of the new technologies deployed, may be useful in the planning of other Closure Projects.

Six topic areas include descriptions of technologies that directly supported the improvement in Closure Project cleanup efficiency:

Placing the decisions on technology deployment in the hands of the management directly responsible for execution of the activity ensures that the effort remains focused and accountable, and is more likely to be deployed.

Waste Packaging Innovation addresses methods to characterize and package wastes generated by the decommissioning of radioactive process equipment, which helped streamline the entire process from decommissioning through disposal, and substantially reduced overall Closure Project costs.

Glovebox and Tank Decontamination identifies methods used to decontaminate highly contaminated pieces of equipment, resulting in the minimization of the manual activity of metal cutting and size reduction, and improving safety and productivity.

Size Reduction describes approaches to improve the safety and speed of the metal cutting to package process equipment that could not be decontaminated.

Building Decontamination and Building Demolition describe methods that improved the efficiency of the activities to remove facility infrastructure, decontaminate building surfaces, and finally demolish the buildings.

Environmental Restoration describes techniques developed to improve the control of a soil remediation activity for plutonium contaminated soils.

Technology and improvements in work methods in three additional topic areas also substantially improved Closure Project productivity.

Security Reconfiguration describes approaches that were used to make the security requirements for the decommissioning of plutonium facilities flexible and responsive.

Plutonium Packaging describes methods used to process and remove the remaining Site nuclear material, a critical path activity for closure.

Safety System Support identifies approaches that supported the decommission effort to remove restrictions and address the worker safety risk inherent in major construction activities in a contaminated site.

The descriptions of the individual technologies begin by discussing why a technology was needed. The technology process is then described in enough detail that managers can assess whether it might be relevant for their applications. The description concludes by identifying related processes that either support or are supported by the technology.

One element of the Rocky Flats Closure Project planning strategy was the expectation that contractors would find and utilize work process efficiencies during the course of closure.

One element of the Rocky Flats Closure Project planning strategy was the expectation that contractors would find and utilize work process efficiencies during the course of closure. The closure contract committed the contractor to an aggressive target cost and fee, with substantial loss of fee if the target was not achieved and substantial rewards for cost reduction and schedule acceleration. Extrapolating the cost of the Closure Project scope from the cost of previously decommissioned buildings using then-current Site decommissioning methods resulted in an overall closure cost significantly exceeding the contract target. Although some efficiency improvement was expected as a result of management process changes, a significant improvement in the productivity of work processes was needed to meet target costs. Identification and successful deployment of new technologies was a requirement for Closure Project success.

Prior to addressing the nine technology development topic areas, the section discusses the conditions and approach that framed the technology development decisions at Rocky Flats. Since other EM projects will have different initial conditions (such as site history, contaminants of concern, project scope, waste disposition alternatives, and regulatory considerations), the reader is likely to find some technologies more useful than others. Thus, the subsection following this Introduction describes the

Rocky Flats conditions and strategic closure decisions that impacted technology improvement decisions.

The Closure Project approach to technology deployment is discussed in General Principles of Technology Deployment. The following subsection discusses the nine technology development topic areas. Finally, the section concludes with Key Learning Points that summarize the technology deployment success features from the Rocky Flats Closure Project.

CONDITIONS AND TECHNOLOGY DEPLOYMENT INFLUENCES

Decommissioning is waste processing – it depends on the disposal options and needs to be optimized beginning to end.

Several Site characteristics and decisions impacted which technologies could be effectively employed. Differences between these characteristics and those of future closure projects need to be assessed to determine which technologies might be most beneficial.

The Site production activities were narrowly focused on the fabrication of plutonium, uranium, beryllium, and stainless steel weapons components. This resulted in substantial quantities of Special Nuclear Material (SNM), mostly plutonium and uranium) in purified or concentrated form, sometimes packaged as waste, but often as contamination or "holdup" dispersed throughout the process systems (gloveboxes and tanks). There were over 1000 gloveboxes and numerous tanks within six major mostly-concrete plutonium-process buildings, and a substantial amount of large depleted uranium machining and forming equipment in five other major buildings. The remaining few hundred facilities provided administrative and support functions, and contained little or no contamination. Although there were some organic plumes, they were largely contained within the 380 acre "industrial area," and did not approach the Site boundary. Radiological releases requiring remediation were relatively modest and localized (compared to other major DOE sites), covering approximately ten percent of the industrial area. There were isolated instances of buried radioactive waste on Site, but no major burial grounds or contaminated disposal facilities; historically waste had been shipped elsewhere for final disposal.

Since Rocky Flats contained no high-gamma radiological materials or contamination, much of the material that would become radioactive waste during decommissioning consisted of pieces of equipment that had plutonium or uranium contamination on their surfaces. There was no decommissioning work that could not be done on a "contact" basis (i.e. there is no requirement for remote high-radiation activities such as would be the case for reactor or fission product processing facilities).

A key element of project scope was that the closure involved the entire Site – there would be no ongoing operations. The path to closure involved removing the SNM and packaged transuranic wastes, deactivation to remove process system SNM "hold-up", substantial facility decommissioning, and a modest amount of environmental restoration compared to the other large DOE sites. The disposition location for residues (those plutonium-laden waste-like materials directly derived from plutonium recovery activities) was determined to be the Waste Isolation Pilot Plant (WIPP). Also, a storage facility was built to manage SNM at the Savannah River Site (SRS). The processing necessary to prepare SNM for shipment to SRS and the residues for shipment to WIPP did not require a major new facility – it could all be done by modifying or installing new equipment into existing processing facilities. The principal decommissioning effort was in the plutonium facilities, which required simultaneous compliance with federal and state hazardous material regulations, safeguards, physical and personnel security, nuclear safety, criticality safety, and radiological safety. The layered and sometimes conflicting requirements complicated efforts to change methods of executing work in these facilities.

Size reduction or repackaging to improve waste packing density was rarely cost effective; these activities were minimized whenever possible.

Rocky Flats obtained a DOE policy decision in 1997 that it would not bury "waste" on site. This meant that all waste had to be suitably packaged for over-the-road DOT-compliant transportation (as opposed to other DOE facilities that may have onsite RCRA or CERCLA cells that can be accessed independent of public roads, and/or make use of re-usable waste containers). It follows that waste disposal had significant costs: disposal fees, container costs, transportation costs, along with the cost and schedule risk from inability to dispose of materials. These costs initially provided an incentive to reduce waste quantities where practical, such as minimizing the generation of low-level waste from facility structures.

The cost of manual work in highly contaminated areas was too high, and there were additional disadvantages for worker safety.

The Site decided to use the surface contamination levels in Nuclear Regulatory Commission Guide 1.86 as the standard for unconditional release of facilities and equipment. Initial plans were to decontaminate facility surfaces to that level, demolish the facility, and either use the demolition debris as fill or dispose of it offsite as sanitary waste. Most of the plutonium facilities were concrete, which could be cost-effectively decontaminated and used for fill on site or transported for disposal at local landfills. In practice, sections of facilities such as floor slabs, and in two cases most of the buildings, were demolished and disposed of as waste at the Envirocare of Utah (Envirocare, now known as Energy Solutions) disposal facility. Risk analysis techniques (as opposed to unconditional release under Reg Guide 1.86) were used to justify leaving contaminated structural materials undisturbed or as fill on the Site after closure in specific situations and to support certain "no further action" determinations for environmental restoration areas. The regulators approved their use on a case-by-case basis.

In the final years of the closure project (FY04-05) the Site received no new technology development (TD) funds. By that point there were very few activities that could have benefited from extensive R&D because the TD effort had defined solutions for the Site's technical challenges and the Site was then ahead of schedule to complete the cleanup. DOE HQ decided to focus limited TD dollars on risk reduction at other sites that could benefit the EM cleanup efforts throughout the complex. It is also unclear whether additional TD efforts could have been implemented effectively in the time remaining. However, the Site continued to implement the TD improvements identified in the early years of the project, and worker suggestions and innovations were implemented routinely.

GENERAL PRINCIPLES FOR TECHNOLOGY DEPLOYMENT

The key measures of success for a new technology were the quantifiable improvements it made in worker safety, in reducing activity duration and cost, and in streamlining waste disposition. Choosing which technologies would provide the most improvement at the beginning of the Closure Project was a speculative process. The overall TD approach that achieved the greatest success was to identify technologies that represented incremental improvement within an ongoing process – evolution versus revolution.

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Managers and work crews directly responsible for executing the work were able to identify tangible problems and success parameters, often achieving results with off-the-shelf equipment that had not been previously used for that purpose. Direct connection with the work crews was also important, as technologies that had worker acceptance were more easily implemented. Selected deployment of contractors with narrow technical niches for specific tasks, such as decontamination or characterization of specific types of equipment or structures, also assisted in implementing technologies. These "bottoms-up" methods for identifying and implementing technologies were most effective for longer-term activities, and where conventional methods could be employed immediately, even if inefficiently, and then improved. "Pilot projects," such as the Building 123 and Building 779 projects, started early in the Closure Project allowed evolution in technologies (as well as evolution of management and regulatory techniques) to begin earlier as well.

For shorter-term or expedited activities that could not be executed with existing technology, a "top-down" approach was used. Identifying and deploying technologies from a top-down perspective depended on the planning and baselining process and on identifying and assigning project and worker safety risk to individual execution activities. Early in the planning process the details of how technically complex activities would be executed was not known. Assigning a risk and contingency cost to activities where methods to execute the work were unknown or poorly defined allowed prioritization of technology development to reduce those risks. Also, knowledge of the estimated activity cost prevented investing in developing technology options that could not substantially improve overall Closure Project costs. Cases occurred where several parallel technology development efforts were initiated in areas of substantial project risk to ensure that at least one suitable method could be deployed – the most notable being glovebox size reduction where a centralized automated facility, local "Birdcage" facilities, and glovebox decontamination were all initiated simultaneously.

For decontamination or size reduction of highly contaminated equipment with diverse plutonium systems, hands-on manual work was more effective than remote or automated action.

Three general principles were found effective in directing the work and hence the technology deployment effort. First, for decontamination or size reduction of highly contaminated equipment with diverse configurations, hands-on manual work was more effective than remote or automated action. Automation proved too inflexible to adapt to the very unique configurations, even less efficient than the expensive and safety-challenging process of workers in extensive personnel protective equipment (PPE) and contamination control enclosures. Second, work options such as glovebox size reduction that required the handling of uncontrolled highly contaminated materials (i.e., not containerized waste) were minimized whenever possible. For example, additional size reduction or waste repackaging to improve waste packing density was rarely cost effective – the cost of manual work in highly contaminated areas was too high, and there were additional disadvantages for worker safety. Finally, activities were outsourced off-Site if at all practical – even if nominally more expensive (within limits). Offsite contracted work avoided some of the inherent DOE Site inefficiencies, interference with other activity schedules and resources, and the diversion of management attention. Through understanding of these issues, technology deployment evolved to focus on minimizing or enhancing manual activities for plutonium decommissioning activities, investing effort in activities that had to be done on Site, and avoiding overly complicated or automated solutions.

Technology deployment evolved to focus on minimizing or enhancing manual activities for plutonium equipment decommissioning activities, investing effort in activities that had to be done on Site, and avoiding overly complicated or automated solutions.

One last principle of the TD program at Rocky Flats was an expansion beyond physical or engineered solutions. TD was broadened to include processes, management, and system innovations that may or may not have an equipment component. Innovation in any form was used to increase safety, efficiency, and/or effectiveness. This broader perspective on TD will be apparent in several of the examples described below.

TECHNOLOGIES USED TO ACHIEVE SITE CLOSURE AND AVAILABLE FOR DEPLOYMENT AT DOE CLOSURE SITES

The technologies discussed below are given generally by topic area – Waste Packaging, Equipment Size Reduction, etc. Each technology discussion begins by explaining the drivers for developing that technology, to help the reader decide whether the technology might have any application for their site or project. The discussion continues with a brief description of how the technology is deployed or what was done. The description is not intended to provide sufficient detail to allow the reader to recreate the technology; it is intended to inform a reader that the technology exists and has been successfully demonstrated at Rocky Flats. The technology discussion ends by identifying other technologies that were associated, typically synergistically, with the described technology to ensure that the impacts of that technology are viewed within the overall Closure Project context.

The first six sections below discuss decommissioning and cleanup technologies that are generally applicable to a variety of DOE facilities. The final three sections address more specialized technologies key to the success of the Rocky Flats Closure Project.

A. Waste Packaging Innovation

Waste packaging and its association with the waste management efforts to reduce waste disposal costs were critical to the successful acceleration of Rocky Flats closure. While some of the innovations reduced the cost of handling packaged waste, the greater impact of the technologies was the ability to reduce the cost of the actual decommissioning effort itself. The waste packaging activities in this section dealt mostly with decommissioning-generated waste. The waste activities dealing with more concentrated "residue" materials are discussed in the Plutonium Packaging topic area.

<u>Characterization of Materials using Surface Contaminated Object (SCO) Procedures</u>

The driver for developing the SCO procedure was the need to characterize larger pieces of equipment to be shipped as waste with the minimum of size reduction. The characterization method had to assure that the overall package contents had transuranic radionuclide concentrations less than

100 nanocuries/gm and could be definitively determined to be low-level waste (LLW) and not transuranic (TRU) waste. This was a particular problem for plutonium-contaminated equipment due to the low gamma emissions.[113]

The process employed was the statistical surveying and sampling of equipment surfaces to calculate the total activity (nanocuries) of the individual items placed in the package, which were summed to yield an average contaminate concentration and total package activity. It relied principally on direct alpha readings of interior as well as exterior equipment surfaces, readings often in excess of one million counts per minute. The process depended on the majority of the hard-to-size-reduce materials being contaminated exclusively on the surfaces, and not within the material matrix. Previous characterization procedures required all materials in process areas to be size reduced sufficiently to meet the geometry requirements of non-destructive assay (NDA) equipment (i.e. 4 ft. by 4 ft. by 8 ft. maximum). The SCO process allowed equipment to be packaged in cargo containers or larger sizes, limited only by over-the-road transportation constraints, and avoided substantial manual size reduction.

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An initial effort early in the Closure Project validated non-process materials in operating areas as being much less than TRU concentration. Characterization accuracy improved until process equipment could be surveyed, and selected parts of equipment could be decontaminated or removed to leave the majority of the piece less than 90 nanocuries/gm. The SCO characterization results were validated by NDA techniques. The SCO characterization process benefited from improved characterization and survey instrumentation, better waste profiling procedures, the use of cargo containers for disposal of larger pieces of equipment, and glovebox and tank decontamination improvements.[114]

The improvement in speed, efficiency, and worker safety that resulted from minimizing process equipment size reduction was one of the biggest technical factors in the Closure Project success. A second major consequence was a dramatic reduction in the volume of TRU waste. The cost of TRU waste transportation and disposal was a general EM departmental cost not specifically included under the Closure Project costs. Even without the EM savings in transportation and disposal costs, the reduction in TRU waste still resulted in a substantial waste savings for the overall Closure Project since the costs to characterize and manage the waste containers were typically much higher by volume for TRU than for low-level waste.

Use of Cargo Containers as LLW Packaging Containers

The driver for the use of cargo containers as waste packages was the need to minimize size reduction of equipment using an inexpensive, easily handled over-the-road transportable container.[115] Previous to cargo container use, relatively small portions of LLW materials had been placed in wooden crates with a volume of about one hundred cubic feet. Minimum Department of Transportation (DOT) regulations for radioactive waste shipping of LLW required strong, tight containers, and the Nevada Test Site waste disposal facility (NTS) could readily handle cargo containers at a reasonable disposal cost. Cargo containers, ranging in size from one thousand to two thousand cubic feet, were particularly useful for more highly contaminated LLW and equipment that might puncture or otherwise compromise less robust containers. They were easily handled on Site and large enough to take many types of equipment with minimal size reduction. Effective use of cargo containers benefited from the implementation of the SCO characterization of contaminated equipment and the use of non-expansive foam for filling the package voids, and improved container loading techniques.

Cargo containers provided an inexpensive, easily handled, over-the-road, transportable container that minimized the need for size reduction.

Structural Foam/Encapsulant

The driver for implementing the use of container foaming was to avoid the shifting of cargo container contents in transit and the attendant potential to breach container containment.[116] Additional benefits were the abilities to meet disposal facility subsidence requirements and to provide an additional “layer” of contamination control. Original procedures for cargo container packaging required custom carpentry to provide wood blocking and bracing to maintain container integrity while in transit to the disposal site. The new process consisted of filling the cargo container with non-expansive foam after the container had been filled with waste, certified, and closed. After a tank or glovebox had been determined by SCO characterization to be non-transuranic, it may have been filled with foam. Foam was inserted using a small drilled hole and standard industrial foaming system. The deployment of waste package foaming improved the packaging process for cargo container shipment. Foam was later used for other uses, although when used in very large void areas heat generation during curing and resultant combustion potential became a limiting factor.

After the cargo container had been filled with waste, certified, and closed, it was filled with non-expansive foam to avoid the shifting of contents in transit and the attendant potential to breach container containment.

Dealing with Glovebox Lead Shielding

Gloveboxes containing equipment that processed large quantities of plutonium usually had lead shielding to reduce the radiation exposure of the process operators, with the lead being attached in a variety of ways. During decommissioning the lead was normally removed from gloveboxes being decontaminated for disposal as LLW (i.e., activities less than 100 nanocuries/gram), because allowing the lead, a hazardous constituent, to remain would cause the glovebox sections to be low-level mixed waste (LLMW), and LLMW with activities greater than 10 nanocuries/gram did not have a convenient disposal path.

While this approach was reasonable for most gloveboxes, many of the gloveboxes in Building 371 were fabricated with the lead sandwiched in stainless steel compartments covering the glovebox surface. To remove the lead, the D&D worker would first have to remove the outer layer of stainless steel and then chisel off the lead, an extremely laborious process. The Site identified an approach to decontaminate the glovebox to less than 10 nanocuries/gram and then worked with Envirocare to fill the glovebox with foam to stabilize the internal contamination and meet Envirocare's waste acceptance criteria.[117]

Improved Cargo Container Loading

The driver for improving the cargo container loading was to avoid removing individual pieces of waste from the contamination controlled area to cargo containers located in clean areas, with the resulting inefficiency. Two general approaches were used. Special doors and airlocks were developed to allow the cargo container to abut the building walls, allowing the cargo container interior to become part of the contamination controlled area.[118] The airlock doors allowed the pressure integrity of the facility to be maintained while the cargo containers were changed. Doors were placed at the levels needed, which required use of hydraulic platforms for second story doors and excavation for basement doors. In cases where size reduction was less of a concern, cheap cardboard boxes that could be nested in the cargo containers were used to collect materials throughout the building and then moved to the waste loading area and placed in the cargo containers.[115,119] These boxes allowed more efficient packing of the cargo container, more efficiently using the space at the container top.

Special doors and airlocks were developed to allow the cargo container to abut the building walls, allowing the cargo container interior to become part of the contamination controlled area

Use of Railcars to Transport Low Level Waste

For most of the project, shipping of LLW was conducted by truck transport. This was acceptable in the early phases of the decommissioning. Waste generation rates were lower and the wastes more contaminated as the D&D workers were mostly hand-removing the process systems and associated equipment. As the project progressed to higher waste generation rates, mainly due to the demolition of contaminated facilities and ER activities, it became clear that truck shipments involving reusable containers (e.g., intermodals) would not be efficient. The lower waste contamination levels allowed the use of soft-sided containment and bulk disposal using rail gondola cars. Demolition of the larger facilities provided an opportunity for point-of-generation shipping that justified the expense of expanding onsite rail lines. Rail spurs were constructed beginning in 2004, extending existing lines to areas adjacent to Building 776 and Building 371. Other precursors to rail shipment were the development of authorization bases that allowed open air work with bulk contaminated materials and regulatory approval (achieved through the implementation of selected RFCA Standard Operating Protocol). Each railcar held as much as 100 tons of waste, the equivalent to seven trucks. Larger containers allowed workers to spend less time size-reducing large pieces of equipment, building structural elements, and rubble with significantly less worker exposure to safety hazards. It also removed approximately 5,000 trucks from the highway, reducing the chance of public accidents.[100,120]

<u>Development of the "InstaCote" Process for Packaging Large Pieces of Equipment</u>

Thousands of man-hours of difficult and dangerous size reduction in anti-contamination clothing were avoided by use of InstaCote.

The driver for developing the "InstaCote" packaging process was to avoid size reduction of large pieces of equipment – pieces too large to fit in a cargo container (e.g., in lieu of diamond wire cutting, etc.).[121] Some pieces of uranium metal forming equipment had been purchased and received as a single massive unit, and would have been difficult to size reduce to fit into the 8' X 8' X 30' maximum size of cargo containers. Instead of creating custom strong, tight boxes around the equipment, the "InstaCote" process was developed. The oversized equipment is placed on a strong (typically custom) pallet, shrink wrapped, and sprayed with multiple layers of "InstaCote" polyurea coating (similar to truck bed liner) to form a DOT "strong-tight" container. The ability to characterize the equipment using the SCO process supported the use of "InstaCote" packaging. Easily thousands of man-hours of difficult and dangerous size reduction in anti-contamination clothing were avoided by use of InstaCote.

