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SITE WIDE INTEGRATION OF THE ROCKY FLATS CLOSURE PROJECT

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ABSTRACT

The prime contractor for the Rocky Flats Closure Project (RFCP), Kaiser-Hill, in concert with the Department of Energy - Rocky Flats Field Office (DOE-RFFO) has applied a fully integrated, life-cycle, critical path schedule and work planning system to manage to work that is required to close the Site. The closure of the Site is complex, in that it houses over 700 facilities, 19,600 kilograms of Special Nuclear Material (Plutonium and Uranium), and over 160,000 cubic meters of Transuranic, Low Level, and Hazardous Waste. The deactivation, decommissioning, decontaminating, and demolition of this large number of facilities, while at the same time accommodating difficult on-going activities, significantly increases the sophistication required in the planning process.

The Rocky Flats team has overcome these difficulties by establishing a "money" oriented critical path process, to provide a "least-cost" avenue to supporting on-going activities and a "line-of-balance" process for production oriented activities. These processes, when integrated with a typical activity-based project planning system, guide the way to the shortest and most cost-effective course for the closure of the Rocky Flats Site.

INTRODUCTION

The Rocky Flats Site, constructed in the 1950's, developed into an industrial complex consisting of more than 700 facilities and structures. The main production and support facilities occupy approximately 385 acres of the 6,200 acre site. Production of nuclear and non-nuclear weapons components contaminated many of the facilities and much of the equipment with radioactive and other hazardous materials. The Site posed potential risk to health and safety from the presence of large amounts of Special Nuclear Material (SNM) in various forms. Rocky Flats currently stores approximately 12.9 metric tons of Plutonium and over 6 metric tons of highly enriched Uranium. Much of this material has been stored in temporary packaging since 1989, following abrupt cessation of nuclear materials production activities. As one can see in Figure 1, the Rocky Flats Site is a complex industrial site.

The mission at Rocky Flats is simple - **close the site down**. Closing down of the Rocky Flats Site is extremely complex, because significant interplay between facilities is required to stabilize and ship SNM and to gather, package and ship waste. The materials that Rocky Flats currently has in inventory, plus the total amount of material that will be generated during the conduct of the Closure Project is presented in Table 1. Figure 2 presents an artists concept of what the Rocky Flats Site will look like at completion of the RFCP.

In addition, the Site must close the major plutonium buildings as soon as possible to reduce the "mortgage" costs thus, allowing redirection of money currently being spent on building support to be spent directly on site closure activities. A multitude of interactions and interdependencies is created by closure of this complex Site. This creates a very complex set of activities, restraints and interfaces and requires an intricate and sophisticated work planning effort. This plan must identify and quantify all the activities that need to be performed, place them in the proper time frame,

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determine the correct sequence (logic), determine the shortest path to completion (critical path), and at the same time be flexible enough to adjust to changes in projected annual funding.

Rocky Flats applies an integrated, life cycle, critical path, site closure schedule to fully consider management and operating parameters and focus on the critical closure activities. Figure 3 illustrates the planning process that starts with a "vision." The Rocky Flats vision is the basis for the Rocky Flats Cleanup Agreement (RFCA), which is an agreement between the DOE, the State of Colorado, and the U.S. Environmental Protection Agency. This agreement defines what the end state of the RFCP is, the guiding principles on how it is to be achieved and establishes milestones dates for key events. This "vision" and agreement is used to guide the development of a strategic plan.

The strategic plan is a top down driven plan that is based on a set of assumptions, developed by the most knowledgeable senior personnel at the Site, that establishes a time frame and a required funding profile for achieving the vision. The Closure Project Baseline (CPB) is then developed to implement the strategic plan and is a "bottoms up" developed plan that utilizes an activity based computer planning system, in our case Primavera. The CPB itself is a summarized version of the subcontractor's implementation schedules and integrates all work activities required to achieve the desired end state. The two plans are then compared and differences reconciled. A Fiscal Year Work Plan is then developed by expanding the detail of scope and schedule contained in the CPB, matched to annual funding provided by DOE, of the current fiscal year. This then becomes the Fiscal Year Baseline. Performance measures are established for the current fiscal year but are based on what was projected in the CPB.

