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CHALLENGES IN CONCEPTS AND STRATEGIC PLANNING FOR ENVIRONMENTAL CLEANUP AT U.S. DEPARTMENT OF ENERGY FACILITIES

FMPC--2202

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INTRODUCTION

The Feed Materials Production Center (FMPC) is a large scale, integrated facility designed to produce uranium metal products used as feed materials in the U.S. Department of Energy (DOE) defense programs. Since January 1, 1986, the Westinghouse Materials Co. of Ohio (WMCO) has served as the maintenance and operating contractor for the facility under prime contract to the DOE. The FMPC is implementing strict modern standards for health, safety and environmental protection. All upgrades, improvements and cleanup efforts are designed to bring the 38-year-old facility in line with current day standards and regulations.

The DOE has embarked on a major environmental cleanup program at the FMPC in conjunction with the U.S. Environmental Protection Agency (USEPA) and the Ohio Environmental Protection Agency (OEPA). This program is part of a concentrated nationwide effort by the DOE at all its facilities to achieve compliance with laws, regulations, and agreements aimed at protecting human health and the environment. With priorities derived from a fair and equitable process, DOE is focusing its resources to (1) assess and clean up inactive waste sites and facilities, (2) continue safe and effective waste management operations but emphasize systematic minimization of waste generation, and (3) coordinate an aggressive applied waste research and development (R&D) program keyed to developing innovative environmental technologies to yield permanent disposal solutions and lower costs.

THE FIVE-YEAR PLAN

Under the direction of the new Secretary of Energy, Admiral James D. Watkins, the DOE initiated a five-year plan that would serve as the basis for the planning efforts to provide a unified approach to solving the environmental problems resulting from DOE's nuclear activities over the past 40 years. This Plan is the cornerstone of the DOE's long-term strategy in environmental restoration and waste management. It consolidates DOE's three major areas of nuclear operations: those under the Assistant Secretaries for Defense Programs and Nuclear Energy and the Director of the Office of Energy Research. The Plan is revised annually, incorporating progress, and updated to reflect changes in planning as more definitive cost estimates are developed for those actions required to meet compliance obligations. The first Five-Year Plan, issued in 1989, includes changes in anticipated costs and schedules for the activities included in the Defense Waste Management Plan, but its scope goes far beyond the Defense Waste Management Plan--encompassing all radioactive, hazardous, mixed, and sanitary waste activities, including applied research and development activities to accelerate the deployment of new technologies to achieve better results at lower cost.

The Plan provides an integrated approach to Corrective Activities, Environmental Restoration, and Waste Management Operations. The challenges in these areas cut across traditional DOE organizational and budgetary lines. Responsibility for management overview, policy, planning and funding of waste activities is consolidated at the DOE Headquarters level. Task management and implementation will continue to be at the DOE Operations Office and installation levels.

The Plan also announces DOE's commitment to a 30-year goal to clean up and restore the environment at its nuclear sites, to revitalize its own internal culture, and to break with the dysfunctional aspects of its past activities and corporate posture. However, the job has just begun. To effect a culture change and to demonstrate DOE's commitment to open, candid public communication and compliance with environmental laws and regulations is a major undertaking that requires careful and thorough strategic planning and implementation. For national security reasons many DOE defense mission activities must remain classified. However, DOE must and will address environmental problems in an open, forthright manner through effective communication with Indian tribes, local, State, and Federal agencies, and the general public.

This paper deals with the environmental restoration facet of the five-year plan and

how it specifically relates to cleanup activities at the FMPC.

FMPC SITE HISTORY

A key facility in the DOE's nuclear production capability is the Feed Materials Production Center (see Figure 1). The facility, which is located northeast of Cincinnati, Ohio, in the town of Fernald, Ohio, is capable of producing uranium metal and uranium compounds for use in production reactors and other defense facilities. The Reactive Metals, Inc. (RMI) facility in Ashtabula, Ohio, has supported this program by providing extrusion capabilities for FMPC in-process material. An integral part of this mission is the safe operation of defense program production facilities and the effective management of derived waste materials.

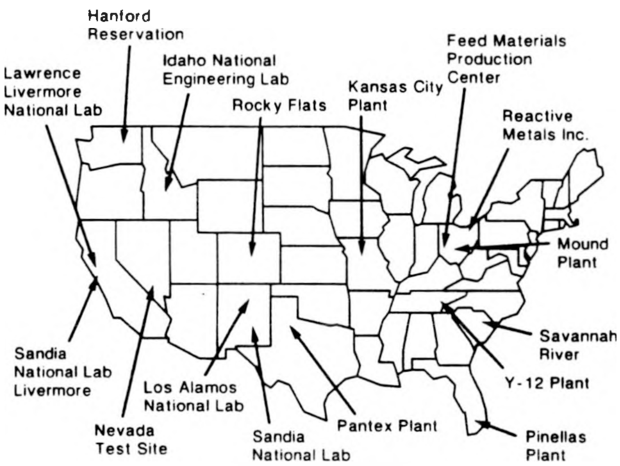

FIGURE 1. FMPC Location

The FMPC was built by the United States Atomic Energy Commission and began operations in the early 1950s. The property covers 1050 acres and the production area itself is approximately 135 acres. The site was constructed to establish an in-house integrated production facility for processing uranium from uranium ore concentrates. A wide variety of chemical and metallurgical processes are employed at the FMPC to support the production of high-purity uranium metal (see Figure 2). These production processes have generated a significant quantity of waste material containing low levels of radioactive and hazardous constituents. Increased national emphasis on environmental enhancement has resulted in the evolution of new technologies and regulatory requirements regarding the management of these waste materials.