<u>Preferential Use of Larger TRU Waste Containers (Standard Waste Boxes)</u>

The driver to use standard waste boxes (SWBs) instead of drums was the desire to minimize the size reduction of equipment and to reduce the number of containers of TRU waste to characterize and handle. Disposal of TRU waste in 55-gallon drums had been the packaging method of choice due to the easier physical handling of the smaller containers and the belated development of NDA techniques for SWBs. However, for all but the smallest items of equipment, the use of 55-gallon drums resulted in either considerable unused (void) space or additional size reduction of materials at a substantial labor and worker safety cost; the use of SWBs resulted in improved packing density. Also, the costs for managing the wastes correlated strongly to the number of containers handled, i.e. the costs are similar for drums and for SWBs, although the SWB waste volume is nearly ten times greater. Thus, SWBs were used whenever practical, with occasional relatively minor exceptions (e.g. use of drums of Raschig rings and sludge based on NDA considerations).

Worker safety often leads to improved cost and schedule efficiency when it focuses on improving methods for achieving work.

For the Site to use SWBs for the TRU waste generated from the size reduction of process equipment there needed to be an efficient means of reliably determining the fissile material quantity. The Site worked with LANL to implement the upgrade of LANL's original high-energy neutron counter, implementing the "Super-HENC" as a mobile unit. The Super-HENC was then integrated into the Site TRU waste characterization process.[122] The increased use of larger TRU waste packaging also depended on the upgrading of Site TRUPACT II loading capabilities and the consolidation of TRU waste codes to avoid unnecessary segregation.

Tracking Waste to Improve TRU Waste Management

While Rocky Flats had long experience with a database that tracked some waste information on a container-by-container basis, prior to beginning the closure process much of the information required as part of the quality assurance process was contained on "travelers" attached to the containers. Information collected on the database was manually keyed into the database resulting in delays, errors, and incomplete information. As the waste generation increased, particularly the TRU generated from residue processing, a system was implemented using bar codes, scanners, and direct input from certain characterization equipment. The system resulted in improved residue process control, a substantially reduced entry error rate, improved efficiency, reduced worker exposure, and better waste quality assurance program compliance and traceability.[123]

Gas Generation Testing to Improve TRU Waste Characterization

The requirements for shipping and disposing of TRU waste include criteria on the quantity of hydrogen that may be present within the waste and provides a standard formula that may be used to estimate the hydrogen based on the TRU activity and packaging configuration. The requirements also allow for direct testing of the hydrogen levels in the waste drums or other approved containers. As the Site moved to dispose of higher activity residues and wastes, use of the standard formula would have resulted in packaging or repackaging materials into containers with as little as 9 grams of plutonium per drum, well below the 325 grams of plutonium otherwise allowed. The Site developed and qualified a testing system to measure the actual levels of hydrogen in the drums that included providing the reproducibility and quality assurance necessary to receive appropriate disposal site and regulatory approval. The mobile system allowed drums to be characterized in their storage location with relatively little additional movement.

Had the Gas Generation Testing system not been implemented the Site would have had to package and load 17,000 additional drums of TRU to dispose of the same quantity of actual waste.

As a result of using this system the Site was able to place more plutonium in each drum. Had this system not been implemented the Site would have had to package and load 17,000 additional drums of TRU to dispose of the same quantity of actual waste. Moreover, the DOE would have had to transport, and the WIPP site would have had to dispose, this additional volume. The Site additionally would have had to repackage numerous drums that were otherwise suitable for disposal,[124] incurring considerably greater cost, schedule, and personnel exposure.

Use of Reusable or Flexible Container Systems

The driver for selecting differing containers to support the closure activities was to reduce the overall process cost for the decommissioning packaging effort, waste containers, transportation and disposal. It was also used as an external wrapping to ensure container DOT compliance instead of repackaging.[125] For numerous wastes (such as soil, tanks, or other materials), nominally 8-mil plastic covers or sacks were cheap, convenient, DOT-approved, strong-tight containers. Containers were purchased in various sizes and shapes to fit in frames (for soil loading), reusable gondola cars,[100] or end-dump trailers; or custom made to fit specific equipment. Reusable "intermodal" containers transported by truck or rail provided another alternative (although they still required liners for contamination control).

Container decisions depended on transportation distance to the disposal location, disposal site handling and emplacement requirements, differing disposal fees, project conditions and loading facilities, and type and activity of the waste. The bulk of the Rocky Flats radioactive waste was disposed of at WIPP (TRU waste), NTS (LLW) and Envirocare (LLW and Low-level/RCRA mixed waste), with selected smaller waste streams disposed of at other disposal facilities. The other technologies that most impacted the container choices were facility and equipment decontamination methods, and facility demolition approach.

B. Glovebox and Tank Decontamination

Since the most technically challenging portion of the Closure Project was the plutonium process decommissioning, the technologies used to address preparation for its removal are discussed in more detail. The ability to decontaminate process equipment and avoid the TRU waste generation and size reduction effort resulted in substantial cost savings to the Closure Project.[94]

Cerium Nitrate Decontamination Process

Cerium Nitrate was also effectively used in a remote spray application inside tanks for decontamination, reducing activity levels to low-level waste, and avoiding size reduction and manual work in confined spaces.

The driver for use of the Cerium Nitrate process was to reduce TRU waste volume, reduce residual contamination levels to make size reduction safer, and reduce the amount of size reduction by disposing of more process equipment as larger pieces of LLW. The process involved the use of a "superoxidant" as a solvent to extract the plutonium oxide from the contaminated surfaces (mostly gloveboxes and tanks) and allow it to be readily wiped or washed off. This decontamination enhancement reduced surface contamination and overall radioactivity, in most cases to below TRU threshold concentrations.[114]

One particular success in the use of Cerium Nitrate was with Building 371 gloveboxes that had been fabricated with lead shielding sandwiched within the glovebox walls. If the shielding was not removed (removal was an expensive and time-consuming effort) the size reduced gloveboxes would become low-level/RCRA mixed waste, which could not be disposed of at the NTS facility and were subject to radically reduced radioactivity limits if disposed of at the Envirocare facility. An equally undesirable alternative was the size reduction and TRU disposal of all of the gloveboxes. The Cerium Nitrate process was effective in reducing the contamination concentration to less than 10 nanocuries/gm, an order of magnitude below levels previously consistently achieved. This allowed large pieces of glovebox to meet the Envirocare waste acceptance criteria as low-level/RCRA mixed waste at a considerably reduced overall effort and cost. Cerium Nitrate was also effectively used in a remote spray application inside tanks for decontamination, reducing activity levels to low-level waste, and avoiding size reduction and manual work in confined spaces.

The decontamination method worked in combination with SCO characterization and use of cargo containers to minimize the size reduction of highly contaminated equipment. It was developed and used in parallel with Acid-Base Decontamination Process (some substrates were better addressed with Cerium Nitrate, others with the Acid-Base process). It was used subsequent to the Raschig Ring Vacuum for tanks and with strippable coatings for surface decontamination.

Acid-Base ("Three-Step") Decontamination Process

The driver for use of the Acid-Base process was the same as for Cerium Nitrate, to reduce TRU waste volume, reduce residual contamination levels to make size reduction safer, and reduce the size reduction required by allowing more process equipment to be disposed of as larger pieces of LLW. The process involved the use of a proprietary multi-step process to extract the plutonium contamination from the contaminated surfaces (mostly in gloveboxes) to reduce overall radioactivity, in many cases to below TRU concentrations.[126] The decontamination method worked in combination with SCO characterization and use of cargo containers to minimize the size reduction of contaminated equipment. It was developed and used in parallel with Cerium Nitrate Decontamination Process (some substrates were better addressed with Cerium Nitrate, others with the Acid-Base process).

Use of Vacuum Systems for Removal of Bulk Contaminated Material

Use of the raschig ring vacuum prevented worker contamination while packaging the rings in disposal-compliant containers.

Two systems were deployed at the Site that used suction equipment to remove bulk contaminated equipment, one to remove raschig rings from tanks and one to remove gravel from pits. The driver for the use of the raschig ring vacuum was the need to remove glass "rings" (used to prevent nuclear criticality in tanks), to prevent contamination uptake by workers and puncturing of protective clothing, and to package the rings in disposal-compliant containers. This was a particularly large problem at Rocky Flats, with hundreds of large tanks filled with raschig rings, i.e. 1-1/2 inch diameter by 1-1/2 inch long hollow cylinders of borated glass. The process[127] used a specialty vacuum cleaner with sufficient power, exhaust filtration, and criticality controls as an alternative to hand-removal. This technology interacted with Cerium Nitrate to allow its use for decontaminating tank interiors, thereby avoiding or reducing the need for size reduction. Raschig rings in drums, the waste packages resulting from the process, could be more accurately assayed to determine whether the waste was TRU or LLW.

In Building 776 pits up to 18 feet in depth containing potentially contaminated gravel inside the building represented a significant and unique technological problem. The Site obtained a vacuum system similar to that used in mining operations and modified it to act as its own shipping container. It installed sufficient HEPA filtration to ensure that radioactivity was not spread during the vacuum operation.[128]

C. Size Reduction

The size reduction of plutonium processing equipment to allow it to be packaged in TRU waste containers presented particular worker safety and cost efficiency challenges.

Plasma Arc Cutting

The driver for plasma arc cutting of contaminated metal was the need to increase the speed of size reduction in ways that reduced worker stress, fatigue, and potential for injuries (versus hand-held reciprocating saws), but retaining the flexibility to cut varied shapes. Plasma arc cutting[129] used hand-held plasma-arc cutting torches to cut metal at several times the cutting speed of standard hand-held saws. Additional fire risk and contaminant dispersal limited the use of this technology to more controlled environments. This technology depended on the "Birdcage" containment systems and glovebox and tank decontamination techniques to reduce and control contaminant spread. The combination of equipment decontamination, SCO characterization, and LLW disposal was a competing technology. Over time this combination of technologies reduced the percentage of contaminated equipment that required size reduction, and reduced the impact of the plasma arc process. However, there was always a substantial quantity of the process equipment that was best handled through size reduction.

Plasma arc cutting of contaminated metal increased the speed of size reduction in ways that reduced worker stress, fatigue, and potential for injuries, yet retained cutting flexibility.

"Birdcage" Containment

The Birdcage Containment system[129] came out of the need to control radioactive airborne contamination during equipment size reduction. Early in the Site's decommissioning of plutonium-contaminated gloveboxes, high airborne contamination levels ("derived air concentration", or DAC) exceeded operating parameters for workers in supplied air suits. To provide additional physical controls to reduce the DAC, Rocky Flats developed "cabinet" enclosures to provide an additional layer of containment within larger soft-sided containment structures. These cabinets were large enough to surround the glovebox, and provided airflow control to remove contamination from the worker environment. The cabinets had portable cutting tools suspended from retractable load-bearing cables to reduce worker fatigue. Workers would then reach inside the cabinet to perform size reduction work, hence the name "birdcage." This better control of airflow reduced the airborne contaminants to levels where workers could work in lower levels of PPE and reduce potential for skin contamination (due to lower levels of surface contamination on PPE and work surfaces). However, working partially inside the cabinets degraded ergonomic factors and size reduction

Birdcages were developed to provide additional physical controls to reduce high airborne contamination levels which exceeded operating parameters for workers in supplied air suits.

efficiency. This was partially compensated by lighter tooling, aids for gripping and lifting, and other tooling improvements. The Birdcage containment interacted with various tooling improvements and the plasma arc cutting to provide an improved method to deal with large, extremely contaminated equipment not suitable for decontamination. It competed with the combination of equipment decontamination, SCO characterization, and LLW disposal as a method to dispose of highly contaminated equipment, and to some degree with fogging as a means of airborne contamination control. Better training and experience allowed workers to reduce levels of physical controls over time while maintaining DAC and surface contamination at acceptable levels.

Improved Size Reduction Procedures, Training, and Experience

The driver for improved work processes was to provide continued improvement in safety, work efficiency, and contamination control. The approach depended on getting work started, even with heightened controls and less-than-optimal efficiency, and then provided continued worker and first-line supervisor feedback for size reduction methods, contamination control, and procedure and paperwork requirements. This typically involved engineering and operations staff under a common project manager, and supported continued improvement in efficiency and introduction of new techniques. The approach addressed workflow bottlenecks such as reducing unnecessary movement between controlled and uncontrolled areas, locating waste containers convenient to work locations, and other means of reducing unproductive time. It interacted to implement and enhance the impact of new technologies and benefited from organizational cooperation, and Safety System Support. Although these actions were not TD in the typical sense, they represented continuous opportunity for innovation, and particularly innovation linked directly to the needs of the workforce. In this way they continually supplemented and reinforced the other TD efforts.

D. Building Decontamination

Building decontamination was defined as both the removal of contamination from facility surfaces (as opposed to highly-contaminated process equipment), and also the removal of equipment associated with the facility such as heating systems and ventilation ducting. Decontamination of facility equipment located in operating areas was not cost effective. The cost of equipment characterization in plutonium facilities for unrestricted release was typically greater than the cost of disposal as LLW. For uranium facilities, the different release levels allowed cheaper characterization of unpainted surfaces; as a result, a large

Decommissioning is a crude business that requires flexibility and resists elegant solutions portion of the support equipment was released and disposed of as sanitary waste.

Fogging

The driver for fogging was the need to reduce the airborne contamination (i.e., DAC) present in rooms to acceptable levels for workers in more work-efficient forms of PPE. Very high DAC levels were often present in canyon or vault areas, and were exacerbated by work activities that disturbed and suspended contaminated dust. The Fogging process[130] involved the use of a device to diffuse an aqueous aerosol (i.e., "fog") containing glycerol through an opening into the contaminated room or space, effectively "scrubbing" the air of particulate. Upon drying, the highly mobile contaminated dust was deposited on surfaces, reducing the airborne contamination levels by orders of magnitude. The deposited glycerol was much less susceptible to resuspension, although it was soluble and could be subsequently decontaminated from facility surfaces. The process interacted with technologies using strippable coatings; these were polymeric coatings sprayed on surfaces that would bind the glycerol-immobilized contamination, either for further decontamination (by stripping the coating off the surface after it was dry) or for reduction of surface contamination levels to improve area working conditions. Dyes that fluoresced in ultraviolet light could also be added to the fogging liquid to allow easy identification of contamination on clothing during removal of personal protective equipment.

Ultra-high Pressure Abrasive Water Jet Cutting

The driver for using water jet cutting was the need to cut large, moderately contaminated equipment, while suppressing airborne contamination and reducing the need for contamination control enclosures. The process[131] used water jets containing abrasives at pressures greater than 10,000 psi to cut contaminated metal equipment such as tanks and vessels. Equipment had to be under conditions where liquids were contained, and contamination was at levels below which criticality was a concern, and the water lances were a safety concern – they were difficult to control, and could easily cut flesh, electrical cables, and conduit. Using technologies that allowed the recycling of water was advantageous to minimize liquid waste generation.

Water lances were a safety concern – they were difficult to control, and could easily cut flesh, electrical cables, and conduit.

Chipless Duct Cutter

The driver for developing the chipless duct cutter[132] was the large quantity of highly contaminated cylindrical exhaust duct that maintained the negative pressure differential for process equipment, and connected the gloveboxes to the filter plenums. The duct was difficult to remove due to its often-inaccessible location, the difficulty in fixing contamination within the duct, and difficulty in erecting contamination barriers (e.g., soft-sided containment). Saw cutting resulted in a substantial spread of contamination and increases in the level of airborne contamination, as well as higher injury rates from the reciprocating saws.

The process was to use a rotating cutter (similar in principle to a pipe or tube cutter), where knives were rotated around the cylindrical duct until the duct was sectioned off. The cutter could be operated in a small semi-enclosed contamination control enclosure to minimize contamination spread, due to its proximity to the duct and the relatively low ejection of contamination during cutting (as opposed to a saw blade that moves in and out of the contaminated duct interior). Limited set up area allowed work to occur in confined or elevated areas such as duct or pipe chases. Round duct was removed in sections convenient for packaging, with duct ends sleeved and tied off – the duct interior was not exposed to the work environment during handling. The technology interacted with rigging and access enhancements such as lift tables, improvements in contamination control enclosures, and improvements in training and procedures.

Explosive Cutting

The driver for explosive cutting[133] was worker safety, in particular to avoid elevated work with heavy materials on scaffolds. The process involved using small charges to cut bolts, hangers, and other metal and masonry materials, principally to take elevated materials and drop them to floor level for further processing. As an example, large uranium facility duct located at high-bay ceiling level could be cut in large lengths by workers on man-lifts while it was still suspended, and then the hangers cut explosively to lower it to the floor level for further size reduction. Explosive cutting was done during off hours with workers removed from the building. The technology was supported by powered and hydraulic equipment.

...small hydraulic equipment could either be used to grasp, shear, and pneumatically hammer materials such as duct, conduit, walls, and piping to avoid manual handling.

Building Interior Powered Hydraulic Equipment

The driver for use of powered and hydraulic equipment inside buildings[134] was improved worker safety and efficiency on materials where contamination spread could be controlled. The process utilized small hydraulic equipment that could be used to grasp, shear, and pneumatically hammer materials such as duct, conduit, walls, and piping to avoid manual handling. “Bobcat” vehicles were also used to support loading of masonry and other materials into waste containers. Extra industrial safety precautions were required to provide adequate ventilation for workers in rooms with the propane or natural gas-powered vehicles, and training and safety controls for equipment operation.

Treatment Approach for Low Level Mixed Waste Sludge

The largest legacy LLMW stream that was handled during the Closure process was approximately 732,000 gallons of pond sludge. The pond sludge resulted from the Site's draining of its solar evaporation ponds in the 1990s, which had resulted from a failed solidification attempt and substantial regulatory conflicts. The sludge was stored in 79 fiberglass 10,000-gallon tanks on a RCRA-permitted pad under large tent structures. The Site conducted extensive treatability studies to assure that the solidified product materials would contain no free liquids and be LDR-compliant. After receiving regulatory approval, the Site processed the sludge – mixing it with polymer and other chemicals – and placed the resulting materials in intermodal container for transportation to the Envirocare facility. The tanks were partially size reduced to allow better access to the residual materials, and then the tank bottom was itself cut up and disposed of as waste. The process had to address different sludge densities and constituents and the difficulty in pumping such inconsistent materials.[135]

Another LLMW sludge stream resulted from the draining of two large steel evaporator feed tanks. The sludge was pumped out using a remote lance system and processed through a centrifuge to increase the solids concentration. The resulting sludge was packaged in drums and SWBs and sent to Envirocare for final treatment and disposal.[136]

Hydrolazing

The hydrolazing process used an ultra high-pressure water spray that readily removed the paint and surface layer of concrete without creating substantial airborne contamination.

The driver for the use of hydrolazing[137] was that, for plutonium facilities, most of the contamination on concrete was near the surface, in many cases encased in layers of paint. There was a need for a means of rapidly removing paint and upper surfaces of concrete without causing contamination spread or airborne contamination. The paint removal was also necessary to allow surveying of the underlying structural surfaces to determine residual contamination levels for facility release, since the paint also masked surface alpha readings.

The hydrolazing process used an ultra high-pressure water spray that readily removed the paint and surface layer of concrete without deep penetration and without creating substantial airborne contamination. The decontamination technology was less sensitive to cracks and small variations in surface smoothness than some mechanical decontamination techniques. Initially spray nozzles were hand-held which represented a safety hazard. Subsequently, the spray nozzles were mounted within a contained, movable, vacuum-supplied enclosure similar in size to a lawnmower housing. The water and solids were vacuumed into a cyclone separator with a filter that separated the solids as a waste sludge and allowed the recycling of the water. The movable enclosure was deployed from a hydraulic boom to decontaminate floors, walls, ceilings, and (with a special enclosure) columns. Results were generally good, although in some cases the process appeared to drive contamination further into the concrete. The technology was dependant upon the liquid waste treatment technology to allow recycling of water and used in conjunction with concrete cutting, scabbling or impact hammering for removal of the "hot" spots identified after the surface paint has been removed. It competed with cheaper dry surface techniques like concrete shaving, particularly in uranium buildings.

Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) Survey Techniques

The driver for using MARSSIM survey techniques was the need to use an approach to release facilities that was efficient and had credibility with the public and regulators; 100% surveying of all potentially contaminated facilities would have been prohibitively expensive. Various governmental agencies had certified the MARSSIM methods to characterize facilities and environmental sites. The methods used statistical survey techniques and risk assessments to determine residual contamination levels, depending on the method of disposal and/or the future use of the site. Rocky Flats chose to use the MARSSIM statistical survey techniques supplemented by 100% surveys in selected areas to support waste determination and facility/material unconditional release. The risk assessment component was included for environmental restoration activities. Interior walls could be segregated and removed piecemeal as sanitary or recycled material after release. The ability to effectively employ the MARSSIM approach for unconditional release of facilities was dependent on effective radiation survey instrumentation and database management,[138] and on early agreement with regulatory organizations regarding the exact release requirements and techniques.