OVERVIEW OF THE PROJECT MANAGMENT SYSTEM

Rocky Flats management organizes work into integrated projects focusing management attention to accomplish measurable progress toward the closure of the Site. Thirty Project Baseline Summaries (PBSs) comprise all mission and support work necessary to achieve Site closure. DOE-RFFO's Integration and Management contractor, Kaiser-Hill Company, LLC, assigns Project Management responsibility for each project to a Project Director/Manager, who is accountable for achieving the clearly defined scope, schedule, and performance objectives within the projected cost.

The Kaiser-Hill team uses an integrated state-of-the-art system to plan and manage projects. The major components of the integrated financial/project control system includes: PBDs, Work Breakdown Structure (WBS), Basis of Estimate Software Tool (BEST), PeopleSoft Accounting System, Primavera Project Scheduler (P3), MicroFrame Project Manager (M*PM), and an Oracle Data Warehouse/SQL Server.

The Kaiser-Hill Strategic Plan, encapsulated in the CPB, drives the planning process. The Site Strategic Plan (a.k.a., the Rocky Flats Environmental Technology Site 'Accelerating Cleanup: Path to Closure') defines the strategy to achieve the mission. The strategic plan defines the overall approach to complete the mission. The WBS subdivides the mission into manageable pieces of work, identified in the PBDs. Basically, the WBS organizes the closure projects Statement of Work.

The CPB is an integrated scope, cost, and schedule plan to close the Site. The CPB is also the performance measurement baseline for Kaiser-Hill and its subcontractors. Kaiser-Hill Project Managers delineate work scope and schedule to accomplish their part of the Site closure effort as defined by the CPB. Project Managers use Project Execution Plans to bring project elements together and provide a central focus for each project team. Each fiscal year plan is validated by the RFFO prior to the start of each fiscal year and approved by the RFFO Site Change Control Board (SCCB). The fiscal year plan is submitted prior to the fiscal year based on the expected funding for that fiscal year. The plan is then revised to the actual funding provided and again approved by the SCCB.

PROJECT CONTROL DOCUMENTS

The project control documents collectively describe how the RFCP is being managed, identifies the work required to complete the project, estimates the cost to do the work, and contains the work logic and schedule that has been developed to complete the work. The Basis-of-Estimate (BOE) is linked electronically to the schedule at the Project Closure Baseline level of the schedule. This provides a means to maintain configuration control while allowing desired changes in project logic and work tasks to be made, and to easily associate cost estimates with the scheduled activities. The Project Control Documentation consists of the following:

- Project Management Plan (PMP)

The Project Management Plan describes how Kaiser-Hill is conducting the RFCP. This document was developed to ensure that all parties working on the RFCP have the same understanding of the mission, objectives, and goal of the project.

- Work Breakdown Structure (WBS)

The WBS is the central unifying feature of the project control system. It identifies all scope elements required to perform the work that is required to complete the project. The WBS number ties the scope, cost estimate, and schedule together, thus allowing costs to be compared against budget, actual progress to be measured against scheduled progress, and changes to be made in an organized and disciplined fashion.

- Budget "Project Baseline Summary" (PBS) Documents

These documents summarize the scope in the PBDs below, and are budget documents submitted by the DOE-RFFO to DOE-Headquarters for the RFCP. These are formatted as required by DOE-Headquarters.

- Project Baseline Description (PBD)

The PBD is a reformatted budget summary PBS described above that contains the entire work scope for the RFCP. The PBD is the collection of PBD, Work Authorization Document (WAD),WADlet and WBS element work scopes. This work scope is tied to the Primavera Schedule and the BOE's via the WBS.