A major transition in the FMPC site mission has occurred over the past few years. The production capabilities provided by the FMPC are being transferred to private industry through a vendor qualification program, and environmental compliance and site cleanup is the primary focus. In line with this program, the production of uranium products at the FMPC was suspended in July 1989 in order to concentrate all resources on the environmental mission. The plant remains in a standby condition until the commercialization program is demonstrated.

FMPC SITE HAZARDS

Production of uranium metal involves nine different plants each responsible for a step in the process. Numerous chemicals and radioactive substances are used in the process and result in the generation of waste materials such as sludges, slurries, scrap metal, waste waters, etc.

Past waste management practices included the storage of low-level radioactive wastes in six shallow-ground waste pits. At the time, the use of pits for waste storage was consistent with environmentally acceptable standards. However, because of the pit design, the nature of the waste involved, and their potential to affect groundwater, these pits are not considered permanent disposal facilities. The six waste pits at FMPC range in size from that of a football field to a baseball diamond and vary from 13 to 30 feet deep. Most of the waste materials in the pits contain small amounts of uranium resulting from the FMPC production process. These materials had uranium and thorium concentrations that were considered too low to be economically recovered for recycling. There are approximately 475,000 tons of this waste in the pits.

Waste Pits 1, 2, and 3 have been covered with topsoil and are not in service. Pit 4 is a dry waste storage pit that is out of service and covered with water-resistant bentonite clay as an interim closure method. Pit 5, a rubber-lined pit, is a wet chemical storage area and is filled to capacity and no longer in use. Pit 6, also a rubber-lined pit, was used primarily for dry waste storage and is now out of service. Pit 6 is approximately 75 percent full.

The K-65 silos contain waste from the Manhattan Project, the World War II program that produced the first atomic bombs. For this work, a uranium-rich ore called pitchblende was imported from the Belgian Congo. Pitchblende was treated with nitric acid to dissolve the uranium away from the ore. The remaining residues were mixed with water and pumped into the silos, where the solids settled. The liquids at the surface were pumped back out of the silos into a treatment facility. What remains in the silo now is about 9,700 tons of residual solids.

The residues in the silos emit radiation. The radioactivity levels of the residues are