MARSSIM survey techniques provided an approach to release facilities that was efficient and had credibility with the public and regulators and avoided 100% surveying of all potentially contaminated facilities.

Ventilation Stack Characterization

The ventilation exhaust stacks for contaminated facilities represented unique demolition problems. Uncontaminated stacks are normally demolished by explosively removing a portion of the stack base and causing the stack to topple into a designated impact area. Water sprays are used to reduce the dust that otherwise becomes airborne on impact. Manual dismantlement, an approach that might be used to minimize dust emissions from a lower-profile contaminated structure, would entail substantial safety risks (and/or costs to avoid that risk) due to the stack height and configuration. Similarly, manual surveying that might be routine for building interior surfaces becomes difficult inside of a stack.

The Site developed an automated system that could be placed on the top of the 170-foot Building 771 stack by a crane that would progressively lower instrumentation suitable for detecting contamination on the interior stack surfaces. The system provided scans of 676 locations, four per axial foot that allowed the majority of the stack to be unconditionally released. Along with some additional surveys at the stack base, the use of this system allowed the whole stack to be demolished using conventional explosive demolition techniques.[139]

Use of Radio Frequency Alarms as Buildings Go "Cold & Dark"

During the decommissioning process the electrical power and utility services were removed from a building to reduce the possibility of worker injury from electrical events. There were cases where sufficient combustibles remained in the building to require fire detection and suppression. In order to avoid rewiring the fire alarm system the Site developed a system that interfaced with existing fire detection systems to provide the necessary fire detection coverage. The system was solar powered and used wireless technology to interface with the Site fire alarm system.[140]

E. Building Demolition

Demolition was defined within the Closure Project as the demolition of the facility after all of the equipment and contamination had been removed, with the facility being as close to an uncontaminated facility as practical.

Explosive Demolition

Explosive demolition was far more effective for smaller scope applications, such as towers and stacks, and the harmonic delamination of concrete walls.

The driver for explosive demolition[141] was worker safety; i.e., removing workers from the vicinity of unstable structures, and to improve demolition efficiency for concrete buildings. The major difficulty was coordination with public and regulatory organizations to ensure their support, and to assure the public of the Site's ability to control any release of radioactivity through decontamination, modeling, water spray, monitoring, and test projects. The explosive demolition process used commercial explosive demolition contractors to explosively cut the building structural members and allow the structure to collapse upon itself, or implode. The resultant debris was then most often disposed of as sanitary waste or as recycled concrete using standard construction equipment; in selected cases the debris was left in place with regulatory approval. Explosives were used to topple air stacks and to crack massive (eight-foot thick) concrete walls through "harmonic delamination[197]" to ease size reducing the concrete by conventional hydraulic hammers. Prior to demolition, building surfaces were first decontaminated to release levels (or acceptable residual contamination levels). During demolition, water sprays were used to reduce fugitive dust emission and local air monitored to confirm the presence or absence of contaminant releases. Although the demolition is rapid, there were substantial preparation times, some of which could not be conducted in parallel with in-building activities. The building structural members needed to be weakened so that the final explosive detonations would confidently collapse the structure. This added additional structural engineering analysis to verify that adequate building structural integrity was maintained for worker safety. The technology depended on decontamination and surveying techniques and on air dispersion and other computer modeling of short and extended-duration demolition activities. Transport of explosives on Site also provided significant security and safety authorization basis challenges. Based on these additional challenges required to implement explosive building demolition, it was only used for one large facility. Explosives were far more effective for smaller scope applications, such as towers and stacks, and the harmonic delamination of concrete walls.

<u>Commercial Demolition</u>

The driver for use of commercial demolition, i.e. use of large hydraulic equipment often mounted on tracked excavators, was to avoid putting workers in harms way and improve efficiency. The process was similar to that used for explosive demolition, in that the building surfaces were decontaminated to release levels (or acceptable residual contamination levels), and then the construction trades used standard large construction excavators with hydraulic shears, hammers, etc. Significant quantities of water were sprayed on the sections being demolished to reduce fugitive dust emission, and air monitoring conducted to demonstrate the absence of contaminant releases.

In some instances steel plates were used to cover and protect clean rubble from re-contamination during demolition.

When the buildings contained contaminated structural members and their removal prior to demolition would constitute a worker hazard, this demolition process was more amenable to engineering controls and selective demolition of sections of buildings. Prior to demolition, the radioactivity on the contaminated surfaces was fixed; in other instances steel plates were used to cover and protect clean rubble from re-contamination. The sections were then demolished, and the contaminated materials segregated for disposal as low-level waste. The technology also interacted with decontamination and survey techniques and methods to provide bulk disposal or recycling of environmental media.

F. Environmental Restoration

The following approaches and techniques were particularly useful in Rocky Flats Environmental Restoration (ER) activities. Some are discussed further in the Environmental Restoration section.

Temporary Structures for Remediation of High-Contamination Areas

The driver for using temporary, movable structures[142] during the soil remediation was the need to cost-effectively provide environmental controls during removal of plutonium-contaminated soil and address stakeholder concern about windborne dispersion. The remediated area had become contaminated in the 1950s from plutonium-containing solvents leaking from drums stored outside. The contaminated soil was relatively near the surface of an area subject to high winds. The remediation project purchased movable sprung structures (tents) large enough to enclose operating construction equipment and a staging area for intermodal waste containers, but small enough to be moved progressively across an area of contaminated soil without disassembly. Additionally, the structures provided better control for soil characterization and higher worker comfort and productivity during inclement weather.

Temporary moveable structures addressed concerns about windborne dispersion during soil remediation, provided better control for characterization efforts, and higher worker comfort and productivity during inclement weather.

On-Site Laboratories to Support Environmental Analyses

The driver for limited onsite laboratory capability was the need for rapid turnaround for analyses of selected contaminants in environmental media. The approach was to provide trailer-based laboratory instrumentation to support the rapid turnaround analyses for the selected contaminants of concern necessary to distinguish the soil to be removed from the soil that could be left in place. Only limited analyses were needed, covering only a limited number of constituents, and with resolution only as necessary to identify whether the constituents were above or below the soil action levels. The analysis process included a data management system and computer-based contaminant map that supported field decisions virtually real-time. Offsite laboratories were used for confirmatory analyses and to provide a complete suite of environmental analyses, at a more competitive price than was available from onsite or dedicated facilities. This technology benefited from improvements in characterization instrumentation for environmental media.

Contaminated Ground Water Treatment

There were three areas at Rocky Flats of contaminated groundwater, two involving primarily volatile organic compounds and one involving uranium and nitrates. After the removal of the concentrated materials that were the sources of the groundwater contamination, impermeable barriers were installed and the groundwater collected and treated. The treatment systems relied on passive treatment approaches that had relatively low operation and maintenance costs, and operations continue under Legacy Management.[143]

Information Management to Support Remedial Action

As the Site proceeded into the last few years of closure it recognized that its investigation and characterization environmental data would substantially increase. Also, the shortened decision-making process needed for accelerated closure would require improved data organization to obtain the necessary information. The Site implemented an environmental data management system that combined geo-spatial data with its characterization, legacy, and laboratory data to provide a single comprehensive database. The system integrated the data quality and verification and validation processes to provide reliability and to automate and facilitate the compliance process. Finally, the system supported the modeling and risk assessment processes necessary to provide the information to justify remediation decisions.[144]

Under Building Contamination Characterization

In the Rocky Flats industrial area with many contaminated buildings located adjacent to each other it was necessary to characterize the soil under the buildings to properly determine and integrate the eventual remedial actions. Normal drill rigs could not be operated in the buildings and, since the buildings were contaminated, direct drilling through the floor slabs potentially would have released contamination to the environment. The Site's approach was to use Horizontal Directional Drilling and Environmental Measurement while Drilling, a process developed at Sandia, to collect the necessary radiological information. The process used a pneumatic drill head and associated radiation detector to drill under the building foundations from the outside the building perimeter and provide preliminary measurements for selected buildings.[145] As a result of these measurements the Site was able to substantially reduce and bound its estimates of the under building radiological contamination. This supported the planning and discussions with the regulators for allowing major sections of the plutonium facility foundation to remain in place after demolition.

As a result of these measurements the Site was able to substantially reduce and bound its estimates of the under building radiological contamination.

G. Security Reconfiguration

The change of the Rocky Flats mission from production to restoration inherently reduced the Site security risks, particularly as Special Nuclear Material (SNM) and classified materials were consolidated and removed from the Site. What remained was a security infrastructure designed for plutonium operations that was unnecessary and costly, both for the labor and facilities to provide the security and for the closure activity effort and delay to comply with the security requirements. The driver for the security analyses, as well as the associated implementing techniques such as changing the physical security configuration or receipt of waivers, was to reduce the inefficiencies and costs imposed on closure activities by the security requirements while maintaining an acceptable security posture. The following approaches were particularly useful in addressing safeguards and security issues during Site closure. Additional information is provided in the Security Reconfiguration section.

All plutonium processing, storage, and infrastructure was consolidated in an existing structure.

Security Posture Time-phased Analysis

The overall approach for matching the changing security needs and systems was to examine the actual security vulnerabilities and controls against the DOE Material Control and Accountability, and Security requirements to determine which controls were really needed and which were unnecessary or redundant. A parallel effort was to review the Closure activities (a baseline was required), identify which security constraints really were causing additional costs, and define options that would reduce those costs (i.e., where the benefit was greater than the cost of implementing the change). For those activities with a potential net benefit, the Site further evaluated the combinations of physical changes, changes in security processes, or submittal for waivers or variances that could most practically be implemented.

The area that would remain protected, the modified PA, was surrounded by a newly-built physical barrier that provided substantial physical protection and intrusion detection capability.

Protected Area Reconfiguration

The original Protected Area (PA), designed to facilitate production by providing security surrounding all plutonium facilities, imposed unnecessary restrictions for entry/access and personnel security on facilities in which decommissioning was occurring and which did not contain large inventories of accountable materials. The process used to implement the reconfiguration was to consolidate all plutonium processing (PuSPS, Residues) in an existing structure (Building 371), including all storage of SNM, the processing equipment, and infrastructure necessary to support those operations. The area that would remain protected, or the modified PA, was separated by a newly-built physical barrier that provided substantial physical protection and intrusion detection capability but substituted additional labor-intensive security operations to mitigate for reduced levels of physical security equipment compared to the original PA. The combination of physical security and security operations provided equivalent protection but reduced the installation cost and, more importantly, the procurement, construction, and start up time for a system that would only operate for a couple of years.

The limited storage space within the modified PA required the Site to remove as much lower-grade inventory (Attractiveness Levels D&E) from buildings undergoing decommissioning as well as waste material not requiring additional processing, and to consolidate it into stand-alone secured areas. Facilities undergoing decommissioning outside of the modified PA needed to reduce inventory quantities and assess in-process inventory configuration to allow closure of Material Access Areas. The major PA reconfiguration effort depended on additional physical reconfiguration (e.g. new barriers and intrusion detection systems), effective use of Vulnerability Analyses (e.g. Pipe Overpack Container storage in limited area), and support within various levels of the DOE security organizations with waivers and variances to DOE Orders. It was also dependent upon detailed closure planning to identify time-dependent activities and needs.

Vulnerability Analysis

The driver for the innovative use of the vulnerability analyses process was the need to assess the impact of changes on the overall Site vulnerability based on the combination of risk reduction due to closure and physical changes needed to support closure. The Site Safeguards and Security Plan originally established security requirements based on pre-closure characteristics (e.g. material at risk, threats, and barriers) for selected facilities and areas; the plan was updated yearly and supported by a detailed vulnerability analysis. The process used to develop the vulnerability analyses was the standard methods defined in the DOE Orders; the process used to implement the vulnerability analyses was to incorporate it into the annual Site Safeguards and Security Plan update.

These refinements in the vulnerability analyses for selected areas allowed changes in closure activities that resulted in significant cost improvement without loss of adequate security.

The team developing the annual update conducted detailed vulnerability analyses, modeling analyses to determine risks and consequences based on proposed new configurations and proposed changes to the security posture. The analyses were iterative; if a configuration indicated unacceptable vulnerabilities, planned configurations or activities were changed and remodeled to ensure compliance. These refinements in the vulnerability analyses for selected areas allowed changes in closure activities that resulted in significant cost improvement without loss of adequate security. The changes were implemented through the revision to the SSSP with normal DOE-HQ reviews.

One particular characteristic of decommissioning was that SNM materials are often inaccessible – spread in very small quantities in duct systems (requiring many hours for trained D&D workers with specialized tools to remove) or packaged in extremely robust containers (requiring hours and special tools to remove). Incorporating the time necessary for a threat to access and remove these materials into the vulnerability analysis models in many cases supported significant improvement in security posture, and allowed other security elements to be relaxed. A second major factor identified in the analyses was that although there was a loss of capability for the physical security systems particularly in the newly built security barrier, the substantial reduction of distances in the modified PA improved security force response times, partially compensating for the loss of capability. This supported the need to evaluate multiple factors in the vulnerability analyses.

The technical output from the vulnerability analyses served as the basis for requests for waivers and variances and the design criteria for changes to physical configurations and relocation of wastes. The vulnerability analyses benefited from improvements in accountability instrumentation and modeling of SNM in inaccessible areas such as glovebox equipment and ducts, which allowed the use of more accurate SNM quantities and reduced the use of conservative assumptions.

Waivers and Variances

The driver for implementing waivers and variances to DOE Safeguards and Security Orders and requirements was the need to take advantage of flexibility in the system originally designed to support a stable production operation and shown to be unnecessary by a vulnerability analysis. The process was to review areas where significant efficiencies could be obtained by receiving a waiver or variance, and work with DOE-RFFO and DOE-HQ organizations to receive the waiver or variance. Examples were the variance for safeguards termination authorization of Attractiveness Level D and E materials and "Safeguard Termination Limit" materials to support the storage of such materials outside of the PA prior to shipment as waste, and variances to allow non-standard designs for intrusion detection systems and PA barriers. This process depended on the removal of materials from the Site and physical reconfiguration to reduce overall vulnerability and vulnerability analyses to provide the technical basis for the waivers.

The driver … was the need to take advantage of flexibility in the system originally designed to support a stable production operation and shown to be unnecessary by a vulnerability analysis.

H. Plutonium Packaging

When the decision was made to cease further plutonium weapons production at Rocky Flats and close the Site, the Site contained the largest SNM inventory of plutonium not fabricated into weapons in the country. It also contained virtually all of the country's inventory of plutonium "residues"- materials containing a high concentration of plutonium but which had not been refined prior to the Site's cessation of production operations. These materials had to be removed from the Site before security operations could be terminated and the Site could be closed, and in fact became the critical path effort for all initial closure efforts. The success of these technology development efforts was due to a long-term vision, coordination of efforts, and a focus on a technical solution to a complex problem; the success was reflected in that these techniques are now the baseline method to dispose of some of these materials as TRU waste. The following approaches were particularly useful in addressing plutonium packaging issues during Site closure. Additional information is provided in the Special Nuclear Material Removal Project section.

Rocky Flats housed the largest SNM inventory of plutonium not fabricated into weapons in the country, and virtually all of the country's inventory of plutonium "residues".

<u>Pipe Overpack Container</u>

The driver for development and implementation of the Pipe Overpack Container (POC) package[146] was to resolve a combination of TRU Waste disposal requirements, including the WIPP-WAC[147] TRUPACT II SARP,[148] and WIPP RCRA Permit,[149] to allow the disposal of residue materials. These requirements resulted from the DOE historically not recognizing that an end to plutonium operations would result in greater quantities of more concentrated plutonium-containing materials being disposed of as waste. The assumptions of TRU waste containing modest plutonium concentrations permeated all risk calculations, and resulted in numerous impediments to Site closure such as small quantities of plutonium allowed per drum. Accepting these restrictions would have increased disposal costs several-fold due to unnecessary processing and buying and handling several times the number of containers. Schedules would have been increased adding years to Site closure. TRUPACT II resources and a significant portion of WIPP's total capacity would have been wasted, at a tremendous cost to DOE and the country.

Developing and validating a hydrogen generation rate testing process provided direct package compliance data that, along with use of vented bags, avoided unnecessary repackaging of TRU waste.

A number of DOE organizations spearheaded by Rocky Flats created a standard package for low-mass/high-activity residues that fit inside a drum to take advantage of the WIPP handling infrastructure, but provided substantially more protection for the material during a transportation accident. This POC package included both six-inch and twelve-inch diameter pipes manufactured to provide protection for small packages in the event of fire or pressurization. The necessary safety and risk analyses were performed and the SARP changed to accept the revised package, all of which occurred over a period of years. The POC packaging supported the residue processing, and depended on the development and acceptance of residue characterization techniques since normal TRU waste characterization techniques were not accurate at residue plutonium concentrations.

Residue Processing to Meet WIPP-WAC

The driver for improvements in residue processing was the need to achieve compliance with the WIPP Waste Acceptance Criteria in parallel with the approval of the WIPP-WAC procedures. At the initiation of the residue processing effort the requirements for residue disposal at WIPP had not been completely defined. Definition required continued improvement in quality and processes, and close coordination with the WIPP organization to create the acceptance process to allow shipment of materials. The process included the implementation of NDA techniques and quality assurance processes for different container types and acceptance of residue characterization techniques for items shipped in POCs for which standard WIPP assay techniques were inadequate. Characterization process improvements included changing the TRU waste process designations to streamline shipping logistics and using statistics and process knowledge to characterize residue populations instead of 100% sampling. Developing and validating a hydrogen generation rate testing process provided direct package compliance data that, along with use of vented bags, avoided unnecessary repackaging of TRU waste. Residue processing development benefited from the development of the POC and continuous quality improvement, and improvement of NDA techniques to better address residue concentrations and configurations.

Characterization process improvements included changing the TRU waste process designations to streamline shipping logistics and using statistics and process knowledge to characterize residue populations instead of 100% sampling.

Safeguards Termination

During the development of the disposal path for higher-plutonium concentration materials such as plutonium fluoride and some plutonium oxides, it became clear that the materials were unsuitable for acceptance at the SRS SNM storage facility. The driver for developing and receiving acceptance of the blending process was the need to identify a disposal pathway for SNM materials for which there was no other disposal path. Rocky Flats received DOE Complex support to increase the discard limits for the higher-concentration materials, and developed a simple blending process to allow the materials to be mixed with non-radioactive materials into a form that would meet safeguard termination limits. The process was introduced into active gloveboxes inside the modified PA and operated as necessary to meet the WIPP waste acceptance criteria, concurrent with ongoing plutonium stabilization activities and decommissioning activities occurring in the same building. This process was a successor to the residue processing necessary to meet WIPP requirements and the implementation of the POC package.

Plutonium Stabilization System

DOE recognized that the elimination of Rocky Flats plutonium operations, and the need to store plutonium materials for prolonged periods of time, would exacerbate the problems with package integrity and pressurization already present in the stored SNM. This recognition resulted in a new DOE Complex-wide processing and packaging standard for SNM storage. A processing system had been developed and partially fabricated by a consortium to meet this standard. The system included substantial automation and complex mechanical devices designed to minimize operator exposure. The Site recognized that the startup, stabilization, and operation of the Plutonium Stabilization and Packaging System (PuSPS) to compliantly package all of the SNM for storage at the SRS SNM storage facility would be on the critical path to Site closure.

With the focus on accelerating closure, the original complex processing system was substantially reengineered and streamlined to substitute manual glovebox actions for automated actions while maintaining the final packaging systems necessary to meet the receiver requirements. It should be noted that even with the reengineering, the PuSPS system was unreliable and difficult to maintain operational. The largest cost and schedule overruns within the closure project were attributed to the PuSPS. The system was also directed at just the current Rocky Flats inventory and modified to be installed in an existing facility in the modified PA. Installation and operation of the system was also expedited. The ability to implement this technology depended upon the support for package certification (both of the PuSPS product containers and the transportation overpacks), disposition support in designating SRS as the SNM storage facility, and development of improved material characterization technologies. The ability to blend and package plutonium materials for disposal at WIPP that were below the plutonium concentrations required for SNM storage avoided the creation of a plutonium purification process that would have required substantially greater effort and schedule.

The largest cost and schedule overruns within the closure project were attributed to the PuSPS.

I. Safety System Support

The following approaches were particularly useful in addressing Safety issues during Site closure. Additional information is provided in the Safety section.

Decommissioning Basis of Interim Operation (DBIO) and Site Safety Analysis Report

Safety and Authorization Basis documentation previously used at the Site had addressed activities related to plutonium fabrication and recovery, not decommissioning; i.e. the operating processes and not a project. Additionally, the safety analyses were based on operational material-at-risk quantities, levels that are normally removed and packaged prior to the initiation of decommissioning. The driver for developing and implementing improved authorization basis documentation was to better address the risk conditions present during facility decommissioning and recognizing the temporary and time dependent nature of facility closure project activities. Instead of revising the facility-specific Safety Analysis Reports that had provided the Authorization Basis for operating facilities, the Site developed Decommissioning Basis of Interim Operations documents. These documents expedited the regulatory process for the authorization of nuclear facilities and incorporated elements supporting the relaxation of facility authorization basis requirements as packaged plutonium and plutonium-processing systems were decommissioned and removed from the facility. This allowed for a reduction in the compliance activities as the risks were reduced, and precluded the need to revise documents as the facility decommissioning progressed. Concurrently, the Site developed a Site Safety Analysis Report to provide an authorization basis for decommissioning activities in external areas and non-plutonium facilities and to analyze generic activities. The process benefited from the definition of the conditions under which the risk of a nuclear criticality within a facility would no longer be credible, with the resulting removal of requirements and controls.