- Basis of Estimate

The BOE is captured and documented in an electronic spreadsheet known as the "Basis of Estimate." The cost of work elements are estimated at various levels of the WBS. The level of task that the estimate is developed for is determined by the complexity, historical knowledge, and experience of the estimators, i.e. has the task or a similar task been performed many times before and a high degree of understanding exists or is the task a first-of-a-kind. First-of-a-kind tasks are estimated at a much greater level of detail than tasks with a high degree of understanding. The actual scheduling of tasks however, particularly those with good prior cost knowledge, are usually at lower levels of detail than that at which they are estimated. BEST is electronically interfaced with the Primavera CPB schedule which loads the estimates, according to one of several loading curves, into the schedule for each scheduled task. Thus, the estimated costs are time phased accordingly. Costs are captured, typically, at the level of the estimate or at one level higher.

RFCP SCHEDULE

All work performed on the RFCP is scheduled and integrated by inclusion in the controlled, master resource loaded, critical path schedule. Kaiser-Hill, as the integrating contractor, uses the CPB schedule to direct and manage subcontractor work. Kaiser-Hill determines which subcontractors are to perform the work. Subcontractors develop detailed working plans that support the CPB.

When one "bores into" the detail of the RFCP Schedule it is readily seen that the RFCP schedule actually consists of five elements. The five schedule elements are:

1. First, is a one page schedule that identifies the primary work elements and their duration, identifies key internal milestones, necessary external milestones, and the critical path. No work logic is included in this schedule (see Figure 4).

2. Second, is the Management Summary Schedule (MSS). This is a very summary level schedule (one sheet) that has the schedule logic for the entire project in a form that can be easily understood by personnel not routinely involved in project activities. This schedule has dates and logic consistent with the computer based CPB described below. This schedule is utilized primarily for explaining project progress and how external milestones relate to the RFCP work efforts, to personnel outside of the project.

3. Third, is the Extended Management Summary Schedule (EMSS). This is a summary level logic schedule with about four times the detail of the MSS that is suitable for personnel that have a substantial understanding of the work efforts of the RFCP. This schedule is used to validate current logic and to assess the impact of new strategies that have the potential of accelerating the closure of Rocky Flats. Like the MSS the EMSS has the schedule logic in a graphically friendly form that is consistent with the CPB.

4. Fourth, is the CPB schedule. This is a Primavera schedule that is the Kaiser-Hill integrating schedule. This schedule is a summary level of all working schedules of the primary subcontractors to Kaiser-Hill as described below. This schedule has approximately 6,000 activities, excluding the level-of-effort activities, and is adequate for assessing the progress toward closure from both a schedule and cost

standpoint. The CPB has a gradually diminishing level of detail as the schedule gets farther out in time and is consistent with the working schedules.

5. The fifth schedule element consists of detailed working schedules of the primary subcontractors that are used to guide the actual performance of the work.

Status is determined at the working schedule level and is "rolled up" electronically to status all the summary schedules. Schedule and Cost variances are determined at the CPB level (schedule element 4). Schedule reports, such as schedule variance reports, reference the CPB Schedule. It is important to note that plan-of-the-week and plan-of-the-day schedules that are used for daily management of the work are direct derivatives of the CPB, but reflect the latest work tactics and status. The RFCP uses "rolling wave" planning methodology. The "rolling wave" approach to planning employs the concept that more detailed levels of planning are needed for the work you are going to do today and for the next several months (12 to 18) than for work you won't be doing for several years.

The RFCP has an overall critical path, shown in Figure 4. Collectively, the individual project schedules support this site wide critical path to closure of the Site. Schedule integration considers overall schedule logic, on-site and off-site interfaces, resource availability, customer priorities, and the fiscal year funding constraints. Individual project schedules, each which has its own individual critical path to manage to, support the CPB.

The plan is driven from the top-down by strategy, and completed with bottom-up schedule and cost estimates. EMSS are used in the Rocky Flats project control system as the representation of the integrated planning case. The EMS schedules identify the key on-site and off-site interfaces, and all performance measurement milestones. Comparison of the individual CPB project schedules and cost estimates to the EMS schedules and the fiscal year funding constraint aids validating for the ensuing fiscal year plan.