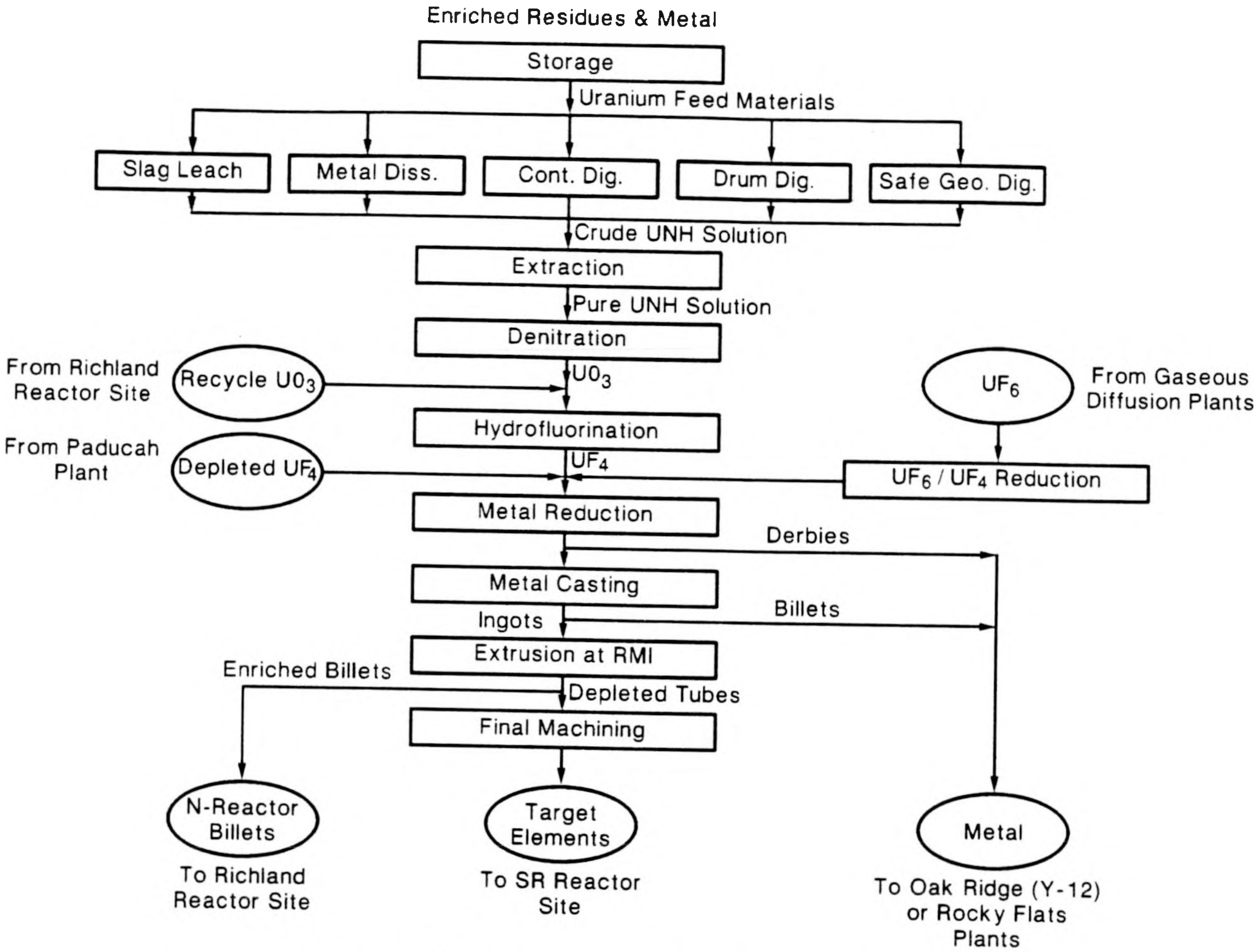

FIGURE 2. Chemical and Metallurgical Processes

higher than ordinary tailings from uranium mining and milling. Like other uranium ore tailings, these residues produce radon gas, although in considerably larger quantities. FMPC has taken major steps to control radon emission from the K-65 silos.

The stored residues present a potential hazard and require careful storage techniques to ensure safety and isolation from the environment.

Thorium has been stored at the FMPC since the mid-1960s when the United States was studying the use of a thorium/uranium fuel cycle for commercial production of electricity. Approximately two-thirds of the thorium at FMPC was processed on site, with the remaining portion originating from other DOE facilities. Over 1,316 metric tons of thorium is stored in silos and steel drums at FMPC.

The potential radiation hazard of thorium at the FMPC makes the substance an environmental concern for management. Like any radioactive element, thorium gives off energy in the form of particles and rays of radiation and, in the process, changes to other elements. This process is called radioactive decay, and the resulting elements are called daughter products. One of the daughter products of thorium is thoron, a radioactive gas that is chemically identical to radon but much shorter lived (56 seconds compared with 3.8 days). Thoron is continuously generated by the stored thorium. Other daughter products also emit radiation. Because radiation presents a health hazard, exposure to it is kept to a minimum.

Other environmental issues that are being addressed are stored inventories of process residues (waste), contaminated soils and groundwater, asbestos and contaminated scrap materials and equipment. The diversity of these hazards play a heavy role in the strategic planning and feasibility studies for an integrated site cleanup program.

CURRENT CLEANUP PROGRAMS

Consistent with national emphasis, the U.S. Environmental Protection Agency issued a Notice of Noncompliance on March 9, 1985, tothe DOE identifying their major concerns over potential environmental impacts associated with past, present, and future operations at the FMPC. In accordance with Executive Order 12088 (42 CFR 47707), on July 18, 1986, the DOE entered into a cooperative agreement with the USEPA, entitled the Federal Facilities Compliance Agreement (FFCA), pertaining to the FMPC. The intent of the FFCA was to ensure compliance with existing environmental statutes and regulations and to guarantee that environmental impacts associated with past, present, and future activities at the FMPC are thoroughly and adequately investigated so that appropriate remedial actions can be formulated, assessed, and implemented.

On November 21, 1989, the FMPC was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL). In accordance with Section 120 of CERCLA pertaining to NPL facilities, a Consent Agreement (CA) governing the completion of the Remedial Investigation/Feasibility Study (RI/FS) and the implementation of remedial and removal actions was entered into by the USEPA and DOE. This agreement establishes responsibilities and authorities between the USEPA and DOE relative to the FMPC.

A key focus of the CA is the completion of a sitewide RI/FS (see Figure 3). The RI/FS will assess existing and potential environmental impacts associated with FMPC operations and evaluate remedial action alternatives to mitigate these impacts pursuant to CERCLA and current Environmental Protection Agency (EPA) guidance. Consistent with DOE draft Notice 5400.4, negotiations are underway to integrate the RI/FS and the National Environmental Policy Act (NEPA).