The DBIO process allowed for a reduction in the compliance activities as the risks were reduced, and precluded the need to revise documents as the facility decommissioning progressed.

Training and Procedures

The driver for providing continuous improvement in training and procedures was the need to avoid an increase in accidents as the occupational safety risks increased during decommissioning. The Closure Project successfully implemented the Integrated Safety Management process to facilitate safe work, track accidents and near-accidents, and respond with improved equipment, training, and procedures. In conjunction, the Closure Project continued to streamline work packages to provide the appropriate level of detail to allow work to proceed safely without unnecessary actions or work stoppages. For higher risk activities, particularly in contaminated environments, the Closure Project utilized approaches to ensure better control of the safety environment. This included selected use of better-trained Site personnel (i.e., D&D workers) and subcontracting work with substantial prime contractor management involvement. Additional training was provided as new techniques were being implemented and as safety statistics provided indications of accident or near-accident trends. The execution of pilot projects early in the Closure Project provided experience that was used throughout the project.

KEY LEARNING POINTS

1. The technologies that will be applicable to a closure project will vary based on the kind and magnitude of the site characteristics and project scope. The magnitude of the plutonium process decommissioning and the nature of the transuranic contamination defined how technologies could be applied.

2. For the Rocky Flats Closure Project the greatest portion of the work was decommissioning. Decommissioning is essentially the front end of waste processing – it depends on the disposal options and needs to be optimized beginning to end. This includes consideration of how actions will impact the waste type (TRU vs. LLW vs. LLMW), and how packaging impacts transportation and disposal cost.

3. Placing the decisions on technology deployment in the hands of the management directly responsible for execution of the activity ensures that the effort remains focused and accountable, and is more likely to be deployed. This is also an excellent way to engage the workforce and gain their buy-in, since in most cases it is the workforce that uses (or doesn't use) the new technology.

4. Beginning work and placing incentives in place to deploy new technologies to address specific problems has a greater chance of success than creating a new technical system and waiting to begin execution until the system is started. This is the evolutionary vs. revolutionary mindset which Rocky Flats consistently found to be more effective.

5. Identifying the technological approach that would be the winner before the actual work was begun was speculative. For substantial project risks that required TD support, parallel development of competing and/or complementary technologies was most effective.

6. The impact of a number of technical innovations is greater than the sum of the individual innovation impacts, due to synergy, compounding, improvement of schedule, reduction in complexity, etc.

7. Decommissioning is an inherently crude business that requires flexibility and resists elegant solutions. In general Rocky Flats had

greater success with straightforward technology applications, as compared with highly engineered equipment.

8. Non-manual (typically hydraulic) machinery should be substituted for hands-on cutting whenever possible; however, the need for contamination control often overrides the ability to substitute machinery for people. This supports (up to a point) the need to decontaminate early in the process.

9. During planning, the technical problems become intertwined with other regulatory or management problems; separating the problem types is useful to ensure that the problems being addressed actually have a potential technical solution.

10. The planning process should support the continual reexamination of activities to evaluate how technology improvements could address activity safety and cost, and the management and regulatory issues that need to be negotiated to support those improvements.

11. The ability to deploy a new technology to support a project activity depended on the schedule of that activity in the project. Deployment options range from none – using current proven methods because the implementation time would adversely impact Closure Project critical path schedule – to investing in multiple technologies to allow selection among options for longer-running or future crucial activities.

12. Technology that improves worker safety often leads to improved cost and schedule efficiency, especially when it focuses on improving methods and tools for achieving work.

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Rocky Flats Closure Legacy

Future Land Use, End State and Stewardship

Most of the former Rocky Flats Plant will become the Rocky Flats National Wildlife Refuge under the management of the U.S. Fish and Wildlife Service. An unintended consequence of being a secure government installation was that there was no farming, grazing or development of the site's security perimeter area (the buffer zone), making it superbly suited for its new refuge mission.

INTRODUCTION

An end state vision was developed in 1995 that provided a common focus for disparate groups interested in the cleanup of Rocky Flats. As the cleanup proceeded, however, the unresolved details of the end state vision emerged, and became increasingly important to the community dialogue as the project progressed. The principal components of the end state vision - future Site use, end state, and long-term stewardship - became increasingly relevant as accelerated closure became more likely. Initial discussions about future Site use predated the cleanup mission, and future use issues were not fully developed until June 2005 with the issuance of the Comprehensive Conservation Plan (CCP)[35] for the Rocky Flats National Wildlife Refuge. End state refers to the environmental conditions on Site at completion of the active cleanup. End state was somewhat predetermined by the nature and extent of contamination on Site, and by three key cleanup decisions: no long-term onsite storage or disposal of radioactive waste, no long-term storage of plutonium in a vault, and removal of all structures to at least three feet below grade. Stewardship, as it is understood in the DOE, was a concept and term that was integrated into the cleanup only recently. Although CERCLA requires consideration of long-term care when making remedial decisions, programmatic stewardship discussions evolved separate from the cleanup initiative. The Department of Energy addressed stewardship as an evolving new mission, with creation of the Office of Legacy Management, and Rocky Flats was the first major site to coordinate the transition of Site activities to Legacy Management. When the final land transfers take place to U.S. Fish & Wildlife Service, they will begin the stewardship role for the wildlife refuge as directed through legislation.

Provide for early involvement of stakeholders in cleanup decisions. This will lead to greater community acceptance of the cleanup, and better decisions by the DOE

DISCUSSION

FUTURE SITE USE

The Early Future Use Debate

Community debate about future Site use pre-dated the formal declaration of Rocky Flats as an accelerated cleanup site, and in fact began over three decades ago. In 1974 Colorado Governor-elect Lamm and Congressman-elect Wirth responded to constituent concerns about Rocky Flats by creating a citizen's Rocky Flats Task Force. The final report dated October 1, 1975[150] included among its recommendations that the Governor and Congressman request Congress and the President to "…reassess the Rocky Flats Plant as a nuclear weapons component manufacturing facility…and decontaminating and converting the Plant's facilities to a less hazardous energy-related industry…". The Energy Research and Development Administration (precursor to DOE) disagreed with the Task Force, however the political exchanges continued and in April 1979 the DOE agreed to undertake the requested study. The Long-Range Rocky Flats Utilization Study was published in February 1983[152] covering twelve major analysis areas, among them decommissioning and decontamination, and demolition. Regarding future use the Study concluded in part, "In terms of reuse potential, Rocky Flats is an extremely complex – single-purpose – facility, and it does not lend itself to many alternative uses."

Although pleased that the DOE had consented to the study, Governor Lamm and Congressman Wirth appointed the Blue Ribbon Citizen's Committee (BRCC) with a grant from the Federal Emergency Management Agency to provide independent assessment of the thoroughness, completeness, and objectivity of the DOE analysis. One notable member of the committee was District 5 State Representative Frederico Pena, who was elected Mayor of Denver in 1983. He later served as Secretary of Energy from 1997 – 1998, making significant contributions to Rocky Flats closure described in the section *Congressional and Executive Administrative Support.* The BRCC followed the DOE work closely, with monthly committee meetings and over a dozen public meetings and workshops. The BRCC Final Report was released in December 1983[153] and while critical of some study elements, it generally supported the DOE future use conclusions. For the future use issue the greater contribution of the BRCC was raising the overall level of awareness regarding Rocky Flats throughout the Denver area. Prior to the BRCC the DOE activities at Rocky Flats were known mostly by a small group of politicians and activist groups. The high profile BRCC put Rocky Flats in the public spotlight with media coverage almost every day. Positions concerning Rocky Flats future use were established and alliances formed in the political and stakeholder community almost ten years before the DOE's Office of Environmental Management was formed.

In 1983 the high profile BRCC put Rocky Flats in the public spotlight with media coverage almost every day. Positions concerning Rocky Flats future use were established and alliances formed in the political and stakeholder community…

Another study relevant to Rocky Flats future use was commissioned by Governor Romer in 1989. The Citizen Advisory Committee of the Colorado Environment 2000 Project issued their report in June 1990.[154] It had no specific recommendations regarding Rocky Flats, although the recommendations regarding water quality and hazardous waste would later impact the regulatory environment for the Rocky Flats closure. In hindsight the Colorado 2000 report likely contributed to the Rocky Flats closure in its discussion of emerging issues. The report made a strong statement about environmental ethics, listing key ingredients that included, "acting in the face of uncertainty, collaborating to solve problems, and setting priorities for action." These components appeared very clearly three years later during the first dialogue with Colorado regarding a new regulatory agreement.

The approach to establishing future use can be best described as evolutionary. An advantage of this approach was that the cleanup was able to move forward even without complete resolution of these issues.

The raid of Rocky Flats by EPA and FBI agents in June 1989 focused a public spotlight on Rocky Flats that would remain bright for many years. Local governments and citizen groups had strong and disparate views about the future use of Rocky Flats; however, following the raid most stakeholders associated future use with cleanup levels. Formal discussions about future Site use designations commenced prior to the cleanup, but a specific use was not determined until midway through the cleanup project with the passing of the Rocky Flats Refuge legislation[155] in 2001. Even then, the details of Site access were not completed decided until the U.S. Fish & Wildlife Service's CCP was issued over three years later.

The approach to establishing future use can be best described as evolutionary. As interests were identified, and the cleanup proceeded, clarity of future use was achieved. An advantage of this approach was that the cleanup was able to move forward even without complete resolution of these issues. A disadvantage was that failure to identify and refine a future use early in the cleanup project, enabled citizen and local government land-use interests to permeate (and distract) discussions through the duration of the cleanup. These interests ranged from installing high fences to having no fences, and from allowing recreation to prohibiting access. These discussions were often highly charged, seldom had a technical or regulatory basis, and may have been reduced or avoided with a stronger focus on establishing future Site use up front.

However, establishing the end state was somewhat analogous to the accelerated action approach to cleanup whereby there was a bias for action.[36] The DOE accepted incomplete information regarding future use (as it did regarding final cleanup levels) in order to move forward with the cleanup, and with an informed opinion that all future use alternatives remained viable.

Developing a risk-based end state enabled greater community input in the cleanup, bounded the range of alternatives and provided a balance between characterization, risk, and public acceptance.

<u>Rocky Flats Future Site Use Working Group (FSUWG)</u>

The Rocky Flats Local Impacts Initiative (RFLII) was chartered as a community reuse organization early in June 1992 by the Secretary of Energy, following the elimination of the future weapons mission for Rocky Flats. RFLII sponsored the first formal discussion of future use, dating back to June 1994, two years prior to the signing of the Rocky Flats Cleanup Agreement.[3] The RFLII-sponsored Future Site Use Working Group (FSUWG) gathered dozens of members from a broad cross-section of stakeholders, and their 1995 report contained the consensus and non-consensus recommendations for future Site use. Beyond any specific recommendation the FSUWG report[5] revealed the importance of future Site use to the community, the myriad associated political and technical issues, and the need for the DOE to address future Site use early in the cleanup process. The themes that were raised in this report – cleanup to background, purchasing of mineral rights, natural resources, technology development, limited personnel access to the Site – would provide an undercurrent for cleanup discussions for the next ten years.

The FSUWG forum was also valuable in that it allowed the vetting of community interests early in the cleanup process. It bounded the range of alternatives, albeit a broad range, and thus facilitated moving forward with many cleanup decisions. By having the community interests revealed and written down, even though some recommendations were unrealistic, it provided for a certain level of accountability from the community, and a reference point for continuing community dialogue. The report also provided an early indication that some community members advocated cleanup to background levels regardless of future Site use, cleanup laws or human health risks associated with residual contamination. This would become important later in the process when the discussion moved from future use to end state, and the concept of the future user was introduced in the context of the cleanup laws and risk.

By having the community interests revealed and written down, even though some recommendations were unrealistic, it provided for a certain level of accountability from the community, and a reference point for continuing community dialogue.

Despite the extensive FSUWG dialogue the future use issue was not ripe for resolution in 1995, and the Rocky Flats Field Office (RFFO) did not fully address future Site use issues until relatively late in the process. The DOE response to the FSUWG was reflected in the Rocky Flats Cleanup Agreement (RFCA), signed in June 1996, one year after the RFLII report was issued. This was a positive advancement of the future use discussion but did not resolve the issue, although the broad open space designation contained in the RFCA provided the agencies a sufficient conceptual framework to proceed with the cleanup.

Earlier involvement and increased stakeholder participation must be accompanied by accountability by stakeholders to the same regulatory and budgetary constraints placed upon the DOE.

Rocky Flats Cleanup Agreement (RFCA)

The RFCA was signed in July of 1996, one year after the FSUWG had issued their report, and made several important references to end state, without providing final resolution. Included in the RFCA preamble was the following language regarding future Site use:

"Cleanup decisions and activities are based on open space and limited industrial uses; the particular land use recommendations of the Future Site Use Working Group (FSUWG) are not precluded…"

Also, Attachment 5 to RFCA, RFETS Action Levels and Standards Framework for Surface Water, Ground Water, and Soils,[105] describes future conceptual land uses including capped areas, an industrial use area, a restricted open space area, and unrestricted open space area. The concept that the predominant future Site use would be open space, with the possibility of some restricted reuse in some areas, was perpetuated, but without any specific land use designation achieved. Also, by including the land use scenarios in Attachment 5, a closer association of cleanup levels to future use was established by DOE and the regulatory agencies. This was important since some community members continued to maintain that future use and cleanup levels were two separate issues. That is to say, their goal for cleanup was to ensure maximum cleanup and the most restrictive future use, without any technical or regulatory correlation between the two.

Unfortunately, the RFCA discussion of future use was as non-resolute as its treatment of cleanup levels. While the issuance of RFCA served to bound the future use debate, the broad descriptions of land use were open to interpretation. The RFCA open space designation supported myriad land uses from golf courses to public parks to ecological research. Early in the project, this broad description of future use did not hinder cleanup. The priority risk reduction activities, draining actinide solutions from pipes and tanks and shipping materials to other DOE sites, were not impacted by this uncertainty in future site use. But the very mechanism that enabled cleanup to proceed under the accelerated action framework also left end state and future use unresolved. As cleanup progressed from materials stabilization to decommissioning and environmental restoration, it became increasingly important that a more concise future Site use be defined, to ensure that the cleanup would support that use.

National Conversion Pilot Project

After the regulatory and liability issues became insurmountable, the failure of the National Conversion Pilot Project all but eliminated any viable reuse of the industrial area of the site for re-industrialization purposes.

The RFLII organization played a key role in sponsoring the FSUWG, but they also were involved in sponsoring the National Conversion Pilot Project (NCPP). The NCPP, announced by the DOE in December 1993, was to be the nation's first economic conversion project at a Department of Energy facility. The pilot project at Rocky Flats would clean and transition certain industrial buildings for use by a private, industrial manufacturer to recycle contaminated scrap metals. The RFFO funded the first two stages and engaged the regulatory agencies to develop the regulatory framework under which the manufacturer would operate. After more than two years of effort, the regulatory and liability issues were insurmountable and the NCPP was terminated before stage 3, which was to prove the economic viability. Although this pilot effort failed to advance to a viable enterprise it signaled a marked change in the dialogue regarding reuse of the industrial area. On the heels of the unsuccessful NCPP, RFLII chartered another working group in July 1997, the Industrial

Area Transition Task Force, to explore other options for reuse of the industrial area. Their final report was issued in September 1998[156] and all but eliminated any viable reuse of the industrial area of the Site, rather focusing to possible industrial reuse along the western boundary of the Site. The RFLII itself was succeeded on April 1, 1999 by the Rocky Flats Coalition of Local Governments (RFCLOG, described in the section *Stakeholder Involvement)* providing for a broader perspective on issues of cleanup, closure, and stewardship issues.

Colorado Natural Heritage Program and Rock Creek Reserve

The FSUWG report in 1995 had identified open space use, broadly defined, for most of the Site with some possible industrial area reuse. After several years of study and the unsuccessful NCPP it was becoming clear to everyone that industrial reuse was unlikely. During the same time period following the FSUWG report, DOE advanced several studies to better understand the buffer zone and attempt to narrow the broad open space definition. One very significant study was the 1996 Phase II Report on the buffer zone prepared by the Colorado Natural Heritage Program (CNHP), a research entity of the Nature Conservancy housed at Colorado State University.[157] This report identified the conservation significance as very high, owing mainly to "…the largest example of a xeric tallgrass prairie remaining in Colorado, and perhaps in North America." It was identified with CNHP's highest priority for protection.

Although the Rock Creek Reserve designation was an important step for buffer zone preservation, it also marked an important step to further define the nature of the open space use for the buffer zone.

Somewhat in response to the awareness raised by the CNHP study, RFFO began development of a Natural Resource Management Policy (NRMP) to guide management of the buffer zone while cleanup activities were progressing under RFCA. The NRMP was intended to be generally consistent with the RFCA Vision as well as the FSUWG report in guiding buffer zone management. As a significant policy document it was released for public comment. Public comment focused heavily on preservation of the ecosystems, and acquisition of mineral rights to facilitate that protection. The final NRMP was released in September 1998[158] and identified the public concerns as emerging issues. In response to comments the DOE stated it "…would support and participate in a process…" to resolve the conflict between the mineral rights (quarrying) and tallgrass prairie protection. A major step to advance the issue was creation of the Rock Creek Reserve by the Secretary of Energy in May 1999. This designation of 800 acres of Rocky Flats buffer zone, uncontaminated and unaffected by Site activities for 40 years, was heralded by the Governor, local governments, the U.S. Fish & Wildlife Service, and most stakeholders. Although the Rock Creek Reserve designation was an important step for buffer zone preservation, it also marked an important step to further define the nature of the open space use for the buffer zone.

Rocky Flats National Wildlife Refuge Act

The Rocky Flats cleanup and closure had received strong bipartisan support since its inception. Senator Allard and Congressman Udall, who had been following the cleanup closely, recognized the impasse created by the uncertainty of future land use. While the broad parameters had been established (although limited industrial reuse had been effectively eliminated through the public dialogue among all parties) a final designation was necessary to achieve the clarity of an endpoint and transition to a future mission. Building on the strong public support and approval for the Rock Creek Reserve, legislation was introduced in 2000, ultimately enacted into law in 2001,[155] designating Rocky Flats as a national wildlife refuge to be managed by the U.S. Fish and Wildlife Service (USFWS). This legislation provided for a specific land use consistent with the RFCA, compatible with adjacent county and city lands being managed as open space, and supported by a broad consensus of local stakeholders.

Future use discussions evolved somewhat analogous to and in parallel with the evolution of the cleanup. Vision and broad consensus was achieved first, then built upon with continuing dialog and information, taking limited action as allowable

The legislation provided a more specific end point for the project. Discussions regarding Site access and uses within the refuge framework were led by the USFWS, who had an operating assumption that the cleanup would support a refuge. The future user (refuge visitor) and future Site worker (USFWS refuge worker), were no longer hypothetical. This enabled the DOE and K-H to demonstrate through characterization, monitoring and modeling, that the cleanup would far exceed the standards necessary for the Site to support refuge uses.

The discussion in the paragraphs above shows that future use discussions evolved somewhat analogous to and in parallel with the evolution of the cleanup. Vision and broad consensus was achieved first, then built upon with continuing dialog and information, taking limited action as allowable. As additional information was developed, progress was made until, ultimately, final decisions were achieved.

END STATE

End state refers to Site physical conditions upon completion of the cleanup mission, and regardless of the future use. This is an important distinction that often is confused by stakeholders. Although future use can influence end state, end state may be different than future use, and for Rocky Flats was bounded by the RFCA, which described the framework for soil and water cleanup. But within both the contractual and regulatory framework, there was considerable flexibility to incorporate community interests.

Because of the nature and extent of contamination at the Site and evolution of the cleanup project plans, the physical conditions at closure could be fairly accurately forecasted. By 1997, a most likely end state was taking shape, including two landfill covers, three groundwater treatment systems, and groundwater and surface water monitoring stations. The specific number of monitoring wells, final surface soil cleanup levels, and the possibility of an additional groundwater treatment system were open issues, but the range of outcomes for these issues would be relatively insignificant with respect to footprint, post-closure surveillance and monitoring, or human health risk. Being able to quantify these conditions early in the cleanup process was extremely useful during discussions of surface and subsurface soil cleanup levels. In fact, the DOE may have benefited from placing even greater emphasis on the end state footprint earlier in the process to set the context of cleanup decisions and communicate the bounded end state conditions.

Being able to quantify the physical conditions at closure early in the cleanup process was extremely useful during discussions of surface and subsurface soil cleanup levels.