MONEY CRITICAL PATH

In addition to the normal time oriented critical path the Rocky Flats Management team is using a "financial" or Money Critical Path technique. The Money Critical Path is a planning approach to identify points within a Project Plan where completing certain activities liberates funding for other mission work by reducing surveillances, support and oversight requirements. Additionally, this planning approach identifies the major milestones that lead to the completion of project phases. By evaluating the "financial" critical path as well as the time oriented critical path the most effective application of funds can be made to non-time critical path activities. Figure 5 depicts the process to optimize the "financial" critical path. The process delays non-critical path activities that are also not critical to "mortgage reduction," and accelerates significant mortgage reduction work. Mortgage reduction work for the nuclear facilities focuses on closing the Material Access Areas and Protected Areas as these areas are very expensive to maintain.

LINE OF BALANCE SCHEDULING

Many activities performed in the closure of the Site are oriented more towards production activities than project activities. The production oriented activities in the RFCP include: SNM consolidation, packaging, and transportation; Transuranic waste/transuranic mixed waste (TRU/TRM) processing, packaging, and transportation; and Low-Level Waste/Low-Level Mixed Waste (LLW/LLMW) waste packaging and transportation. In managing production activities constraints must be managed and throughput balanced. Constraints can be packaging facilities, loading docks, shipping containers, storage facilities, transportation vehicles or many other resources that are required to implement a process. The impact of a constraint to a production operation is not always intuitively obvious, and project-oriented scheduling systems are not well suited to production activity scheduling. The Kaiser-Hill Team is using a discrete-event simulation model to analyze the production oriented activities, such as material movement logistics during closure of the Site. By simulating the on-site movement and shipment of all material streams, we can analyze the feasibility of baseline schedules, identify constraints, quantify the impact of proposed solutions, and assess alternative scenarios. The Kaiser-Hill model, simulates the movement of SNM, Plutonium residues, TRU/TRM, LLW, hazardous waste, sanitary waste and excess equipment between now and site closure. Using Micro Saint® software, a model has been implemented that represents materials, material processes, transportation vehicles, and storage areas in more than 575 activities and 2300 variables. The emphasis has been on implementing a tool that will give decision makers information concerning constraints on the flow of material, workload changes, the feasibility of long-range schedules, and the need for physical resources.

INDEPENDENT VALIDATION OF THE RFCP PLAN

The life-cycle closure project baseline estimates the cost and schedule of over 15,000 discrete activities needed to complete the project's scope of work. The CPB is the key tool used in management decision making for the safe, orderly, and cost effective closure or shut-down of the Site. Because the Baseline Plan is such a critical management tool, both DOE-RFFO and Kaiser-Hill believe that it is prudent to conduct an independent validation. At the time of writing this paper the DOE-RFFO and Kaiser-Hill management teams are preparing to contract with an independent management consulting firm to conduct the baseline validation. The entire validation process should be completed around the time of delivery of this paper.

CONCLUSIONS

The closure of Rocky Flats has several unique features to deal with that are not normally encountered in the planning of large projects. These features include the large number of existing facilities and structures (>700), protection of large amounts of SNM, maintenance of operational safety envelopes for nuclear buildings, maintaining the basic infrastructure for the site such as utilities to support these ongoing activities, and a site that has, in many cases, unknown contamination from both nuclear materials and other hazardous substances. The deactivation, decommissioning, decontaminating, and demolition of this large number of facilities while at the same time accommodating difficult on-going activities substantially increases the sophistication required of the planning process.

The Rocky Flats Closure Baseline has accommodated these complications by establishing a "money critical path" process to provide a "least cost" path to supporting required on-going activities and a "line-of-balance" process for production activities. These processes have been integrated with a "standard" activity-based project planning system, Primavera, to provide the shortest and most cost effective means to the Closure of Rocky Flats.