The RI/FS will study the active FMPC production area, the inactive waste storage area, other historical FMPC facilities, and private/public properties adjacent to the facility. The progressive findings of the RI/FS have identified and will continue to identify potential FMPC facilities requiring remedial action. In order to support the timely initiation of remedial actions at FMPC facil-

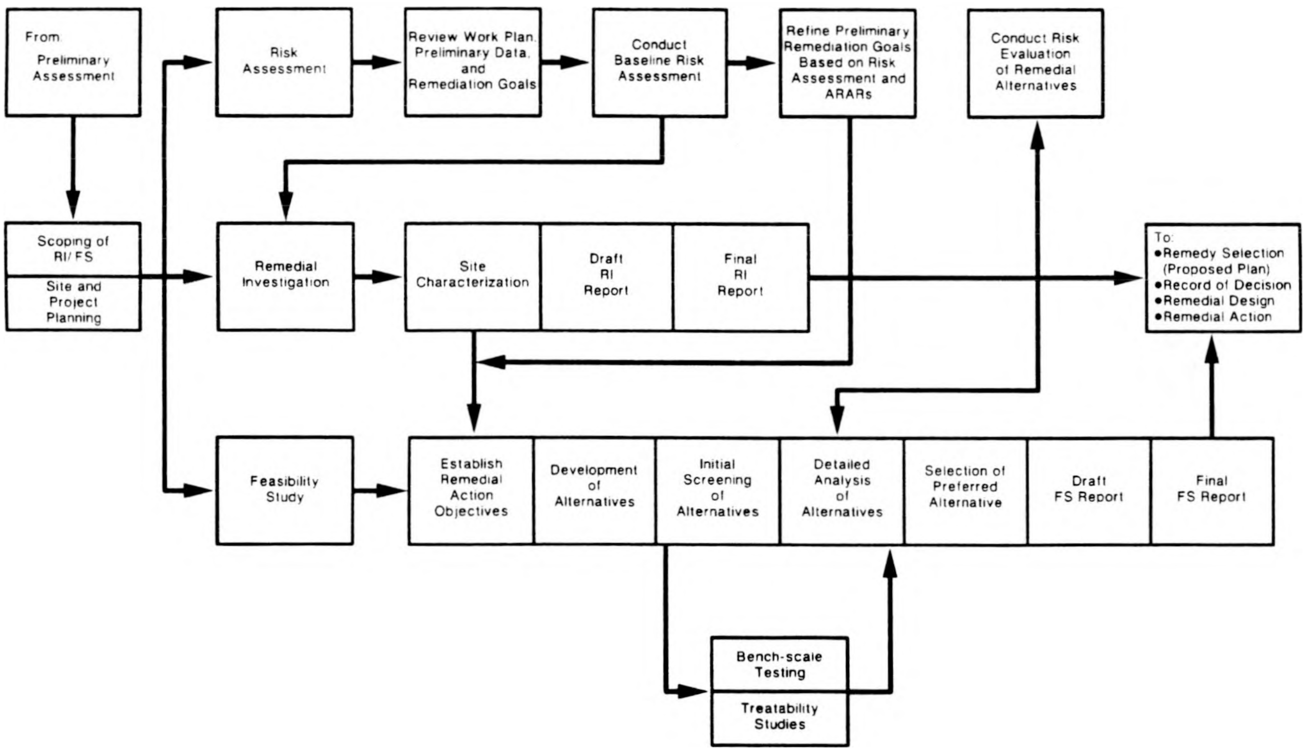

FIGURE 3. RI/FS Process

ities, the RI/FS has been segregated into operable units. These operable units represent discrete facilities or concerns comprising the total scope of the RI/FS process. The selection of these operable units was based on the type of facilities and similarities in the types of potentially applicable remedial action alternatives. Currently, five operable units have been defined:

Operable Unit 1: Waste Pits 1-6, Clearwell, and Burnpit

Operable Unit 2: Other Waste Units, including the fly ash piles, sanitary landfill, lime sludge ponds and south field area

Operable Unit 3: Production Area and Suspect Areas Outside Production Area, including tanks, lines, fire training area, incinerator area, diked areas, graphite burner area, storage pads, stormwater system, stored waste inventory, sumps, soil not in other operable units, scrap metal piles and other suspect areas

Operable Unit 4: Silos 1, 2, 3 and 4

Operable Unit 5: All Environmental Media, including surface water and regional groundwater, sediments, and soils outside the production area

This operable unit concept will result in five Records of Decision (RODs). The RI/FS and ROD schedule for each operable unit is presented in Figure 4. Pursuant to the CA, DOE is required to implement the selected alternatives identified in the ROD of the RI/FS. The Environmental Remedial Action (ERA) Project was formulated to provide the necessary resources to implement the remedial action alternatives identified in the RODs in a cost-effective and timely manner. Environmental restoration activities proposed under the ERA Project are necessary to ensure continued regulatory compliance and to iden-