In what may be an early lesson learned from Rocky Flats, DOE Headquarters developed an approach to align Site end state, and thereby the cleanup plans and baselines, with expected future use. The policy required engagement of regulators and stakeholders through all phases of the Risk-Based End State (RBES) process, as it was termed. The approach was communicated in DOE Policy 455.1, dated 7/15/03, with schedules for completion at each EM site directed by EM-1 memo in 2004. For the Rocky Flats stakeholders and regulators this new requirement caused more confusion than clarity. By 2004 the cleanup and end state were almost completely fixed by RFCA, the closure contract, the Refuge Act, and the completion of actual cleanup work. The Rocky Flats DOE staff completed an RBES document[202] as required by the guidance, but it essentially was a historical recap of the various stakeholder and regulatory processes and decisions to that point. Stakeholders and regulators viewed the exercise as unnecessary and did not engage, but also offered no objection.

STEWARDSHIP

Stewardship worked its way into the vernacular of RFFO and the Rocky Flats stakeholder community only after the Site was more than half way to achieving accelerated cleanup and closure of Rocky Flats. The stewardship initiative provided a forum for discussing the strategy for post-closure care that had previously been discussed only tactically (for individual cleanup actions). Through the late 1990's post-closure care requirements were factored into decision-making, but the details of implementation had not been addressed collectively.

The stewardship initiative provided a forum for discussing the strategy for post-closure care that had previously been discussed only for individual cleanup actions, allowing them to be addressed collectively.

Stewardship Working Group

Throughout the cleanup, individual removal actions had stewardship components that were identified, but the details of implementation, such as resources, reporting, responsibility and accountability were not documented as part of an integrated stewardship plan. The RFCA parties understood that these stewardship requirements would be addressed through the comprehensive Site Record of Decision upon completion of the accelerated actions. But as a 2006 closure started to look achievable, stakeholders became more interested in defining the details, and less willing to wait for the CERCLA process to unfold. They were ready for an integrated plan. Also, there was a real anxiety among some stakeholders that the DOE intended to simply abandon the Site once the cleanup was complete. During 1998, and in response to these sentiments, the Rocky Flats Site Manager requested that the Citizens Advisory Board and the Rocky Flats Council of Local Governments co-chair a public forum to discuss Site stewardship issues. As a result the Stewardship Working Group was formed, and became the focal point for Rocky Flats stewardship discussions.

Incorporation of the stewardship flow chart into the ER RSOP enhanced stakeholder trust and served to enhance the stewardship dialogue… subsequent cleanup decisions were viewed with less concern since there was now a legitimate forum and process for stewardship issues that might manifest themselves post-closure.

The stewardship dialogue served as a relief valve for stakeholder issues that had been building up during the course of the cleanup. The meetings were lively and well attended, and focusing the dialogue with the Stewardship Working Group had an immediate positive result. In response to a community recommendation, the Site modified the Environmental Restoration RFCA Standard Operating Protocol (ER RSOP)[24] to include an explicit evaluation of stewardship implications (this was already being done through implementation of CERCLA, but the accelerated action model did not afford much community dialogue). Incorporation of the stewardship flow chart into the ER RSOP enhanced stakeholder trust and served to enhance the stewardship dialogue. It also served to alleviate some suspicions that there was no substance behind the stewardship initiative. Another subtlety of having the Stewardship Working Group was that subsequent cleanup decisions were viewed with less concern since there was now a legitimate forum and process for accounting for stewardship issues that might manifest themselves post-closure.

Office of Legacy Management

Local stakeholder groups surrounding Rocky Flats weren't the only people looking ahead to completion of the closure project. "A Review of the

Environmental Management Program" report (the Top-to-Bottom Review as it was known) delivered February 2002[159] included among its recommendations a narrowing and focusing of the EM Program scope to accelerated, risk-based, cleanup and closure. It made the specific recommendation, "EM should redeploy, streamline, or cease activities not appropriate for accelerated cleanup and closure." The long-term stewardship activities that naturally follow site closure were some of the tasks considered outside the new, focused EM scope. The report recommendations prompted internal DOE reactions and discussions regarding the appropriate organization to manage long-term stewardship. By February 2003 these discussions had evolved sufficiently for DOE to announce formation of the Office of Legacy Management (LM) to be the office with the primary responsibility for sites that have been closed.[160] In April 2003 Mike Owen, Director of the DOE Office of Worker Transition and designee to standup the new LM, testified to Congress[161] regarding the specific mission of LM, particularly highlighting the anticipated closure of Rocky Flats, as well as the Mound and Fernald sites in Ohio, and the nature of the stewardship functions.

With the LM organization destined to take over Rocky Flats operations after closure, the RFFO began discussions in summer 2003 regarding the future transition. The discussions were productive, but difficult, owing largely to uncertainties related to the closure completion schedule and the evolving mission, tasks, and organization of the new LM office. Complicating the transition discussion was a parallel effort with EM to create a Consolidated Business Center to provide administrative support to small and closing sites. Much of the early dialogue about transition was very unclear regarding which organization might ultimately take responsibility and when, but it was very useful to define the comprehensive list of tasks and issues to be considered. In fact, this was a significant lesson learned, to start the transition process as early as possible to define the scope of the effort. We jointly discovered hundreds of unexpected tasks and subtasks through the early and deliberate transition process.

...it was very useful to define the comprehensive list of transition tasks and issues to be considered. In fact, this was a significant lesson learned, to start the transition process as early as possible to define the scope of the effort.

The Rocky Flats transition planning effort with LM served as both a model and trial effort. Guidance jointly signed by EM and LM in June 2004 was both modeled after and built upon the Rocky Flats transition effort to date. Further guidance with specific Site Transition Plan requirements was provided in February 2005. By this time the transition planning effort was very mature, several small tasks already having been transferred to LM. Rocky Flats submitted their Site Transition Plan (STP) in March 2005[162] according to the directed format, receiving approval of the STP later that month.

An approach for transition that was very successful was the bias toward early transition of tasks to LM, even if EM retained the funding or overall responsibility. These early task transfers allowed LM to gain experience while EM staff were still available as a resource. It also removed the time pressure that would have occurred if all the tasks had been transferred at contract completion. Meeting weekly, sometimes daily, also helped keep communications and issue resolution on track. LM's choice to hire several former RFFO staff members greatly smoothed the transition for both EM and LM. Currently the majority of tasks have been successfully transitioned, with the remainder expected at the beginning of fiscal year 2007. At that time LM will also assume budgeting and funding responsibility for the Site. The interface between LM and EM has continued to be productive and cooperative on a daily basis.

The RFCA parties advocated a bottoms-up approach to stewardship, starting with the regulatory requirements for post-closure operations, maintenance, surveillance and monitoring, and developing the reporting and meeting requirements from that basis

One of several key LM tasks would be assumption of the stakeholder dialogue. The focused Stewardship Working Group dialogue revealed a disparity in expectations between the stakeholders (in general) and the RFCA parties regarding the extent of the stakeholder communication infrastructure that would be necessary or required at Rocky Flats once the period of active remediation was complete. During the cleanup, there was a high level of stakeholder interaction, including correspondence, technical meetings, document reviews, Site tours and public meetings. It became apparent early on that some stakeholders expected many of the same stakeholder activities to continue after the cleanup was completed. This top-down approach did not fully consider the need for public involvement, and was very different than what the DOE envisioned. The RFCA parties advocated a bottoms-up approach to stewardship, starting with the regulatory requirements for post-closure operations, maintenance, surveillance and monitoring, and developing the reporting and meeting requirements from that basis. More specific discussion of the evolution of this topic is in the *Stakeholder Involvement* section.

<u>Mineral Rights</u>

Mineral rights have always been at issue an Rocky Flats owing in large part to mining being one of the major industries in Colorado for well over 100 years. Mineral rights were addressed briefly in the short (20 page) Environmental Impact Statement prepared in April 1972 to acquire the buffer zone.[163] They have been mentioned in every public review of Rocky Flats future use since that time (references listed earlier in this section). When the Rocky Flats Wildlife Refuge Act was passed in 2001 it directed the Department of Interior (DOI) and DOE to draft within 12 months and finalize within 18 months a memorandum of understanding (MOU) in part to resolve the issues surrounding mineral rights. This became a difficult task. A working draft MOU was prepared within several months, but the mineral rights issue prevented signing the draft MOU for more than three years. The issues were (1) DOE insistence that the Refuge Act obliged DOI to take the lands and that the DOE was not funded nor authorized to purchase the mineral rights, and (2) DOI's insistence that receiving lands with the potential for active quarry operations was against their policy and inconsistent with management of the refuge.

At issue was DOE insistence that the Refuge Act obliged DOI to take the lands, and DOI's insistence that receiving lands with the potential for active quarry operations was against their policy and inconsistent with management of the refuge.

As time passed the Congressional sponsors of the Refuge Act became distressed that the MOU was not final and the mineral rights issue remained at an impasse between the Federal agencies. However, by 2005 it was becoming clear that the closure project would finish ahead of schedule and hundreds of millions under the target and budget cost. This presented an opportunity for a resolution to the mineral rights question, to fund acquisition of the mineral rights from the project "savings". Senator Allard began work with the RFFO in January 2005 to develop legislation that would enable a mineral rights action to satisfy DOI, DOE, and any other stakeholders. A substantial amount of information was provided including the historical stakeholder comments on the topic, private landowner interests, the active quarry status, the impact on local gravel costs for construction, natural resource damages, and other related topics. The RFCLOG debated the issue at several meetings and prepared correspondence encouraging resolution of the issue.[164] Key to finalizing the legislative language was DOE agreement with DOI regarding the transfer of mineral rights parcels. In March 2005 agreement was reached and the draft MOU was published in the Federal Register[165] based on the DOE maintaining control of any land parcels with active quarry operations or with sand and gravel mineral rights which could be permitted in the future. DOI would accept transfer once DOE owned the mineral rights, or once the active quarrying was completed and the land had been reclaimed. The process of exactly how DOE would acquire the mineral rights still required work before the parties could agree to a Final MOU. The parties expected the Final MOU to be completed within six months.

In parallel with the MOU issue, the question of natural resource damages as described under CERCLA Section 107 was starting to gain more attention. Natural resource consultation with USFWS had existed at Rocky Flats since 1992 under terms of a Natural Resource Trustees MOU. The individual remediation activities were also developed to mitigate natural resource damages, such that natural resource damages were expected to be very small. However, the law allows for lawsuits to pursue any natural resource damage claims, making the litigation alone a significant cost. The DOE Inspector General also was completing an investigation regarding the status of planning and analysis regarding natural resource damages. The RFFO maintained communication with interested Congressional representatives regarding the natural resource damages concerns, the mineral rights resolution, and the MOU with DOI. Senator Allard's legislation continued to be developed to address multiple needs, finally being proposed, worked through Congress, and ultimately signed in January 2006.[167]

The 2005 DOD Authorization Act authorized $10 million for DOE to acquire the essential mineral rights required for the Rocky Flats Wildlife Refuge identified by the USFWS and DOE. The rights are to be purchased at fair market value from willing sellers. Purchase of the rights satisfies any natural resources damages liability claim against DOE. If DOE is unable to purchase portions of these mineral rights, the Rocky Flats Natural Resources Trustees are to receive a payment equal to the value of those rights, as well as any portion of the $10 million not used to acquire mineral rights. A companion bill appropriated the $10 million. The Defense Authorization Act of 2005 obviated efforts that were underway to prepare a Final MOU between DOE and DOI, as it directed the mineral rights resolution, which would allow the land transfer to establish the wildlife refuge to the satisfaction of both agencies.

The 2005 DOD Authorization Act authorized $10 million for DOE to acquire the essential mineral rights required for the Rocky Flats Wildlife Refuge identified by the USFWS and DOE.

With the resolution path established by legislation the DOE began in earnest to acquire the mineral rights. Consultation with USFWS and DOI proved very useful as they had significant experience with land and real property transfers of this nature. They suggested a third-party negotiator, separate from any Federal entity, to conduct the negotiation and then transfer the parcels to the DOE as a second step. The Trust for Public Lands (TPL), a non-profit organization, was contacted based on their experience with such transactions in the Colorado area. Their negotiation with the private mineral rights holders is underway, and in parallel a valuation of the mineral rights to support the ultimate real property transfer is also being completed.

KEY LEARNING POINTS

1. Public discussion of future site use provides a powerful tool to build consensus and better clarify areas of particular public interest. Although not always discussed in public forums, local and state governments have strong beliefs on future use that extend beyond the typical DOE planning horizon.

2. Inclusion of consensus future use decisions into regulatory agreements provides for stronger buy-in by the public and the regulators, and can help maintain an outcome-based focus.

3. Using a risk-based end state model can facilitate greater community input in the cleanup, although the dialogue will likely be difficult and controversial. Bound the range of end state alternatives, balancing characterization, risk, and public acceptance.

4. Define physical and administrative end state conditions early in the cleanup project. This provides for a broader context when individual near-term decisions become complicated or controversial and serves as a DOE commitment to an endpoint.

5. Maintain open communications with elected officials on future use and end state issues. Elected officials may be very willing to propose and champion legislation that can assist resolution of issues and gain support from their constituents.

6. Develop a Stewardship program early in the project to provide visibility and commitment to the community regarding DOE's long-term obligation for surveillance, maintenance, monitoring and remedy assurance.

7. Begin transition coordination with Legacy Management as early in the process as feasible. Build strong communications links and develop a bias for staged, early transition of activities to LM.

8. Initiate the termination, transfer, and transition of regulatory permits and agreements well before closure. These activities are time-consuming tasks involving substantial negotiations, meetings, and document reviews, and may have a substantial learning curve for LM. This effort would have been a little smoother and less stressful at Rocky Flats if it had been initiated earlier.[169]

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ROCKY FLATS CLOSURE LEGACY

FEDERAL WORKFORCE

MANY OF THE FEDERAL STAFF WERE HIRED FOR THE PRODUCTION MISSION. IN 1995 THEY WERE ASKED TO ACCEPT A NEW CHALLENGE, RETRAIN FOR THE CLEANUP MISSION, AND ACHIEVE THIS IN A DYNAMIC ENVIRONMENT WITH FUTURE EMPLOYMENT UNCERTAINTY. THEY WORKED DILIGENTLY TO ASSURE SAFETY, BUST BUREAUCRATIC AND TECHNOLOGICAL BARRIERS, AND REDEFINE THE STANDARD OF WHAT A GOVERNMENT ORGANIZATION CAN ACCOMPLISH IN THE PUBLIC INTEREST.

FEDERAL WORKFORCE

INTRODUCTION

The role of the Federal workforce is perhaps the single most overlooked success story within the broader story of Rocky Flats. Federal workers zealously working themselves out of a job is unusual, if not unprecedented. Not unlike the trades and steelworkers, the federal staff was by and large hired for the production mission. Most hiring occurred prior to formal transition to the cleanup mission. Employees were poised for resumption of production. Consequently, the closure mission was not immediately embraced by many of the field office staff, and was never fully embraced by all federal staff. But a substantial number of federal employees did redirect their energies toward the cleanup mission, defined the project scope, negotiated a contract, reviewed and approved a baseline, provided required government furnished services and equipment, and provided oversight of budget and safety.

Rocky Flats was an area office through 1989, reporting to the Albuquerque Operations Office. Following the 1989 FBI raid, in 1990 it became the Rocky Flats Office, then soon after the Rocky Flats Field Office (RFFO). Finally in 2004 it became the Rocky Flats Project Office (RFPO) signaling alignment with closure project completion. In 1995 RFFO hired its first closure contractor. So in the matter of a few short years, the federal workforce transitioned from being at its peak staffing level (federal employees and support contractors), preparing for resumption of long-term production mission, to having a closure mission with the goal of achieving safe and compliant cleanup in the shortest amount of time. There was uncertainty regarding the specific role of the feds and skepticism about the ability of the Site to close on such an accelerated schedule. Beginning in 1997, with EM-wide restrictions on new hiring, federal staffing levels were consistently reduced using attrition. Many of the federal employees were anxious at best and disgruntled at worst, having gone through several reorganizations and uncertain of their role with the cost-plus incentive fee contract.

The challenge for RFFO was to retrain the Federal workforce for the cleanup mission, define a new relationship whereby the feds were managing a contract not a contractor, and motivate them to work themselves out of a job.

With strong and creative leadership, good management and good fortune, the federal workforce did persevere in providing unprecedented timely delivery of its Government-Furnished Equipment and Items (GFS&I) items and meeting its responsibilities as defined by the terms of the closure contract. As late as 1995, the Baseline Environmental Management Report (BEMR)[4] forecasted that the remaining cleanup work at Rocky Flats would take seventy years. Later that same year, the challenge was to close by 2010. In 1996 the challenge was revised to become the ten-year plan with a 2006 closure date. And around 2002 it became apparent that a 2005 closure was potentially achievable.

The challenge for RFFO was to retain and retrain the federal workforce for the cleanup mission, define a new relationship whereby the feds were managing a contract not a contractor, and motivate them to work themselves out of a job. Several creative and controversial approaches were used, some more successful than others, to meet this challenge.

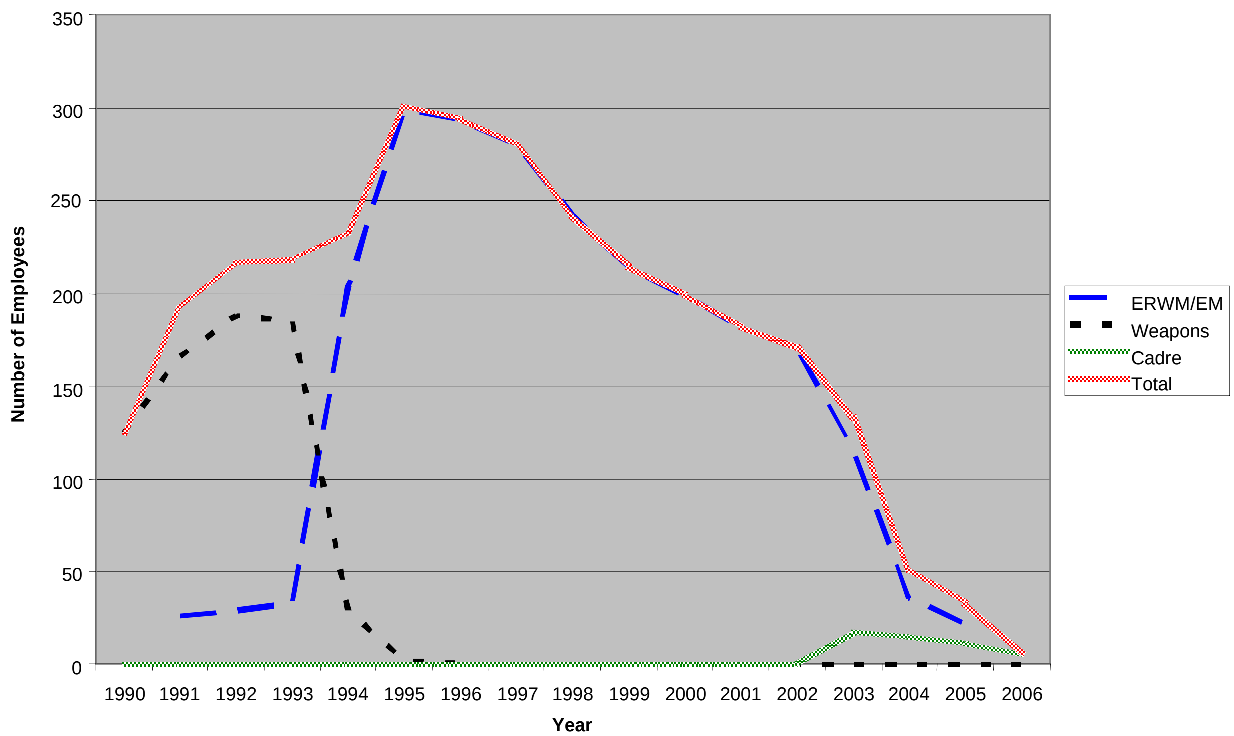

Figure 14-1, Rocky Flats Federal Staffing Levels

[a] Office of Environmental Restoration and Waste Management subsequently renamed the Office of Environmental Management.
[b] Reduction in force executed beginning of calendar year 2004.
[c] Involuntary separation of RFPO employees 1/7/2006.
[d] 25 closure cadre positions were identified. 17 were eventually filled.
[e] All staffing funded by Environmental Management from 1997 through closure.