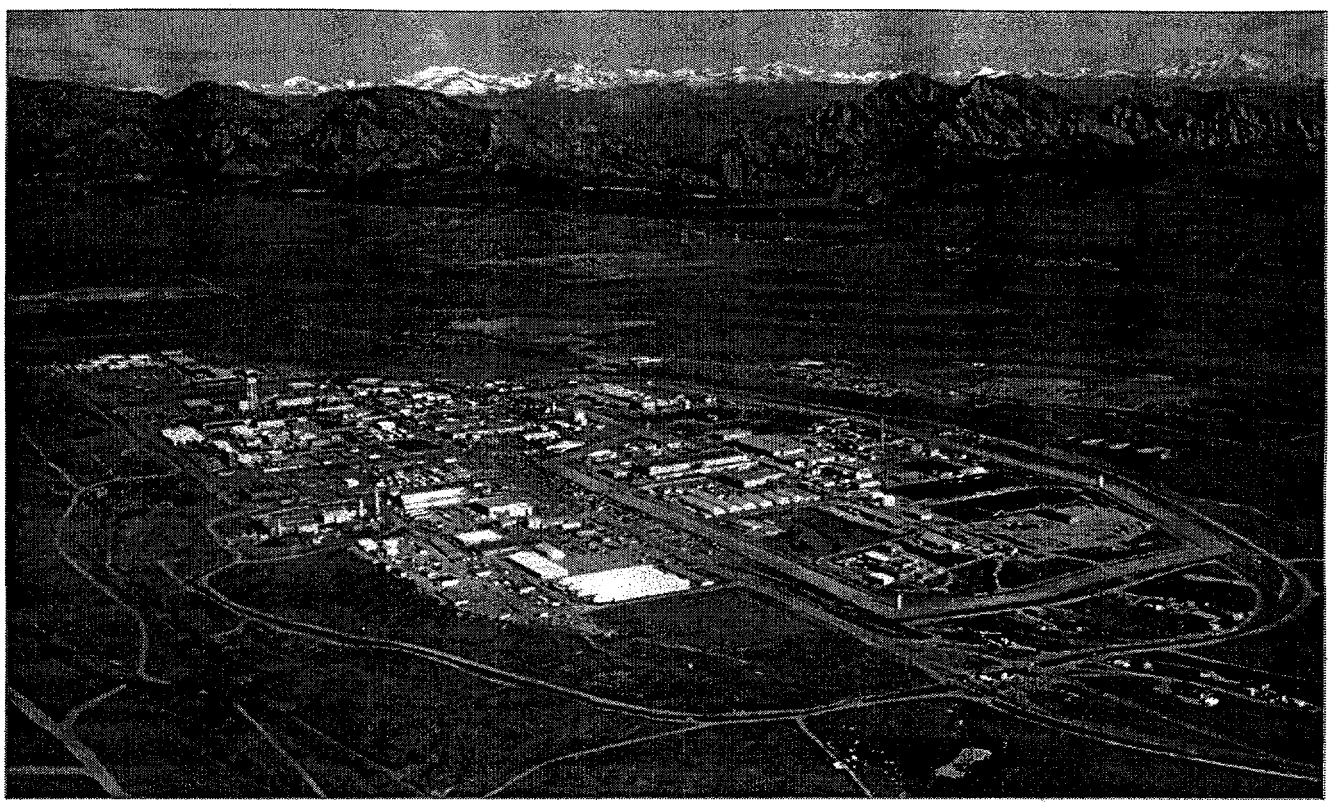

Figure 1
Past Integrated Operations at Rocky Flats Causes Many Complex Interactions During Site Closure

Table 1
Estimated Inventory of Cleanup Materials from the RFCP Presents a Significant Coordination Effort During Packaging, Staging, and Transportation

ESTIMATED INVENTORY OF CLEANUP MATERIALS	
Plutonium Metal	6,600 kilograms
Plutonium Oxide	3,200 kilograms
Plutonium Contaminated Residues	120,000 kilograms
Enriched Uranium	~6,700 kilograms
Transuranic Waste (includes mixed)	~9,000 cubic meters
Low-Level Waste (includes mixed)	150,000 cubic meters
Hazardous Waste	2,300 cubic meters
Classified Documents	3,500,000 documents