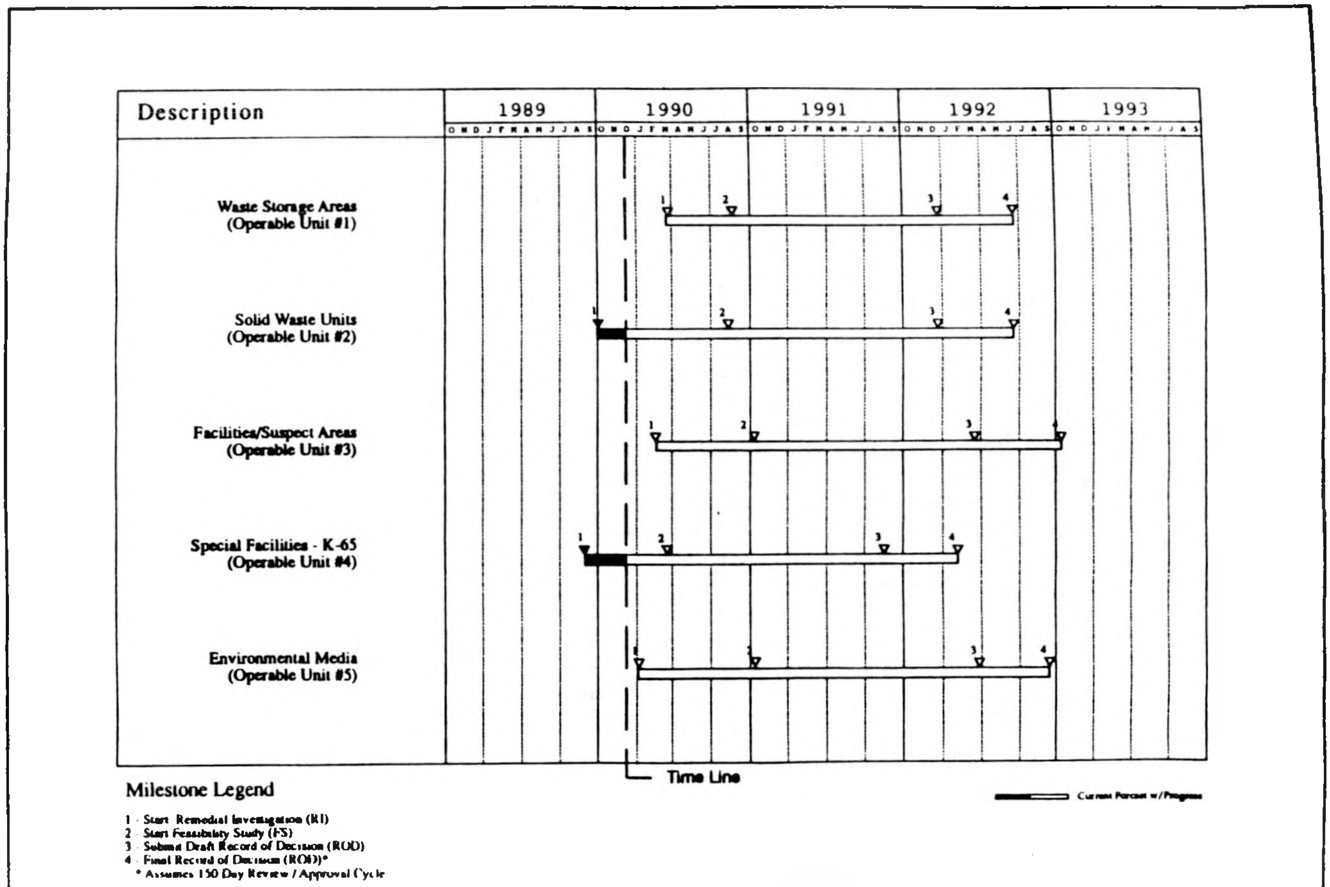

FIGURE 4. RI/FS Summary Schedule

tified environmental impacts associated with past and current operations at the FMPC. Identified environmental restoration activities for the RMI facility will also be implemented under the ERA Project. These remedial actions are necessary even if both plants never resume production operations.

STRATEGIC PLANNING

The planning for a remedial action program is severely constrained by the fact that management plans, schedules, and cost estimates must be formulated before the scope of the work is known. Since the DOE is on a three-year budget cycle, funding needed in outyears must be identified and requested through Congress three years in advance. Generally, however, the site characterization is not complete, all hazards have not been identified and technological solutions have not been selected (i.e., scope of work is not known) to allow proper planning. This requires planning around the minimum, most likely, and worst-case scenarios concept to formulate the budget and schedule and to make constant adjustments as the investigation and feasibility study data becomes available. A close integration between the CERCLA driven RI/FS process and the DOE project management process (including conceptual designs) must be facilitated to achieve minimum rework.

To facilitate this process, the DOE has established the Environmental Remedial Action Project. This project is estimated to cost in excess of $2 billion dollars and will extend beyond the year 2000. The purpose of the ERA Project is to implement the necessary corrective actions to mitigate identified environmental problems at the FMPC and RMI. The ERA Project is being conducted to fulfill the requirements of CERCLA (as amended), the CA, and the FFCA for the FMPC. Specific remedial actions and associated implementation schedules for the FMPC will be defined in the RODs resulting from the RI/FS process. In order to support the initiation of remedial actions and establish a plan within the established time frame following issuance of the ROD, a remedial action concept has been developed for the ERA Project. The ERA Project remediation concept defines a reasonable remediation scenario for the FMPC and RMI based on the technical information available to date. The remediation concept may be revised based on the progressive findings of the FMPC RI/FS and ongoing environmental studies at the FMPC and RMI.