DISCUSSION

<u>"The Draft"</u>

On the heels of awarding its first environmental cleanup contract to Kaiser-Hill, RFFO reorganized. To implement a re-organization of the RFFO coincident with the implementation of the new management and integrating contract, the office held a "draft" in 1995. This "draft," so named because it had similarities to a sports draft process, was a significant emotional event for Federal employees. The concept behind the draft was to create a radical change in behavior by the Federal employees. The RFFO Manager believed that the entire organization, from senior managers to staff, were largely focusing on their own issues, doing little to cooperate across the organization and adjust to the new roles demanded by the new contract structure. The draft allowed for a massive and nearly instantaneous re-assignment of RFFO personnel to other jobs within different RFFO organizations. Jobs requiring specific qualifications such as attorneys were off limits. All other jobs were open for re-assignment. Individuals provided their top three job choices. Some organizations participated in a pseudo-recruitment fair to explain what functions their new organizations were going to perform and recruit desired staff. After everyone had identified their choices, managers met several times to decide where staff would be re-assigned. During these management meetings to re-assign personnel, employee representatives were present to ensure that diversity goals were addressed and that re-assignments were not subjective. In virtually all cases, management placed the staff into one of their 3 choices. The draft achieved the radical change the Manager desired. However, a detrimental outcome of the reorganization was that some staff went into positions with little or no familiarity with the position's requirements. In some instances technical staff were re-assigned into administrative positions. Grade mismatches and certain assignments created widespread resentment and suspicions about the validity of the process and management's intent. The level of upheaval created by the draft allowed for very rapid culture change within the RFFO, not unlike a Marine boot camp experience. However, it also created numerous challenges that lingered for many years.

Within a year of the new performance-based incentive closure contract, and in the aftermath of the draft, there was a recognition within RFFO both that change really was occurring and that a more fundamental change still needed to take place if the RFFO was to be successful in its new mission. Alignment to the closure mission would need much more than a change to the lines and boxes of the RFFO organization chart. Even though the vision and mission clearly identified an accelerated closure project, RFFO behaviors largely reflected business as usual. Assistant Managers were competitive rather than cooperative with one another. Managers and staff continued to manage the contractor instead of using the contract as the basis for interaction with Kaiser-Hill (the contractor also exhibited this behavior). In short, the notion of a completion project, and the opportunity for great achievement, had not been internalized within the RFFO.

Even though there was a new mission, a new contractor, and a new contract, Assistant Managers were competitive versus cooperative with one another.

Manage the Contract, Not the Contractor[49]

Under the M&O contract structure, many Federal employees equated their value with being able to provide the contractor technical direction.

A second significant change occurred in 1996 when the Rocky Flats Manager rescinded all Contracting Officer Representative (COR) delegations and then redelegated the authority to only a handful of managers.[172] Up until that time, the informal practice allowed any federal staff member to provide technical direction to the contractor both in terms of what work should be performed and more importantly how it should be performed. The substantial reduction in the number of CORs and the emphasis on using formal contracting mechanisms provided notice to the feds that business would only be conducted through the Contracting Officer and the CORs, and in accordance with the contract with zero tolerance for unauthorized technical direction to the contractor. Use of a disciplinary letter to an SES Assistant Manager who violated the new policy made clear that RFFO would be managing to a specified scope, and that the old informal "M&O behaviors" had to cease. This had a profound impact on the federal staff, many of whom associated their own value added with being able to provide direction to the contractor. It also served as a catalyst for discussions regarding the new federal oversight role.

Management Alignment Process

The next significant emotional event was the Management Alignment Process (MAPping). While considerable resources were applied to phasing out the management and operating (M&O) contractor in favor of an integrating management contractor, encouraging competition from world-class contractors not traditionally involved in performing DOE work, and designing improved contractor performance incentives, there was not a similarly rigorous complex-wide review of the federal organizations responsible for overseeing its contractors (either in the field or at Headquarters). The RFFO as it existed in 1995 exhibited old behaviors. The Site had a new mission, a new contractor and new performance expectations as a pilot cleanup site, but had not internalized these expectations to achieve recognition that the field office, too, would need to reinvent itself. Even with the drastic reorganization and change in COR authorities, additional changes were needed to align with the closure mission and new contract structure.

During 1997 the RFFO management team entered into the Management Alignment Process. It was a comprehensive exercise of identifying all functions of the federal staff and their associated processes. Senior managers were sequestered for days at a time and thousands of man-hours were expended over the course of about nine months, discussing and analyzing the mission and functions of the federal workforce. Federal functions were defined and proceduralized. Unnecessary functions were eliminated. The processes were compiled into a handbook[173] and the handbook was placed upon a shelf. Consequently, there was a great deal of cynicism about MAPping, some of it justified.

However, the subtler goal of this process was to force the senior managers to work together and to exhibit corporate behavior. The extraordinary time commitment and shared effort of working through the MAPping process, the subsequent involvement of staff in the process, and the development of the handbook all signaled a change in how business would be conducted within the RFFO. Although the MAPping Handbook did not ultimately serve as the daily desk reference it was intended to become, overall, the MAPping process was successful in that it achieved its goal of breaking old behaviors. It was inefficient, however, and was essentially a surrogate for a strategic planning process - setting corporate expectations and holding employees (managers and staff) accountable for their performance.

The extraordinary time commitment and shared effort of working through the MAPping process, the subsequent involvement of staff in the process, and the development of the handbook all signaled a change in how business would be conducted within the RFFO.

Another weakness stemmed from the fact that the Management Alignment Process developed systems but did not develop employees. In part, the process was aligned to the previous mission. The cohesive link to the new contract, new mission, and new role for the feds had not been completely established and reinforced through training. Thus a certain “trial and error” approach was evident throughout the RFFO as managers and staff tried to implement the MAPping imperatives. What was emphasized, however, was that the old way of doing business was not going to cut it. So MAPping represented another important step in the continuum of activities aimed at redefining the DOE role and expected behaviors. The procedures and handbook were not the end product, they were a means to an end.

The goal of the process was to affect cultural change. This effort laid the groundwork for what was to follow – accountability for delivery of GFS&I and development and adherence to a federal baseline. Looking back at MAPping it succeeded in establishing the organizational teamwork and cooperation template necessary to support the future Closure Contract and GFS&I delivery challenges. Those managers and staff that embraced the closure mission and internalized the need to exhibit corporate behavior generally enjoyed the most success as the RFFO continued to adapt to the Closure Contract in 2000. Those managers and staff not embracing the changes struggled as the environment continued to change and move toward closure, many choosing to seek other employment rather than change. In the end, the process was less about the development of work processes, and more about challenging the status quo. The federal managers needed to learn how to work more as a team and less as competitors.

The goal of the process was to affect cultural change. This effort laid the groundwork for what was to follow – accountability for delivery of GFS&I and development and adherence to a federal baseline.

Developing a Federal Baseline

For all the criticism of MAPping, it was largely successful in qualitatively describing the organizational and staff roles, responsibilities and functions for the DOE to support the closure mission. The next important step was to quantify the same information. This was achieved in 1999 through completion of the first RFFO federal baseline, or life-cycle baseline (LCB) as it was called at the time. The development of the LCB for RFFO was a completely new system within RFFO and within the DOE. The LCB organized and documented the entire Federal work scope and resource requirements in support of the overall Site closure project. The RFFO LCB documented the functions of all RFFO staff, applying number of hours each year to each task by individual, and allowed a total closure project baseline that included both the Federal and Contractor elements described and justified at a similar level of detail. The benefits provided by the LCB include a more consistent and objective justification for Federal costs, a more defensible Federal component of the overall closure project cost, a means to objectively measure performance and push for improvement, and a mechanism to increase the accountability of Federal managers for performance against a baseline.

...the LCB provided a starting point for quantitatively defining the RFFO contribution to the Site closure mission. More importantly, it clarified for RFFO staff and management the tasks of each individual and organization, as well as the interplay between the DOE and the contractor.

Although the program management benefits were clear, development of the LCB was difficult and controversial. Quantifying time spent on oversight of contractor activities, or in coordination meetings, to the detail of hours per week was an estimate at best. No database or examples existed for reference or comparison. Also, the declining budget posture caused rumors of a reduction-in-force (RIF) to begin circulating in 1997, making many employees believe that the LCB exercise was merely a ploy to document the elimination of their position. In response, the bottoms-up LCB time estimates tended to be significantly inflated, most employees showing that 1.2 to 1.5 people were required to accomplish their existing scope of work. Despite these problems the LCB provided a starting point for quantitatively defining the RFFO contribution to the Site closure mission. More importantly, it clarified for RFFO staff and management the tasks of each individual and organization, as well as the interplay between the DOE and the contractor. This shared understanding would later serve the DOE under the 2000 Closure Contract when RFFO would be required by contract to deliver GFS&I against strict milestones.

A federal baseline has already materialized at other DOE sites, and is now a required element of site baseline development for Environmental Management. While it can and will continue to be refined, it represents two important principles: the DOE is responsible for delivering product on a schedule (e.g. GFS&I), and the DOE has functions unique from those of the contractor which can be quantified and managed.

Functional Analysis of Federal Staffing

Most RFFO staff were hired prior to 1995, when the concept of a 2006 closure had not been developed. DOE was not staffed for oversight of an environmental cleanup project. With an integrating contractor, a performance-based contract and only a handful of contracting officer representatives, RFFO had far too many staff performing work associated with the previous mission or with an M&O type contract, and was not focused on closure of the Site. As closure project planning started to reflect an earlier forecasted completion, indications of eventual reductions in RFFO staffing levels began to appear. The implementation of a closure contract with a December 2006 completion date provided the impetus to begin substantial federal workforce planning. Initial efforts in 2000 – 2001 built on the data collected from the LCB process and focused on identifying the skills required to fulfill the RFFO mission. This effort was a good first step, but was limited by the same "inflation" of duties and hours, which skewed the staffing projects beyond what management considered reasonable.

Function and Position Analyses (FPA)... took the very controversial step of reflecting when, by quarter, each individual position was no longer needed... Employees were thankful to finally have definitive information upon which to plan their future career, and ... it pushed RFFO management toward efforts to support the worker transitions in the most effective and humane way possible.

The next workforce planning effort in mid-2002 shifted to specific functional needs, with a more direct linkage to the closure project and its timeline. Specifically this effort attempted to align with the DOE functions and skills needed to support the Closure Contract and complete the Site closure mission. Environmental Management provided an independent review in fall 2002 of the Federal workforce planning at the request of the RFFO Manager.[174] The review generally affirmed the planning efforts, but made multiple recommendations for advancing the strategy and processes for the eventual downsizing and worker transition.

The Function and Position Analyses (FPA) completed in February 2003 and updated in July 2003 was a result of the EM review and took the RFFO staffing level planning to the next steps, including specific positions aligned with organizational functions.[175] The FPA also reflected a more accelerated timeline for RFFO reductions based on current and anticipated project performance, acceptance of management risk, and other factors. It also took the very controversial step of reflecting when, by quarter, each individual position was no longer needed, including the name of the incumbent in the position. Employees now had the first document that showed their job being eliminated and when. In general, the backlash many feared would occur from release of this information did not occur. Employees were thankful to finally have definitive information upon which to plan their future career, and although still personally difficult, it pushed RFFO management toward efforts to support the worker transitions in the most effective and humane way possible. The final update to the FPA, completed in November 2004, assumed a physical completion date in October 2005, 15 months earlier than in the initial analysis, and anticipated support from the Consolidated Business Center in June 2005. Along with more accurately linking workforce planning to the overall project performance expectations, it also effectively removed the last elements of doubt about the ultimate requirement for all the EM staff to transition.

Reduction-in-Force

To this point the Federal Workforce section has reviewed deliberate planning and management actions to support the closure mission. However, several more general issues existed as a backdrop during the same time period. In early 1997 rumors circulated that RFFO would be running a Reduction-in-Force (RIF) to reduce the size of the federal workforce that had been staffed for a different mission. The prospect of a RIF was hanging over the heads of the federal employees for nearly a year during the same timeframe as the LCB and workforce planning efforts. Together they had a demoralizing effect on the staff. The formal announcement of RIF planning in summer of 1997 driven by budget limitations did have another affect though; it accelerated attrition. Faced with uncertainty of employment, and as yet, unclear responsibilities vis-a-vis the contractor, employees left Rocky Flats at an unprecedented rate. No RIF took place in 1997 or 1998 as many employees feared, but from that point forward an eventual RIF was always on employees' minds.

Most staff were visibly relieved to have the certainty of the separation notice and date after having the specter of a Reduction in Force looming for nearly six years.

During 2003 the RFFO did initiate a RIF[203] with an actual involuntary separation date of January 10, 2004. The RIF was announced with some certitude many months in advance of mandated timeframes, enabling staff ample time to pursue other government or private sector jobs. Once again the RIF served as a catalyst for employee transition. After having the specter of a RIF looming for nearly six years, most staff receiving RIF notices were visibly relieved to have the certainty of the separation notice and date. They knew it was coming, and many had already planned for it. By actually handing out the RIF notices, it enabled staff to move forward. Management actively supported employee transition to allow buyouts and support placement as described further below. As a consequence, 101 positions were eliminated, but only 20 employees required involuntary separation. An assessment completed in August 2004 documented the more detailed lessons learned from the RIF.[176]

A second and final RIF was conducted during 2005 with separation at the beginning of 2006. It was essentially the mechanism for closing the project office following physical completion of the cleanup, with remaining employees reporting to the Environmental Management Consolidated Business Center (CBC) or to Legacy Management. All RFPO positions were eliminated and thus the typical "bump and retreat" issues within the RIF were moot. Employees had similar success in receiving buyouts or placement, such that only five employees were involuntarily separated, and all but one of those had civilian job opportunities available.

Federal Employee Union

During 1998, the DOE staff unionized as Local 1103 of the American Federation of Government Employees (AFGE). The union activism was certainly in response to the change in mission, the definition of a project (and employment) endpoint, and also in response to the 1997 RIF planning. Although the union had no significant impact on the closure mission, it did consume management's time. Some staff joined the Union because they had been disenfranchised from the DOE mission and the processes (MAPping, LCB, etc.) that RFFO used to advance the mission.

The process for forming a bargaining unit, and its subsequent implementation, was a vehicle for a segment of the workforce to seek justice or retribution for perceived past management mistreatment going all the way back to "the draft". The approval of the Union and formation of the bargaining unit created a division between employees at a time when the organization needed to mature and develop better working relationships. For example, union representatives attended many routine team meetings and staff meetings, and created an adversarial "us and them" environment. At a time when the closure mission was already driving many changes through the RFFO workforce, the Union added another level of turbulence.

In general RFFO management and the Union leaders were never able to forge a truly productive partnership to provide much real benefit to the RFFO mission.

For much of the time that the local AFGE existed at Rocky Flats, management was reactionary. Management was inexperienced with labor relations issues when labor began to organize, and then once a bargaining unit existed, management struggled to provide sufficient priority to develop a productive relationship with the union with all the other competing priorities. Employees received better and more consistent benefits due to the Union, as the Collective Bargaining Agreement provided for many staff desires including such items as alternate work schedules, performance awards, office space assignments, and training opportunities.[177]

In general RFFO management and the Union leaders were never able to forge a truly productive partnership to provide much real benefit to the

RFFO mission. Two AFGE initiatives stand out as exceptions for their future impact on closure and transition. The first was the use of a "Pass / Fail" performance measurement system. Management agreed to this proposal, but wanted to provide for some productive feedback to the employees. A Multiple Appraiser Rating System (MARS) was developed and refined several times to provide for narrative feedback from supervisors, subordinates, and peers.[178] The MARS was cumbersome to manage and ended up taking longer to complete than the previous multi-tier numeric rating systems, such that eventually its use was stopped. However, in the several years it was used the understanding of peer and team member tasks and contributions increased substantially. The teamwork and cooperation between organizations within the office made lasting improvements to RFFO performance, especially when future downsizing required remaining staff to perform multiple jobs. The most significant problem with the pass/fail evaluations would not be understood until much later when employees tried to compete for jobs in other Federal agencies or even in other DOE offices. Employees found that a "Pass" was not very inspiring to a prospective employer, and anecdotal evidence suggests several employees missed placement opportunities because of use of the pass/fail system.

The most significant problem with the pass/fail evaluations would not be understood until much later when employees tried to compete for jobs in other Federal agencies. Employees found that a "Pass" was not very inspiring to a prospective employer...

The second AFGE initiative was an active involvement in the RIF planning process. The Union was essentially "born" because of 1997 RIF rumors, so it was always a priority interest. When the project was clearly finishing and the RIF a certainty in 2003, AFGE demanded to be involved. Through negotiation, the final RIF separation date was extended several months, the window for buyouts was extended, and several other placement initiatives increased. However, in exchange the Union largely supported the RIF and despite elimination of over 100 positions, only one Merit System Protection Board (MSPB) challenge was submitted, and that one was subsequently dismissed as without merit.

Worker Transition

Beginning in 2003, as 2006 closure began to look more likely, management aggressively pursued transition opportunities for federal staff using formal and informal means. The primary purpose was to avoid involuntary separations during a RIF if at all possible, however it was also believed that improved placement would help overall morale of the office and allow better focus on job tasks. The RFFO Manager and senior managers actively "marketed" RFFO employees through the Denver Federal Executive Board, and one-on-one discussions with executives from area federal agencies. With many federal agencies maintaining regional offices in the Denver area, transition opportunities existed that do not exist at many other DOE field offices. One of the most successful arrangements was the placement of about twenty RFFO employees with the Golden Field Office. Other RFFO employees were hired at Denver offices of the Forest Service, US Geologic Survey, Minerals Management Service, Veterans Affairs and the Environmental Protection Agency. These placements were facilitated by use of extended details for RFFO employees to a target agency.[180] Development of worker transition plans revealed that almost all of the priority placement benefits for an employee undergoing a RIF are voluntary for the hiring agency, or can be circumvented. The detail approach was used to allow employees to get into the target employer's office, become known, and hopefully make themselves invaluable, so that the agency would want to hire them. They would be more than just a name on a re-employment priority list. The salary continued to be paid by the DOE, essentially providing a free trial period. The use of details in this manner resulted in a greater that 80% placement rate.

The detail approach was used to allow employees to get into the target employer's office and become known so that the agency would want to hire them. They would be more than just a name on a re-employment priority list. The salary continued to be paid by the DOE, essentially providing a free trial period.

Closure Cadre

Another new approach for workforce planning was developed during 2003, the concept of a core cadre. The intent was for key people from the federal workforce with closure site experience, to serve as corporate resources, administratively reporting to Headquarters, and applying their closure project experiences to other sites when they were no longer needed at Rocky Flats. This would have the dual benefit of applying lessons learned via direct staff interaction, and providing a stable career path for a limited number of people who might otherwise be subject to RIF. Retention of experienced people was important, but equally important was retaining them as a critical mass to perpetuate the closure culture at other DOE sites.

Management was concerned about having sufficient technical expertise available to ensure proper oversight and capabilities to support the completion of Site closure. The concern, that too many RFFO employees would find other jobs (too soon) and leave, resulting in an insufficient number of employees to support closing Rocky Flats, was never realized partly because of the cadre, although the skill mix of the federal staff became more important as staff size diminished.

Toward the end of the project "Closure Cadre" personnel were networked with other DOE sites to facilitate reassignments. A human relations team was assembled at Headquarters, sent to collect information on "Closure Cadre" staff preferences. Unfortunately, the transition to a new administration at Headquarters and the formation of the CBC resulted in transition of Closure Cadre personnel being put on the back burner. The logistical preparation to implement the "mobility agreement," a condition of employment for "Closure Cadre" employees, was inadequate. There was no standardized process for identifying opportunities, placing Closure Cadre personnel, or implementing a permanent change of station. Even though all cadre members were required to sign a mobility agreement as a condition for selection to the closure cadre, the Department was unprepared with processes or budget to implement the mobility agreements. The impression given to the "Closure Cadre" employees was that in exchange for their commitment to relocate, all relocation benefits (i.e., guaranteed home purchase, real estate expenses, etc.) would be provided. In practice each Cadre placement has been unique, and there remains considerable confusion regarding the policies associated with closure cadre relocations.

In practice each Cadre placement has been unique, and there remains considerable confusion regarding the policies associated with closure cadre relocations.

The ten-year history of the RFFO office and other members of the Federal workforce that supported Rocky Flats closure reveals an interesting story. The RFFO was staffed for a job very different from Site closure. The office experienced substantial changes, some instituted by management (e.g., MAPping, Federal baseline) and others management would have preferred to avoid (e.g., unionization), which impacted the structure, operations, and morale of the workforce. Each of these changes, whether viewed as positive or negative at the time, served to increase the mission focus, understanding of fellow worker contributions, and overall sense of teamwork. This evolution of the workforce character and values was well suited to the challenges of the closure contract, and the strict requirements to provide GFS&I. Although it took several years to develop, the Federal workforce reached the point of working proactively and cooperatively with contractors, regulators, stakeholders, and other DOE and Federal offices to advance the closure mission. Actively supporting the actions necessary to advance closure, while maintaining a degree of independence for oversight, was a delicate balance that the Federal workforce performed well and therefore became important to the overall success of the closure.

KEY LEARNING POINTS

1. Build a complete Federal baseline that clearly identifies the tasks, schedules, and necessary skills for the mission.

2. Align the staff with the new mission immediately. Publishing the functional and skills needs, with as much information as is allowable, will assist transition and morale.

3. Directly linking federal workforce staffing to project baseline milestones increases awareness and accountability, and must be communicated to employees.

4. Be creative and consistent in supporting staff to perform. Reward their efforts and support their placement when the mission ends. Develop and implement retention and transition tools to manage attrition , using creative techniques to match the situation and need.

5. A RIF is difficult and challenging for management and the workforce, but can be managed to have minimal impact on productivity and morale.