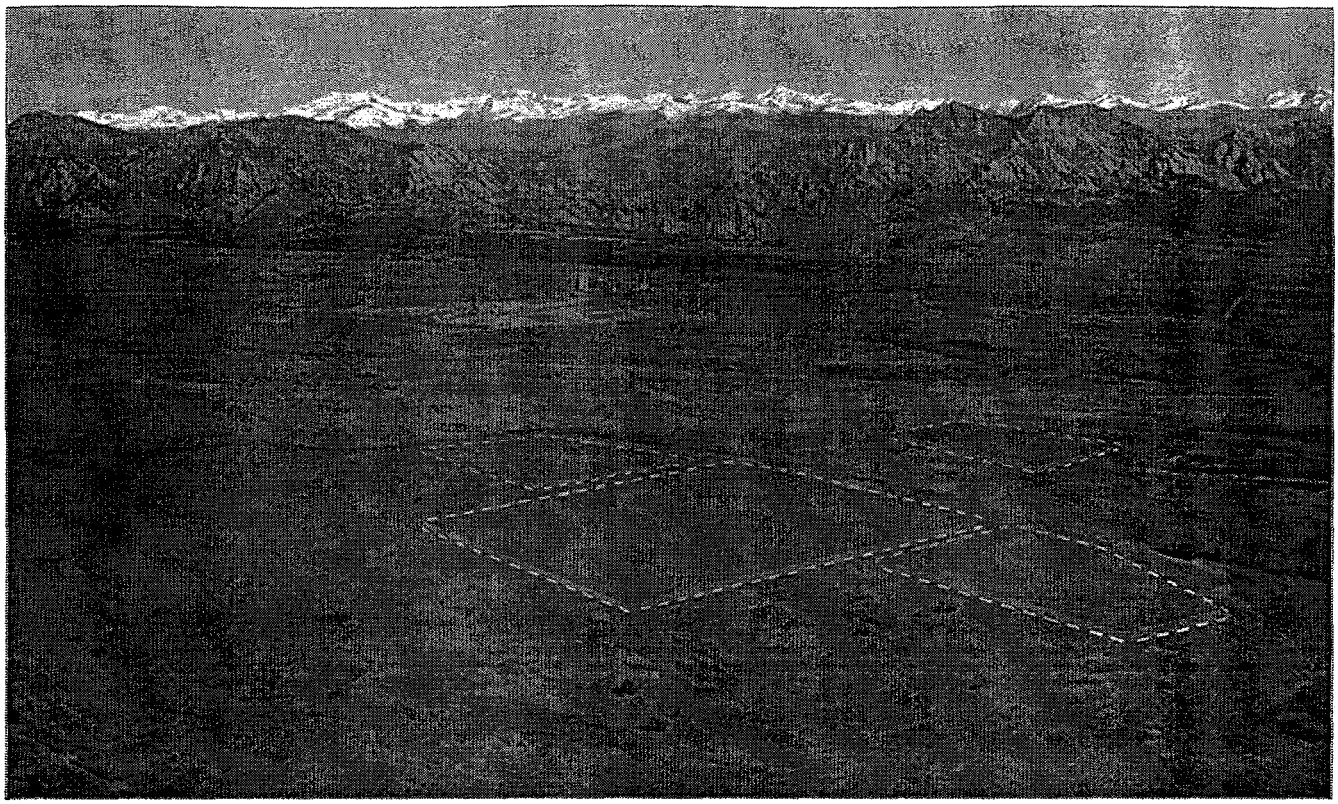

Figure 2
Closure of Rocky Flats is Being Conducted so That Future Land Uses are Enabled and Downstream Water Supplies are Protected