A wide range of alternatives are being evaluated for implementation at the FMPC and RMI. These alternatives include no action, onsite stabilization/disposal, and offsite disposal of waste inventories. The ERA Project remedial action concept is based upon a probable mid-range scenario involving onsite stabilization and/or disposal of materials at the FMPC. RMI low level wastes are being shipped to the DOE Nevada Test Site. RMI generated mixed wastes are being shipped to the FMPC for storage and final disposition.
Major subprojects to be conducted under the ERA Project are defined in the Work Breakdown Structure (WBS) illustrated in Figure 5. The WBS is the basis for the development and control of all planning, costing, budgeting, scheduling and reporting.

FEASIBILITY STUDY/CONCEPTUAL DESIGN INTERFACE

Two parallel efforts are ongoing to meet both the regulatory protocols for conducting an RI/FS and the DOE requirements of project execution and Congressional funding. Figure 6 illustrates the two efforts in terms of schedule relationships. Figure 7 provides additional detail for each effort and identifies the key constraints and trigger points for integration of the two efforts to achieve maximum planning efficiency.

The CERCLA statues for NPL sites like the FMPC requires that "substantial, physical and continuous remediation" be initiated within fifteen (15) months of the Record of Decision. In order to meet this criteria, and to satisfy the budgeting three-year funding constraint, it is necessary to begin the conceptual design effort significantly before the Record of Decision is issued. We have chosen our earliest trigger point as the Initial Screening of Alternatives step. At this point, a long laundry list of possible alternatives has been narrowed down (screened) using the CERCLA criteria. This step generally leaves about five or six viable alternatives for further study. These remaining alternatives are then scrutinized for any common features that may be inherent to all or the majority of the alternatives. This then allows the conceptual design process to begin with some credibility. The next step is the detailed analysis of the remaining alternatives and the selection (recommendation) of the preferred alternative based on risk assessments and the CERCLA selection criteria. At this point, the conceptual design can go forward concentrating on the selected remedy. The feasibility study performed under the RI/FS then serves to satisfy the DOE project management system requirement for a Feasibility Study. One must recognize, however, that the conceptual design will proceed at some risk while the selected remedy is going through rigorous EPA and public review and comment periods which could very well influence the form, fit or function of the selected remedy.

Close interaction between the project team implementing the conceptual design and the agency performing the RI/FS must be maintained to ensure that the feasibility study and the conceptual design are in concert.
This is particularly true from the cost and schedule perspective since the feasibility study is only looking at qualitative comparisons of one alternative against another