6. Treat a federal union as any other key stakeholder group, seeking to build trust, understanding, and collaborative relationships. Union initiatives require substantial management attention, but can be supportive of the mission.

7. Culture change to support a new site mission or major baseline change is very difficult. Radical organizational change can be made, but brings with it substantial morale and workforce issues.

8. The Federal workforce can provide substantial support to the closure mission and contribute significantly to its success depending on how they are organized, managed, and led.

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ROCKY FLATS CLOSURE LEGACY

STAKEHOLDER INVOLVEMENT

THE "STATE OF THE FLATS" (TOP) WAS HELD ANNUALLY AND INCLUDED PRESENTATIONS FROM DOE, K-H, CDPHE, EPA, AND DNFSB. PROTESTERS (ABOVE) LINE UP AT THE WEST GATE TO GREET THE FIRST SHIPMENT OF TRU WASTE FROM ROCKY FLATS TO WIPP.

STAKEHOLDER INVOLVEMENT

INTRODUCTION

Rocky Flats has had an active history of public involvement (see *Future Land Use, End State and Stewardship* section). It is not marked by a particular advocacy group, but rather by changes to its composition. The Community Reuse Organization was the Rocky Flats Local Impacts Initiative. Not unlike other sites, Rocky Flats had a Site specific advisory board, the Rocky Flats Citizen's Advisory Board (CAB). Also, a successor organization to the community reuse organization, the Rocky Flats Coalition of Local Governments (RFCLOG) was formed. Its membership included elected officials from the eight cities and counties surrounding Rocky Flats. The Rocky Mountain Peace and Justice Center, based in Boulder, Colorado, provided consistent, and typically adversarial, participation in Rocky Flats issues.

These formal and independent organizations were engaged in Rocky Flats cleanup and closure issues, and implemented processes for public involvement and interaction with Site officials. The Rocky Flats Field Office (RFFO), Kaiser-Hill (K-H), Colorado Department of Health and the Environment (CDPHE) and EPA supported these organizations and participated in their forums. These community, government and activist organizations were effective to varying degrees in influencing DOE decision-making. Other substantial public process and input was achieved through the formation of working groups focused on specific issues. These included the Environmental Restoration and D&D Working Group, the Radionuclide Soil Action Level Working Group, the Surface Water Information Meetings (SWIMS), and the Stewardship Working Group. These working groups were typically comprised of many of the same players that were members of the formal standing organizations, but these working groups provided a different dynamic, less formality, and a focus on specific issues that enabled a free-flowing dialogue. Much of the substantial progress made in public involvement was achieved through these working groups.

Providing greater stakeholder access to cleanup documents during the early stages of development creates significantly more work for the Federal and contractor staff, but ultimately leads to better decisions and achieves greater community ownership of the cleanup.

DISCUSSION

There was community distrust of Rocky Flats and the Department of Energy, rooted in the cold war mission, but relevant to the ability of DOE and its contractors to implement the cleanup in an aggressive and innovative manner. It was a constant challenge to separate the emotion of the cold war mission from the science of the cleanup mission, and this was essential to gaining community support, and then political support for the cleanup. The DOE was often engaged in arguments that were grounded in events that occurred decades ago and had little to do with cleanup. But the distrust created then carried forward to the present.

The DOE reciprocated the distrust. It became evident that some activist groups were opposed to the cleanup. Under a thin veneer of concern for the environment was a core of anti-nuclear activism, with an agenda of ensuring Rocky Flats remained a negative image of the cold war legacy, versus a positive example of a Superfund cleanup. The misstatements and anti-nuclear rhetoric were transparent, but did find an audience with citizens genuinely interested in being informed about the cleanup. While this strategy on the part of the activists was tedious, it was essential that DOE address each issue raised to begin to correct the low trust of the DOE. This cycle of point and counterpoint with the activist groups created cynicism within the DOE, and skepticism that some stakeholders were not particularly interested in the cleanup, but were more interested in using it as a tool to further other agendas. Fortunately, this was not the majority sentiment as described further in this section.

Once the DOE filtered through the vocal minority, it discovered there were many concerned citizens amenable to open dialogue and with an agenda of ensuring Rocky Flats did not pose a long-term health risk to their communities. The challenge was to create a public dialogue that elicited greater participation from the public at large, particularly in the local communities, and de-emphasized the activist rhetoric.

Site Message

Develop and communicate a consistent site message.

To gain broader community acceptance of the cleanup mission and the risk-based approach, DOE needed to proactively communicate its message about the cleanup. DOE and K-H staff engaged the media outlets, reporters, editors, Federal, State and local elected officials. A consistent Site message was developed and communicated corporately and was derived directly from the vision, the mission, the Rocky Flats Cleanup Agreement (RFCA), and the closure contract. The challenge was to distill these strategies and agreements into a concise and comprehensible message.

The evolution of the “bumper sticker” message reflects the evolution of the Rocky Flats cleanup mission. From “It’s the Plutonium Stupid” of the early- to mid-1990s, to “Make it Safe, Clean it up”, reflecting the full transition from production to cleanup, to “Rocky Flats Closure 2006” which reflected the vision of the DOE to achieve cleanup at a major DOE site by 2006.

There were several consistent themes that were reiterated by Site personnel during public meetings, tours and visits, and media interviews, and were derived from Site planning documents. These messages included safety as a top priority, the comprehensive nature of the cleanup, compliance with regulatory standards, risk management, and the conservative nature of the cleanup. Some of these messages worked well while others did not.

Safety was the ubiquitous Site message. We would not be successful if we were not safe. The safety message was somewhat complicated and was frequently met with skepticism by some stakeholders who believed that the Site only raised safety issues when it wanted to reduce the scope of the cleanup. Long-term risks, forecasted by complicated models, were being compared to near-term exposure and acute risks to workers. These issues entered the dialogue when determining appropriate endpoints for decontamination activities prior to demolishing a building (e.g., How much additional exposure to workers is it worth for additional decontamination of a given facility?). These worker safety issues were most effectively communicated by the contractor supervisors and managers responsible for the workers and for the implementation of work. These "front line" managers and supervisors, directly involved in the decontamination and decommissioning work in the plutonium facilities, brought with them greater credibility than the managers and staff who routinely interacted with the stakeholder groups. What they may have lacked in presentation skills, was more than compensated by credibility and genuine, direct dialogue.

It was essential that the regulators agreed with the Site message that the cleanup would be comprehensive, conservative, and meet or exceed all regulatory requirements. The DOE was not asking the public to trust the DOE, but rather to trust Site regulators.

Another key message was that the cleanup would be comprehensive, conservative, and would meet or exceed all regulatory requirements. This proved to be an effective approach for reaching a broad audience beyond the core group of stakeholders engaged in monthly Site meetings. There was a general trust of the agencies overseeing the cleanup, and therefore, there was a general trust of the cleanup if it was going to meet or exceed regulatory standards. It was important to communicate this message repeatedly. Although it may not seem profound, since of course the cleanup complied with applicable law, this message did periodically get lost in the details of the cleanup. It was always worthwhile to revisit the regulatory sufficiency of the cleanup. Additionally, it was essential that the regulators not only agreed with this message, but were willing to state so publicly. And the regulators did agree that the cleanup was compliant, would satisfy RFCA, and in many cases was conservatively compliant. To their credit, the CDPHE and EPA were willing to repeatedly reaffirm that the cleanup was compliant.

The DOE was not just asking the public to trust the DOE, it was asking the public to trust those charged with overseeing the DOE. Although this approach was not universally effective, it was more effective with the established institutions including the Colorado Congressional delegations, the regulatory agencies and the local elected officials.

One Site message that did not work well at all was regarding risk, and the context of the risk presented by residual contamination at Rocky Flats in terms of cancer and other environmental risks. Since the cleanup was conservative on many levels, including the development of the future Site use conceptual model, the calculation of cleanup levels, and the planning and implementation of the cleanup, the RFFO thought that discussions of risk would reinforce to stakeholders that the cleanup of Rocky Flats was robust. RFFO thought that by promoting this conservative approach, and by putting it into the context of the risks present in everyday life, and sources of exposure to radiation in every day life, that there would be greater acceptance of the risks that were modeled for residual contamination at Rocky Flats. This approach did not work well. Stakeholders that responded favorably to this discussion were generally already supportive of the cleanup. Risk comparisons (excess cancer risks associated with exposure to various sources of radiation) occasionally found their way into the print media in a favorable context. Overall, however, discussions about risk created more distrust than trust. Comparisons of exposure to residual contamination at Rocky Flats, to other sources such as medical treatment, living at altitude (in the Rocky Mountain west) or radon gas, were met with jeers and skepticism. It turned out that the science of the cleanup was not the most important component for the typical stakeholder. Many members of the public still believed that radiation dose received from DOE facilities was somehow worse than exposure from other man-made sources or from natural sources. No amount of fact would dissuade them. Even with respect to meeting regulatory standards, such as the State of Colorado stream standard for plutonium, most stakeholders were much more interested in knowing whether the DOE was in compliance with the standard than whether it was the right standard.

Hold routine technical availability sessions with stakeholders and ensure knowledgeable contractor, regulator, and DOE staff are present to address stakeholder questions.

<u>Openness</u>

The RFFO made a conscious decision to move away from the "announce and defend" mode of doing business and to provide for early involvement in decision making. Tactically, the RFFO wanted to ensure cleanup decisions could be made, even where disagreement existed, and the decisions implemented. One approach to building trust was to increase access by the regulators and stakeholders to the Site, Site employees and Site documents. Since the Site was confident in its mission and its approach, it was also confident that greater public understanding of what was occurring inside the gates would increase trust and also improve the Site's ability to make decisions and take cleanup actions.

DOE agreed to provide draft documents to stakeholders for informal comment. The intent was to provide early involvement in and ownership of decision-making processes, and to reduce the number of comments received during the formal comment period. This approach received mixed reviews by the DOE and contractor staff because this approach clearly increased stakeholder buy-in, but was a tremendous workload for both staff and management.

The RFFO also learned that community interests were not homogenous. The local governments and stakeholder groups were united in wanting Rocky Flats to be deactivated and decommissioned, and unlike other DOE communities, there was not a broad constituency for preserving jobs at Rocky Flats beyond the cleanup mission. But this is just about where the commonalties stopped. Cleanup levels, future Site access and use, and use of fences and signs were all hotly debated by the cities and counties, the Citizen's Advisory Board, and other local groups. Therefore, cleanup decisions often received broad acceptance, but almost always were made in the face of some dissent or minority opinion. The openness of the overall stakeholder interaction helped mitigate the impact of the minority opinions, since it was clear to all that the opinions had been heard. Thus the interactions were generally perceived to be fair, even if not totally satisfying.

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The RFFO benefited from having both the EPA, CDPHE and virtually all active stakeholders in close proximity. Unlike, for example, the Hanford Advisory Board or the Idaho Citizen's Advisory Board, where the members are located across the state or even in different states, most CAB members and RFCLOG members lived within a 30-minute drive of the Site. This facilitated open and frequent communication. Both regulatory agencies were provided office space on Site and meetings occurred daily. Within the major plutonium facilities, the State regulators were invited to have maximum participation in the process and maximum access to cleanup documents. Stakeholder interactions were frequent and were both formal and informal.

Both regulatory agencies were provided office space on Site and meetings occurred daily. Within the major plutonium facilities, the State regulators had maximum participation in the process and maximum access to cleanup documents.

One example of this openness involved the first major nuclear facility to be demolished at Rocky Flats, Building 779. Some stakeholders were concerned about the potential for adversely impacting air quality during the demolition, even though good facility survey data had been presented during public meetings. As a final step in the process, prior to facility demolition, a stakeholder tour was conducted inside the facility. And while such a tour certainly can not demonstrate the level of cleanliness of the facility, it did help to communicate in a non-verbal way that this was a decontaminated facility that was safe to enter in street clothes.

Stakeholder Involvement in Formulation of Cleanup Levels

In 1996, the RFCA Parties announced the interim radionuclide soil action levels (RSALs) for plutonium, americium, and uranium. An action level under RFCA is a level of an environmental contaminant used to decide whether an accelerated action, such as soil removal, is needed. Action levels guided the selection and implementation of most cleanup actions at Rocky Flats. For plutonium, the action level proposed by the RFCA Parties was 651 picoCuries per gram (pCi/g). The action level was calculated based upon a 1 in 10,000 excess risk of cancer to an open space worker (note that this action level was developed prior to the designation of the Site as a future national wildlife refuge).

When the interim soil action levels were announced in 1996, many stakeholders were upset. Without understanding exactly why, they felt that the numbers were too high (not conservative enough). The proposed action level was met with widespread opposition throughout the stakeholder community, for two primary reasons. First, and notwithstanding the fact that the action level was regulatorily acceptable (CERCLA allows a residual risk of between 1 in 10,000 to 1 in 1,000,000 to the anticipated future user), the level was thought to be simply too high to be adequately protective. This criticism was voiced not only by long-time Rocky Flats activists (such as the Rocky Mountain Peace and Justice Center [RMPJC], who for some years had been asking for a cleanup to background levels of radionuclides), but also by local government leaders. The second reason for stakeholder opposition was the perception that the process used to determine the action levels was closed to meaningful public input, and that it was an example of the "decide and defend" strategy. In hindsight, the latter criticism had some merit, especially in light of the process that was to follow.

Earlier involvement and increased participation by stakeholders in cleanup decisions must be accompanied by their acknowledgement of the same regulatory and budgetary constraints placed upon the DOE.

RFFO believed that some community members were clearly only interested in disrupting any process that led to a cleanup standard other than cleanup to background. It was important, however, to counter their arguments at every juncture, because there were other stakeholders ready to listen, and engage. Other stakeholders were genuinely interested in learning about the basis for the cleanup and weighing into the decision-making process. Unfortunately, in an open process, the DOE is not permitted to discriminate between those interested in the cleanup versus those interested in disrupting the cleanup.

The RFFO recognized the level and intensity of community concern, and also recognized that the issue needed resolution before embarking on major removals of contaminated soils, which were scheduled for late in the project. In 1998 the DOE RFFO Manager and Assistant Secretary for Environmental Management agreed to fund a citizen-based group to re-examine the RSALs and propose a technically based alternative to the RFCA Parties. The group came to be known as the Radionuclide Soil Action Level Oversight Panel, or RSALOP, and met from the fall of 1998 through the spring of 2000. The RSALOP hired a private consultant, Risk Assessment Corporation (RAC), to develop a new set of RSALs. RAC's tasks included reviewing cleanup levels at other sites, reviewing available computer models for risk calculations, development of use scenarios and input parameters, and the calculation of the levels themselves. RAC's work ended in a series of reports, which included a recommended RSAL for plutonium of 35 pCi/g.[183] The basis for this number was a no greater than ten per cent chance of a child of a resident rancher receiving more than a 15 millirem dose in a given year. The scenario was exceptionally conservative, calling for the rancher and his family to live at the most contaminated part of the Site without interruption, drinking water and eating food grown only from the property.

The RAC work was subjected to a blind peer review. For this process RFFO agreed to have peer review candidates submitted for consideration by the various stakeholder groups. Then a third party consultant selected peer reviewers from the list. Only the third party contractor knew the identity of the peer reviewers for a given work product. This tended to dampen the rhetoric about peer reviewers and bias, since no one could know with certainty "whose" peer reviewer was responsible for a given set of comments. This blind peer review process proved to be a very effective tool for focusing the public discussion on the technical merits. The RSALOP ultimately recommended the adoption of 35 pCi/g as the new RSAL to the RFCA Parties.

This blind peer review process proved to be a very effective tool for focusing the public discussion on the technical merits.

Both DOE and the regulators attended the RSALOP meetings, but were not members of the Panel. Although provided with copies of draft reports, neither DOE nor the regulators provided substantive technical comments, preferring to allow the evaluation to proceed in a completely independent manner. Importantly (given the conversations that were to ensue with the community), DOE made no attempt to constrain the results of the RSALOP work by introducing either budgetary or regulatory concerns. DOE funding for the RSALOP's efforts totaled about $500,000.

Cleanup Levels and the Stakeholder Focus Group

In 2001, on the heels of the RSALOP's recommendations, DOE convened the RFCA Focus Group to get community feedback on basic approaches to environmental restoration at Rocky Flats, including, if possible, a consensus on cleanup priorities. The RFCA Focus Group's purpose was to facilitate community discussion and debate, and to make the process of setting final cleanup levels more transparent. The focus group developed a syllabus for weekly meetings and focused on issues of national cleanup standards, modeling, future land use exposure scenarios, and dose versus risk. Agendas were developed collaboratively with the regulators and stakeholders.

The RFCA Focus Group had a broad range of participants, including representatives from the established community organizations (CAB and RFCLOG), as well as some of Rocky Flats' most vocal critics from the RMPJC, the University of Colorado faculty, and the community at large. The RFCA Parties and Kaiser-Hill began the Focus Group by providing detailed briefings on environmental conditions at Rocky Flats. Later on in the discussions, DOE and the regulators (especially EPA) confronted the members of the Focus Group with the twin constraints that had not been raised during the RSALOP's deliberations: that cleanup decisions would ultimately be limited by the available budget, and that the RFCA Parties would not be compelled to embark on a cleanup that was beyond the CERCLA risk range for the anticipated future user (by then, the wildlife refuge worker). The reaction from certain members of the Focus Group was strong, negative, and immediate. This was in particular true of those group members who believed strongly that a) the risk from residual plutonium was far greater than the RFCA Parties were representing, b) that it was morally irresponsible to consider making economic risk trade-offs, and/or c) that DOE had a moral imperative to return the Site to its pre-manufacturing condition.[184]

...certain priorities began to emerge. These were an emphasis on the protection of surface water that could leave the Site and, by extension, a desire for as much cleanup of surface soils as regulation and money would allow.

This viewpoint was not universally shared among Focus Group members. Certain members, especially elected representatives of local governments, recognized and were comfortable with the notion of having to make decisions in the public interest under fiscal constraints. Other members (including members of CAB), more accepting of the RFCA Parties' representations of the risks posed by plutonium, openly questioned the need for large expenditures for minimal incremental risk reduction.

Focus Group discussions continued for over a year. In addition to the Focus Group meetings, the RFFO responded to stakeholders that requested additional technical availability sessions. The Site would provide federal and contractor personnel for technical briefings and question and answer sessions prior to the Focus Group meetings. As part of the Focus Group process, the RFCA parties and K-H developed technical papers that served as the building blocks for development of the soil action levels. While no firm consensus was reached on the application of cleanup levels, certain priorities began to emerge. These were an emphasis on the protection of surface water that could leave the Site and, by extension, a desire for as much cleanup of surface soils as regulation and money would allow. Focus Group members in general pushed for as much cleanup as possible. Those that were willing to engage in the trade-off discussion helped to formulate the approach that was later codified in the modifications to RFCA Attachment 5,[105] which posited a much reduced RSAL for surface soil (50 pCi/g), while allowing considerably more residual contamination at depth.

During 2001 and 2002, the RFCA Parties undertook the re-calculation of the RSALs, forming an interagency working group to facilitate the process. Meetings of the RSAL working group were open to the public, affording the chance for interested stakeholders to monitor these highly technical discussions and express their views. This work culminated with the release of the proposed RSALs late in 2002, as part of revisions to the RFCA soil actions level attachment. While a level of approximately 100 pCi/g of plutonium in surface soil was calculated to represent an excess cancer risk of 1 in 100,000 to a wildlife refuge worker, the proposed RSAL was set at 50 pCi/g to further ensure broad community support. The proposed revisions received a 60-day formal review, were adopted in June 2003, and were the basis for the major soil removal actions at Rocky Flats, including the 903 Pad and Lip area.

Recently, the U.S. GAO surveyed local stakeholders on the success of the cleanup, and twenty-two of twenty-four respondents said they were somewhat to extremely confident that the cleanup will be protective of human health and the environment.

The extensive public process surrounding the determination of cleanup levels at Rocky Flats had a number of profound effects. The RSALOP process resulted in a recommended cleanup number that garnered wide public support, echoed in a final RSAL thirteen times lower than the one originally proposed. A number of the technical approaches employed by RAC were adopted by the interagency RSAL working group. Finally, the discussions with the RFCA Focus Group, while often contentious, led to a change in cleanup approach whereby much more surface soil was removed than originally anticipated. Overall, the DOE believes that these efforts resulted in a successful outcome in terms of project completion, regulatory compliance and stakeholder satisfaction. Recently, the U.S. General Accountability Office surveyed local stakeholders on the success of the cleanup, and twenty-two of twenty-four respondents said they were somewhat to extremely confident that the cleanup will be protective of human health and the environment.[185] The relatively few stakeholders still expressing strong objections continue to voice the concerns raised during the RFCA Focus Group, along with an additional concern that the presence of plutonium in the environment will outlast land use controls at the Site.[186]

The process of setting action levels for soil cleanup proceeded iteratively, as described above, for seven years, from 1996 to 2003. The soil-action level issue was always contentious and for many stakeholders was the issue that would demonstrate whether the DOE was really serious about cleanup, or was merely trying to get by with the minimum. A major component of settling the RSALs issue was DOE's insistence and eventual agreement by the stakeholders that the RSAL debate must be conducted within the framework of a risk-based cleanup. Ultimately, what this meant at Rocky Flats was that a lower (more conservative) RSAL could be established for surface soils, where exposure presented a greater relative risk, and a higher cleanup standard would be established for subsurface soils where the risks were lower. The Focus Group process did eventually deliver cleanup numbers that received broad community acceptance. The cleanup numbers became the final numbers, and were the basis for remediation of radionuclides in soil. The process and the levels were generally viewed favorably by Rocky Flats stakeholders, the media and the politicians overseeing the cleanup.