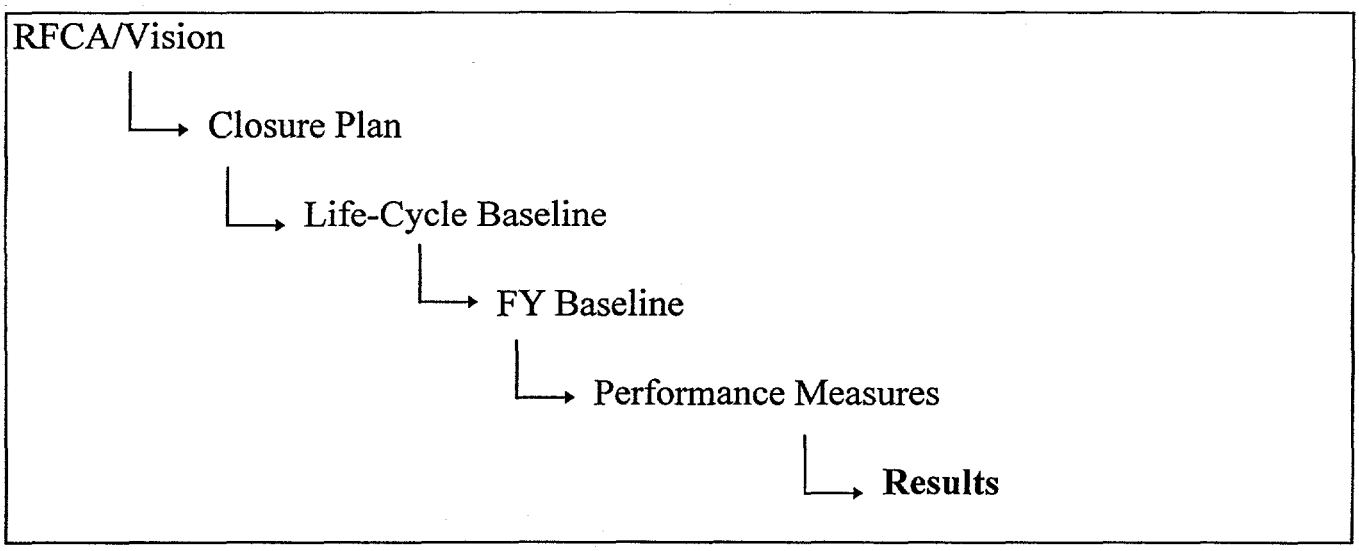

Figure 3
Successful Planning Starts with an End-State Vision

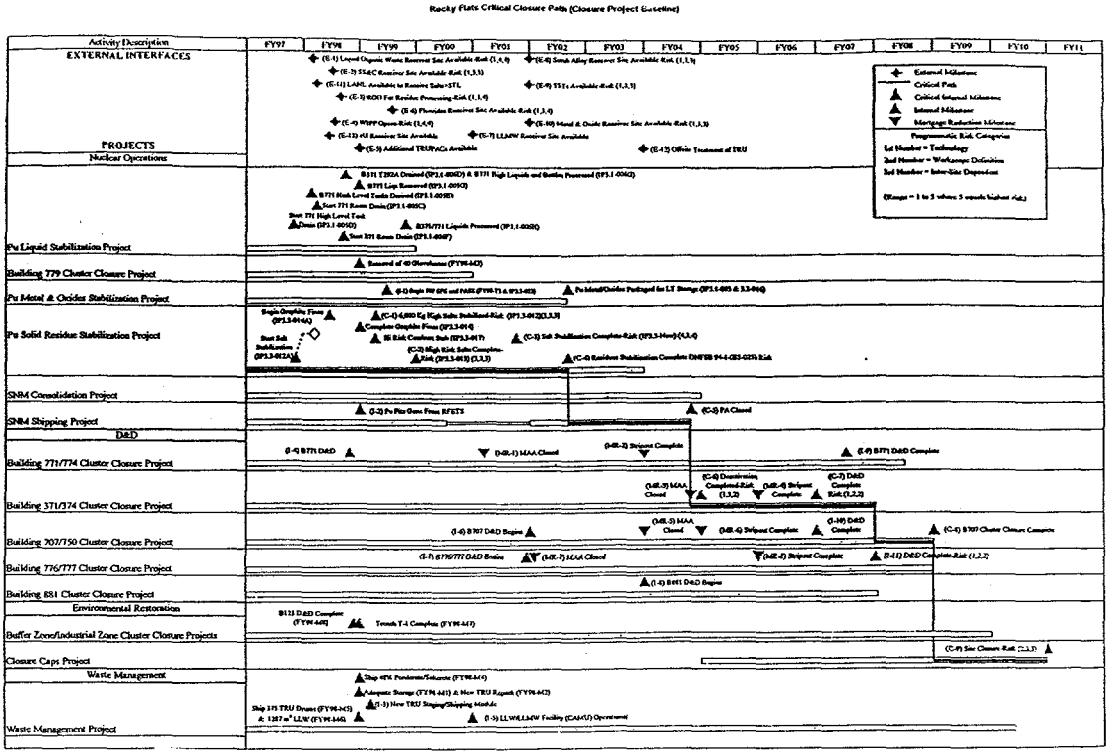

Figure 4