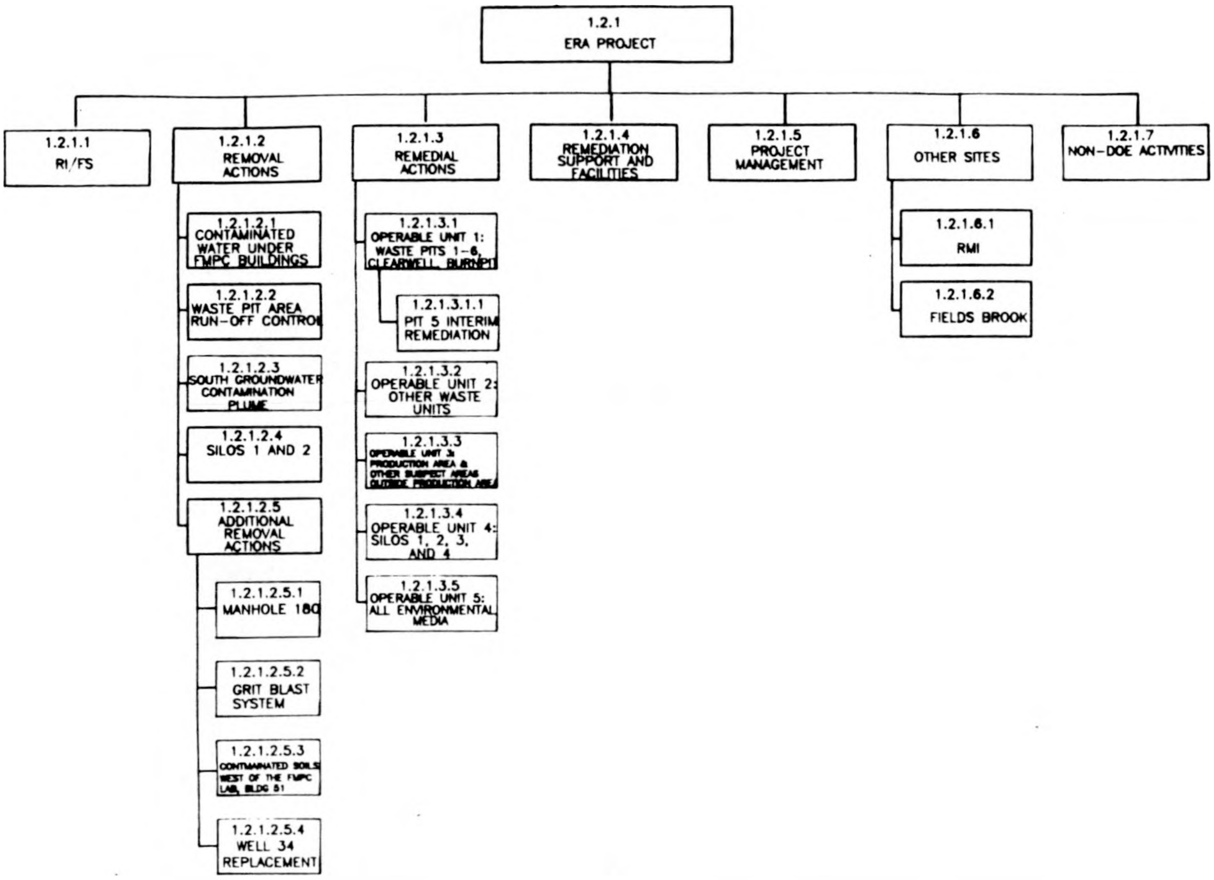

FIGURE 5. Environmental Remedial Action (ERA) Project Work Breakdown Structure

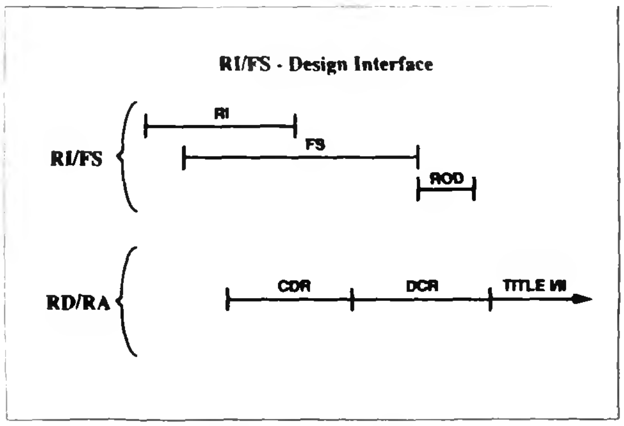

FIGURE 6. RI/FS Design Interface

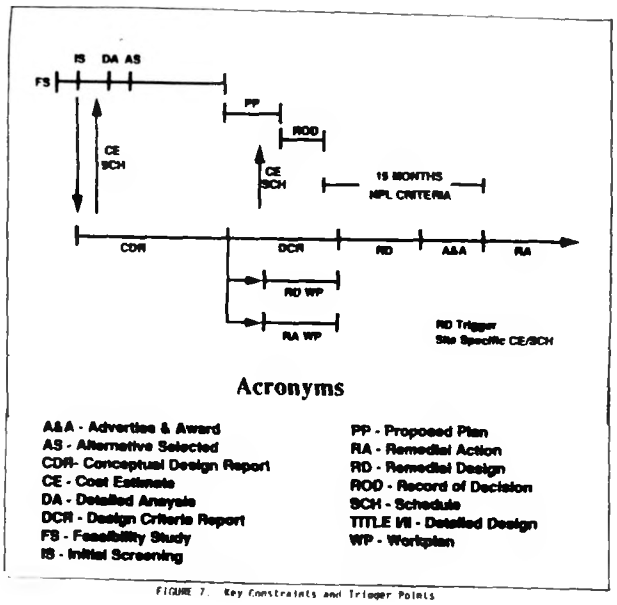

FIGURE 7. Key Constraints and Trigger Points

while the conceptual design must deal with absolute values.

PROJECT MANAGEMENT CHALLENGES

Regulatory Interfaces

Environmental projects are subject to many masters: (1) the DOE (three levels--site office, field office and headquarters), (2) internal corporate policies, (3) USEPA representatives, (4) Ohio EPA representatives, (5) the public, (6) environmental statutes and implementing regulations (CERCLA, Resource Conservation & Recovery Act [RCRA], NCP, etc.), (7) DOE Orders and project management procedures. This often results in a constant state of flux for project requirements since environmental laws and requirements are always being modified and/or enhanced. The guidelines for federal facilities have not been fully delineated by the EPA, and the procedures and policies are often subject to wide interpretations.

The number of local, State, and Federal environmental regulations has increased dramatically over the past 15 to 20 years. Each regulation has numerous specific requirements that must be met; many of these requirements are subject to interpretation by regulators or may be satisfied by different approaches. To complicate the situation further, local, State, and Federal agencies all have regulators responsible for implementing their specific regulations. Often both the regulations and the regulators' interpretation of needed compliance actions vary from site to site and may be in conflict in regard to a specific site or facility. These variations and conflicts can seriously inhibit the project manager's ability to comply with regulations and can lead to significant increases in cleanup costs and schedules with no increase in environmental protection. The requirements for cleanup may differ significantly as enforced by the State for RCRA and by EPA for CERCLA. The Interagency Agreements (IAGs) that have been reached thus far among DOE and local, State, and Federal agencies have helped in reaching mutually agreeable methods for planning and implementing cleanup.

Funding Appropriations

Funding for environmental cleanup places unprecedented demands on budget processes. Each is driven by external forces, which are not necessarily timed to coincide with established Federal budget cycles. Budgeting must, therefore, establish adequate levels of funding, provide flexibility to accommodate unexpected demands from regulators, and assure the public that the strategic planning will be responsive to their concerns.