...in terms of achieving its stated goals for the RFFO and for the regulators, the RSAL process was successful. Cleanup levels were determined that were based in science (albeit, still very conservative), received broad community acceptance, and dispelled the notion that these numbers needed to be revisited yet again.

It should be noted that the RFCA Focus Group was extraordinarily expensive in terms of staff preparation time and would likely receive mixed reviews from agency people involved in the process. It is difficult to gage the impact of not having pursued this process. The level of stakeholder controversy and interest was such that extraordinary effort was necessary for resolution. But in terms of achieving its stated goals for the RFFO and for the regulators, it was successful. Cleanup levels were determined that were based in science (albeit, still very conservative), received broad community acceptance, and dispelled the notion that these numbers needed to be revisited yet again.

Deer Trail Disposal Facility

A contrasting example where the stakeholder dialogue was not successful involved the disposal of low-level radioactive waste. Rocky Flats is the only major DOE closure site to date that does not have onsite disposal of low-level radioactive waste. This decision was agreed to by the RFFO Manager and the Assistant Secretary for EM at a controversial public meeting in September 1997 to discuss some of the most critical assumptions that would enable a targeted site closure by 2006. The stakeholders understood the short-term transportation risks versus the long-term real and perceived risks of waste remaining in the area, and advocated removal of all wastes. After a quick cost comparison demonstrated the cost tradeoff was comparable, the commitment to the community was made and reflected in future planning documents. This commitment to remove all waste is one of the most important when it came to community acceptance of the cleanup; most stakeholders recognized this for the good deal that it was.

At the time the commitment was made, options for disposal of low-level waste were limited to the Nevada Test Site or the commercial facility Envirocare of Utah. K-H took the lead on pursuing a business relationship with a land fill operator in eastern Colorado for the purpose of achieving a radiation license and accepting low-level waste from Rocky Flats. This could have meant substantial savings in transportation costs since the proposed facility was only 90 miles from Rocky Flats, as opposed to shipping low-level waste to Nevada and Utah. It also would add competition for disposal costs with an expected lower cost for disposal. The initiative was picked up as an election issue for the Colorado Governor's race in 1998 and science went out the window. It was portrayed in the media as one of environmental justice, a metropolitan suburb of Denver "dumping" its problem on the poor eastern farming and ranching communities. Ironically, the community of Last Chance, Colorado where the facility was located was supportive of the initiative because of the employment potential. The initiative was ultimately unsuccessful because the issue became partisan and politicized. One of the lessons learned here was to be mindful of the election cycle when pursuing controversial matters.

<u>Community Dialogue on Long-Term Stewardship</u>

The dialogue with local stakeholders regarding the long-term, post-closure maintenance of Rocky Flats, also known as long-term stewardship, began in the late 1990's, as it began to be apparent that the Site would be closed in the foreseeable future. It also began to be apparent that, almost regardless of the level of cleanup, some long-term monitoring and maintenance would be needed at the Site. In June 1999, the Rocky Flats Stewardship Working Group (SWG) was established as a joint venture between the CAB and the RFCLOG. The SWG was formed to examine a number of issues, including the types of environmental activities that would be needed, retention of Site-related information, assurance of funding for long-term stewardship activities, and regulatory oversight and enforcement. The DOE participated in the SWG as an ex-officio member, as did CDPHE and the Colorado Attorney General's Office.

…three primary issues dominated the stewardship conversation: factoring in long-term stewardship concerns into the selection of remedial activities, ensuring the regulatory enforceability of long-term stewardship activities, and funding assurances for long-term stewardship.

During the period of active remediation at Rocky Flats, three primary issues dominated the stewardship conversation: factoring in long-term stewardship concerns into the selection of remedial activities, ensuring the regulatory enforceability of long-term stewardship activities, and funding assurances for long-term stewardship. To address the first concern, the Environmental Restoration RFCA Standard Operating Protocol (ER-RSOP[24], the umbrella decision document under which most environmental restoration accelerated actions were conducted) was revised to include long-term stewardship criteria in the remedy evaluation process.

Additionally, larger, individual decision documents (such as those that were written for the landfill closures) also contained sections on long-term stewardship requirements. When the actions were completed under the ER-RSOP or individual decision documents, closeout reports documented long-term stewardship needs.

The second concern, the enforceability of long-term stewardship requirements, is being addressed by making stakeholders aware of, and allowing informal comment on, early draft versions of the post-closure Rocky Flats regulatory agreement, which is in negotiation at this writing. This was a primary topic at the later SWG meetings in 2004 and 2005, which allowed stakeholders to get an understanding from the regulators and DOE regarding the legal underpinnings of an agreement, and the enforcement powers that the State and EPA had. DOE, the State and EPA will finalize the post-closure agreement for Rocky Flats in 2006, and have committed to allow stakeholders to review and comment on it before it is signed.

The final issue, that of assuring funding for long-term stewardship activities, has been the most problematic, given the extended time that monitoring and maintenance will be required at Rocky Flats, and the inherent uncertainty in the federal budget cycle. In the late 1990's and early 2000's, many stakeholders insisted that a trust fund be established for long-term stewardship, although DOE advised that such a fund could not be established given the agency's annual dependence on Congress for funding. Although never entirely resolved, the establishment of the DOE Office of Legacy Management in December 2003 seemed to give stakeholders more confidence that DOE was serious about funding its long-term obligations at closure sites like Rocky Flats. This confidence was reinforced by a successful transition of physical Site operations from the DOE Office of Environmental Management to DOE Legacy Management in late 2005.

...another example of the lesson learned and reinforced several times at Rocky Flats, that for stakeholder involvement the process (the meetings, discussion, dialogue) was more valuable than the product (a report or plan).

During the long-term stewardship dialogue, both the stakeholders and DOE authored documents on long-term stewardship issues. The SWG produced *Hand in Hand: Stewardship and Cleanup* in March 2001.[187] This report reviewed previous cleanups and stewardship issues at Rocky Flats, and reviewed the long-term stewardship techniques that could be used at the Site. In June 2003, DOE produced the draft *Rocky Flats Long-Term Stewardship Strategy*,[188] which outlined policies on a number of individual topics, including monitoring and maintenance, information management, regulation of activities, and funding. Although overcome by events and therefore never finalized, the *Strategy* provided a documented reflection of the issues discussed with stakeholders, and the policies developed therein have formed the basis for post-closure activities at

Rocky Flats. This was yet another example of the lesson learned and reinforced several times at Rocky Flats, that for stakeholder involvement the process (the meetings, discussion, dialogue) was more valuable than the product (a report or plan).

Independent Verification of Cleanup Activities

In 2004, with the end of the Rocky Flats closure project in sight, many stakeholders, including members of RFCLOG and CAB, became concerned that there was insufficient independent verification that the cleanup had met its goals. Stakeholders asked that DOE fund additional reviews of the cleanup, to be performed by independent experts. This request was forceful, notwithstanding the fact that the closure had been continually subject to regulator approval and community review. Many stakeholders did not consider themselves to be technically proficient to perform such a review, and did not consider the State and EPA to be truly independent overseers of the project. The regulatory cooperation that allowed the cleanup to proceed so successfully, for some stakeholders, was cause to question whether the regulators had lost their objectivity. Also, the 2003 final soil action level decision was still on the mind of many stakeholders.

The regulatory cooperation that allowed the cleanup to proceed so successfully caused some to question whether the regulators had lost their objectivity. To address the concerns, DOE agreed to hire outside contractors to review the levels of residual radionuclides in surface soils following cleanup.

To address the concerns, DOE agreed to hire outside contractors to review the levels of residual radionuclides, especially plutonium, in surface soils following cleanup. The rationale for performing such a review was that surface soils would not be monitored routinely after the cleanup (unlike surface water and groundwater), and a recognition that it was very important to have certainty regarding levels of residual surface soil contamination, given future Site use as a wildlife refuge. Some stakeholders, particularly the neighboring cities of Westminster and Broomfield, were concerned about other more narrow topics, including water management and landfill closures, and retained experts to advise them on those topics as well.

DOE embarked on a three-part approach to characterizing residual contamination in surface soils, which was briefed to stakeholders in early 2005. First, DOE contracted with Bechtel-Nevada to perform an aerial gamma survey of the entire Site using a helicopter. The purpose of this survey was to ensure that there were no undiscovered areas of contamination at the Site, a concern that had been raised on a number of occasions by environmental activists. Second, DOE asked Kaiser-Hill to perform ground-based radiological surveys (in addition to those that were required by the regulators) around the perimeters of soil remediation areas, to ensure that the extent of contaminated soils and their removal had been completely defined. Finally, DOE retained the Oak Ridge Institute for

Science and Education (ORISE) to investigate an area that had already been cleaned up (the so-called 903 Lip Area), to ensure that the residual contamination there was consistent with RFCA requirements.

The first two portions of the DOE verification effort generally went well. Bechtel-Nevada performed the helicopter survey from June 12 to 15, 2005[189]. No radiological anomalies were found, apart from known sources that still existed at the time. The survey initially identified one location with higher readings on the southwest border of the Site, but subsequent more sensitive, ground-based measurements determined that the area was within acceptable parameters. The survey was somewhat hampered by the fact that soil moisture conditions at the time of the overflight did not allow for the level of resolution that had been hoped for, however the survey was still able to satisfy the verification objectives. The inability to reach the desired optimum made it difficult to communicate the relationship between the actual level of detection and DOE's regulatory requirements. In hindsight it would have been better not to identify an optimal target, as some viewed failure to reach the optimum as failure of the entire effort. None-the-less, the aerial survey achieved its goal and DOE judged the effort a success, a sentiment mirrored by many stakeholders.

In hindsight it would have been better not to identify an optimal survey-resolution target, as some viewed failure to reach the optimum as failure of the entire effort.

Kaiser-Hill's scanning of the perimeters of remediated areas, using a more intensive scanning regime than was required by the regulatory decision documents, did find small areas where contamination exceeded the RFCA soil action levels, and these were removed without incident. The survey met the goal of demonstrating that the boundary of the cleanup actions was sufficiently large to have removed the contamination.

In contrast to these first two, the ORISE effort to verify residual contamination levels in remediated areas was was not easily defined in terms of success or failure to the stakeholders. The Rocky Flats survey and sampling protocols had been designed using CERCLA-based techniques which focus on risk while ORISE used sampling and survey protocols known as MARSSIM which focus on dose. The CERCLA-based protocols were based on EPA guidance and had been refined by Rocky Flats and its regulators over a number of years, while MARSSIM was developed by DOE, EPA and the Nuclear Regulatory Commission. MARSSIM had been used successfully by ORISE for several years to verify the levels of residual contamination within buildings at Rocky Flats prior to demolition, and the RFFO believed those protocols could be easily adapted to sampling of soil outside the buildings, and also provide an independent double-check. However, there were fundamental differences between MARSSIM and the CERCLA-based approaches, and both approaches require considerable use of professional judgment. These differences created some legitimate technical problems, however these could be worked out between the technical experts. A greater problem was the significant confusion created for the stakeholders.

The confusion was partly addressed by focusing the use of MARSSIM on two small areas of the 903 Lip Area. The ORISE sampling effort showed that the areas had been cleaned up to meet the 90% probability specified in the RFCA decision documents, and in fact to an even higher 95% confidence level. ORISE also performed a full radiological surface scan of the same areas which identified some locations for "biased" sampling. Laboratory analysis of the biased samples revealed small areas of elevated plutonium in excess of the RFCA action level of 50 pCi/g of plutonium.[190], casually referred to as "hot spots". (Elevated plutonium in some locations is expected due to natural variability and averaging, while "hot spot" has a precise definition related to concentration and size.) The elevated plutonium alarmed many stakeholders who did not understand how one technique used by ORISE could show the cleanup was better than regulatory minimums, while another technique in the exact same area was apparently higher than the cleanup standard. The answer was in the differences between elevated plutonium and "hot spot", differences between risk-based and dose-based analysis, and the differences between action levels and cleanup standards. RFFO and the regulators were not able to sufficiently explain the differences in a way the stakeholders could understand, in fact leading to even greater confusion and suspicion. RFFO decided to remove the small elevated plutonium areas, although not strictly required to meet the CERCLA cleanup requirements. The regulators agreed that no additional MARSSIM-type contaminant surveys would be required in order to meet the cleanup provisions of CERCLA and RFCA. [191]

The entire seven years of dialogue and thousands of contact hours to establish the risk-based soil action levels was not enough for many stakeholders. When the ORISE information came to light they saw the issue as "clean or not clean", and the risk basis underpinning the entire RFCA structure was discounted.

While this episode did cause tension between DOE and its stakeholders, the overall result of the ORISE work was to increase confidence in the cleanup, according to a survey taken by the GAO.[185] The RFFO also learned that its efforts at communicating with stakeholders regarding risk-based decision-making still had a long way to go. The entire seven years of dialogue and thousands of contact hours to establish the risk-based soil action levels was not enough for many stakeholders. When the ORISE information came to light they saw the issue as "clean or not clean", and the risk basis underpinning the entire RFCA structure was discounted.

<u>The Future of Stakeholder Involvement at Rocky Flats</u>

As of March 2006, the RFCLOG was disbanded, and by July 2006 the CAB ceased its operations as well. The Rocky Flats Stewardship Council is now the primary stakeholder organization for Rocky Flats. The Council, funded by DOE Legacy Management, began its operations in

March 2006, and is composed of the seven RFCLOG member governments, one rotating government member, and four openings for citizen representatives. The Council will meet quarterly (as opposed to the monthly CAB and RFCLOG meeting schedules) and will take up issues relating to long-term management of Rocky Flats, including issues related to Rocky Flats former employees.

KEY SUCCESS FACTORS

1. Develop clear and simple site messages regarding your mission and focus. These will serve as a consistent backdrop for stakeholder discussions and also help with internal consistency as other factors impact a project or site over time.

2. Consult stakeholders early in the decision process and, to the extent practicable, empower them to affect the decision that is ultimately made. At Rocky Flats, the best example of this "openness" was the funding of a citizens' panel by DOE to determine a plutonium soil cleanup level that would be generally acceptable to the community. Even for less momentous decisions, DOE routinely provided pre-public comment period drafts of decision documents to key stakeholders, allowing them to become familiar with proposals early and provide critical feedback.

3. Advise stakeholders of legitimate DOE constraints early in the decision-making process. One criticism of the soil action level-setting process, especially by the environmental activist groups, was that DOE was not open about its constraints that the cleanup must be accomplished within budget and regulatory requirements. While seemingly self-evident, more explicit discussion of this earlier in the process would have forestalled this criticism.

4. Similarly, become familiar with the core interests of key stakeholders. As an example, communities to the east of Rocky Flats are fundamentally concerned with the quality of water leaving the Site, which colors their reactions to all Site-related decisions. Knowing these core interests may allow DOE to fashion proposals in a more palatable manner for key stakeholders.

5. Provide opportunities for stakeholder interactions outside of formally established stakeholder groups. This includes scheduling public information and working group meetings, availability sessions, as well as one-on-one meetings with key stakeholder groups. These types of forums allow stakeholders greater access to

DOE personnel, the ability to delve into individual issues with great depth, and encourage informal interchange that builds personal relationships with key stakeholders.

6. Cultivate relationships with Congress and the press. Almost inevitably, unhappy stakeholders will seek assistance from members of Congress and the media for help with issues of concern. DOE staff and management should establish positive relationships with Congressional staffers, members of Congress themselves (in the case of management), and local media representatives. Numerous issues at Rocky Flats (such as independent verification) played out with members of Congress and the media, and having established relationships with these people was very helpful in reducing pressure on DOE in the decision-making process.

7. Provide the stakeholders access to cleanup documents during the early stages of development. It creates significantly more work for the federal and contractor staff, but in the long run it achieves more stakeholder ownership of the cleanup.

8. Schedule and conduct routine informational meetings to apprise interested stakeholders of project progress. This serves to build trust, can be done in a less formal environment (without charters and facilitators) and is an opportunity for the DOE to communicate its message.

9. Consider the cycle of elections when addressing controversial public issues, and the potential for a legitimate technical and policy decision to be derailed by election politics.

10. Be very clear on purpose and goals when pursuing additional actions beyond regulatory requirements. Our independent verification initiative to increase public confidence had the opposite effect with some stakeholders, despite the actual data and results.

11. Establish very clear scope, performance criteria, quality assurance and reporting protocols for independent verification efforts. An "arms length" approach to preserve technical independence can still be achieved while ensuring the business management is controlled per appropriate contracting requirements.

12. You cannot over-communicate with an interested and engaged stakeholder group. Especially with new and unfamiliar technology

and protocols, it is necessary to be very thorough in explaining the technology and achieve good understanding before the results are presented.

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APPENDIX 1

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200	Rocky Flats Environmental Technology Site Property Management Manual (1-MAN-009-PMM), REVISION 1, September 1999.
201	ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE PROPERTY CONTROL MANUAL (MAN-141-PCM), VERSION 0, December 2004.
202	Draft Risk Based End State Vision Document for the Rocky Flats Environmental Technology Site, no date provided.
203	Eugene C. Schmitt memorandum (OOM:BJ:03-00919) to Rocky Flats Field Office Employees Grades 15 and below, Information Notice of Reduction-In-Force, July 30, 2003.
204	EM-RFO--KHLL-NONPUOPS1-2002-0003, Building 865 Rigging Incident October 2002.
205	EM-RFO--KHLL-NONPUOPS1-2002-0004, Active Fire Suppression Line Cut During Equipment Dismantlement, November2002.
206	EM-RFO--KHLL-NONPUOPS1-2002-0005, Improper Respiratory Protection in Beryllium Area, December 2002.
207	EM-RFO--KHLL-NONPUOPS1-2002-0006, Personal Injury While Size Reducing Metal, January 2003.
208	EM-RFO--KHLL-NONPUOPS1-2002-0007, Load Slipped Out of Rigging During Lift, December 2002.
209	Rocky Flats Environmental Technology Site Proposed Plan, July 2006.

Ref No.	Reference
210	Attachment A, *Omnibus* Agreement Regarding Accelerated Closure Contract Issues (*Omnibus* Paper), Revision 5, March 2005.
211	Rocky Flats Environmental Technology Site 2010 Closure Project Baseline Validation Final Report, PriceWaterhouseCoopers, July 1999.
212	Baseline Confidence Review, 2006 Rocky Flats Closure Project Plan, U. S. Department of Energy Rocky Flats Field Office, Ernst&Young LLP, September 1999.
213	External Independent Review (E.I.R.) of the Rocky Flats Integrated Closure Project Baseline (ICPB), June 2001.

ROCKY FLATS CLOSURE LEGACY

APPENDIX 2

"TECHNOLOGY AT ROCKY FLATS" DEMONSTRATION SUMMARY SHEETS

ROCKY FLATS CLOSURE LEGACY

APPENDIX 3

LESSONS LEARNED
(APPENDIX A OF THE ROCKY FLATS BASELINE PERFORMANCE REVIEW REPORT)

Lessons Learned Number and Title	Ref. No.
LL - 01 Contract Language	47
LL - 02 Contract type CPIF easier to Manage	40
LL - 03 Improvements to contract fee payment process	46
LL - 04 Improvements to contract	44
LL - 05 Improvements to contract	42
LL - 06 Improvements to contract related to fee schedules	48
LL - 07 Broader Interpretation of Risk Management Needed	57
LL - 08 Site Management after remediation	111
LL - 09 Make manager responsible for employee's cleanup/out of records	170
LL - 10 Use of "Pilot Project" status to streamline property disposal	95
LL - 11 Cost savings and improved performance by consolidating procurement systems	55
LL - 12 Waste Generation rates are Poor Project metric	56
LL - 14 Contract Language	45
LL - 15 Separation of Private Vehicles and Commercial Traffic	75
LL - 16 Walk-down of job site prior to initiation of work.	71
LL - 17 Review standard work packages prior to start of work.	72
LL - 18 Shipment of Waste	100
LL - 19 Correct shipping containers	115
LL - 20 Waste Handling	119
LL - 21 Shipping of Large Waste Items	94
LL - 22 Mutual Aid Agreements	77
LL - 23 Fire Services	78
LL - 24 Site Directives	76
LL - 25 Federal Worker Mindset	49
LL - 25 [Sic] Safeguards and Security at a Closure Site	112
LL - 26 Tracking Reemployment of Separated Employees	169
LL - 27 Interaction of EPA, State and Stakeholders on Regulatory Agreement	36
LL - 28 Transitioning regulatory documentation	153
LL - 29 Disposition of equipment, after its useful life, for a closure site	96