New Management Summary Schedule goes here

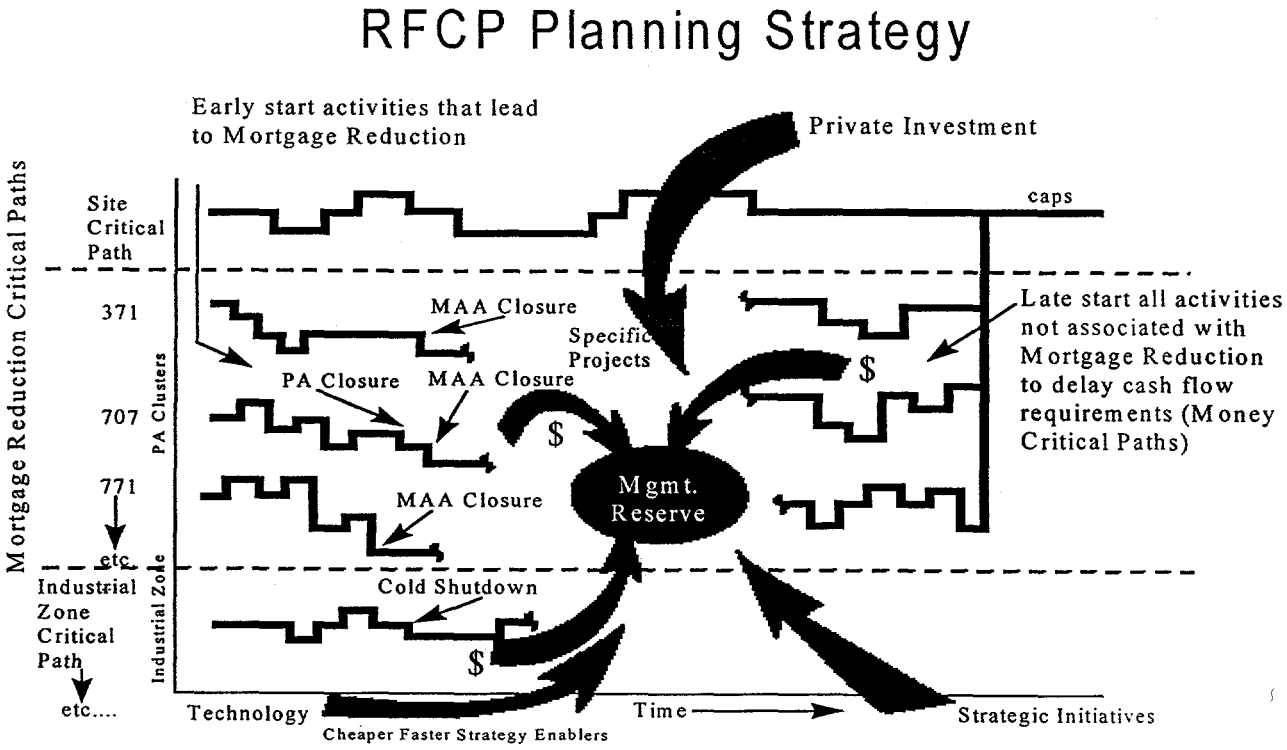

Figure 5
"Financial" Critical Path Analysis Enables Management to Make the Proper Investment Decisions