The usual Federal practice is to fund projects annually, with multi-year efforts subject to annual review and renewal. Such an approach lets the Congress closely monitor progress and provides direction to the agency carrying out the work. Reducing or delaying appropriations can affect the agency's missions, such as cancelling a planned remedial action for which regulatory approvals are in hand. Actions driven by regulations typically occur over two or more years with agreed-upon milestones and completion dates. Some are done under binding agreements that carry the weight of law, including civil liabilities. Not meeting the terms of these agreements because of budgetary processes and constraints is counterproductive and undermines the goal of environmental compliance.

The current multi-year planning process may not identify resources needed to maintain compliance schedules. This possibility results from not knowing the full scope of a compliance project during the planning period. For example, the preliminary assessment/site inspection (PA/SI) phase of a project collects site history, visually inspects the site, and puts boundaries around the nature of the problem and the type of remedial solution. This information is used for initial planning and budgeting. The next phase, the remedial investigation/feasibility study, collects detailed information and evaluates remediation alternatives. This phase may yield revised budgets. The remedial design phase develops detailed plans for remediation, which are carried out in the final phase, remedial action. At any point, discoveries may cause unanticipated spikes in funding requirements. These spikes can have the same result on strategic planning that delayed or reduced annual funding would have.

The accuracy of estimates improves as the activities move from the investigative phase to the actual remediation phase (i.e., similar to conventional construction), but even during remediation, unanticipated accidents (spills, for example) can affect cost and schedule. Given the low level of confidence in the cost estimates in these early phases of the compliance agreements in force, it is imperative that a workable strategy for budgeting be implemented. The budget strategy to ensure necessary funding for program continuity and full compliance with legal requirements involves the establishment of a single Appropriation Account to fund all cleanup activities.

This single Account gives us the flexibility to manage the activities efficiently. In addition, a Near-Term Response Fund is addressed to establish a means to be able to respond quickly as new assessments identify high-priority needs or as new regulatory requirements arise.

Technical Staff

The demand for personnel with specialized skills in environmental cleanup has accelerated rapidly since the passage of environmental regulatory laws such as RCRA and CERCLA. Not only are the project managers of companies affected, but also the regulatory agencies are also faced with the same recruiting and retainment of critical skills. This complicates the strategic planning, feasibility studies and continuity of a program due to high turnover rates as this is a sellers' market. Engineering talent for environmental cleanup is in short supply nationwide; Federal and commercial.

The approach being followed is to utilize experienced project managers (of typical design/construction projects) and to (1) conduct extensive training on environmental regulations and emergency cleanup technologies, and (2) to supplement the project manager with a number of environmental specialists to fill in the knowledge voids of conducting projects in the environmental arena.

On a more global scale, programs are being pursued nationally with universities and colleges to project future manpower needs and skills requirements and to modify educational curricula. Acquiring and maintaining proper skilled and trained technical staff will be a key to achieving a sound program for environmental cleanup.

Scheduling

The implementing regulations promulgated as a result of environmental statutes such as RCRA, CERCLA, and NEPA have provided a basic framework for conduct of cleanup projects. EPA guidance documents and DOE Orders also add requirements. These protocols must then be integrated into the traditional project scheduling logic to ensure proper planning. The number and type of schedule activities for a typical critical path network increases significantly. A complicating factor arises from the fact that many of the work packages involve review and approval by various outside agencies and public hearings the duration and conduct of which is not within the project manager's control. Much higher levels of scrutiny and tracking are necessary.

Also, key is the need for comprehensive detailed scheduling early during the feasibility study phase. This is currently being accomplished through the use of generic logic sequences that have been developed based on regulatory guidelines and experiences on other cleanup type projects.

<u>CONCLUSION</u>

In order to properly integrate the many facets of environmental cleanup projects, early and comprehensive strategic planning, feasibility studies and conceptual designs must be conducted. The impact of unknowns and potential progressive findings with subsequent changes in scope through all project phases can cause significant cost and schedule impacts. Close coordination between the RI/FS team and conceptual design team is essential since these two efforts are by necessity conducted in parallel, yet they must be consistent. The initial screening of alternatives step provides a logical kick-off point for conceptual designs to begin without excessive study of multiple alternatives. The transition from the investigatory phase (the RI/FS) and the detailed design and implementation phase (the Remedial Design/Remedial Action [RD/RA]) must be strategically planned for effective project management while meeting regulatory statutes. Team work by all participants is essential to ensure effective and timely transfer of information between the two processes.

ACRONYMS

CA	Consent Agreement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	Department of Energy
EPA	Environmental Protection Agency
ERA	Environmental Remedial Action
FFCA	Federal Facilities Consent Agreement
FMPC	Feed Materials Production Center
IAG	Interagency Agreement
NEPA	National Environmental Policy Act
NPL	National Priorities List
OEPA	Ohio Environmental Protection Agency
PA/SI	Preliminary Assessment/Site Inspection
R&D	Research and Development
RCRA	Resource Conservation & Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
RMI	Reactive Metals, Inc.
RODs	Record of Decision
USEPA	U.S. Environmental Protection Agency
WBS	Work Breakdown Structure
WMCO	Westinghouse Materials Company of Ohio