COPY NO. 63

SRC-II DEMONSTRATION PROJECT
PHASE ZERO
TASK NUMBER 15

DELIVERABLE NUMBER 12

VOL. 1 ~~OF 3~~

PLAN AND ESTIMATED COST FOR PHASES I, II AND III
MANAGEMENT PLAN SUMMARY

JULY 31, 1979

THE PITTSBURG & MIDWAY COAL MINING CO.
DENVER, COLORADO

PREPARED FOR

UNITED STATES DEPARTMENT OF ENERGY
UNDER CONTRACT
DE-AC05-780R03055

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SECTION 1
P&M COMMITMENT

This document summarizes the Project Management Plan, costs and schedule for the SRC-II Demonstration Project. It provides a brief summary of technical aspects, the management plan, management control systems, costs and economic considerations applicable to the Project. Complete details on these subjects are contained in Deliverable No. 12, Plan and Estimated Costs for Phases I, II and III, Volumes 2 and 3, Project Management Plan and Project Baseline Plans.

The Pittsburg & Midway Coal Mining Co. (P&M), a wholly owned subsidiary of the Gulf Oil Corporation, is committed to the successful conduct of this Project in accordance with the terms and conditions of contract DE-AC05-780R03055.

SECTION 2
PROJECT OBJECTIVES

The objective of the SRC-II Demonstration Plant Project as stated by DOE is to demonstrate the technical, economic and environmental acceptability of the SRC process for conversion of high-sulfur coal to clean burning liquid fuel.

Specific objectives of the SRC-II Demonstration Plant Project are summarized below:

- Design, construct and operate a 6,700 tons per stream day (TPSD) coal liquefaction plant using the SRC-II technology which meets acceptable standards for safety, efficiency and environmental requirements.

- Verify the technical feasibility of the SRC-II process in commercially sized equipment by demonstrating performance through:
  - Confirmation of design criteria for prototype equipment units.
  - Demonstration that supporting processes can be integrated into the SRC-II coal liquefaction process.
  - Identification of proper controls for environmental, health and safety factors.

- Assess the commercial potential of the SRC-II process by:
  - Producing large quantities of low-sulfur fuel oil, gaseous hydrocarbons and chemical by-products for testing by industry.
  - Determining the economic, market and technical aspects of commercialization.

- Establish a design basis for future commercial plants.

- Promote the development of a commercial synthetic fuels industry through technology transfer programs.

SECTION 3
TECHNICAL SUMMARY

3.1 BACKGROUND

Development of the Solvent Refined Coal (SRC) processes began in 1962 at the Spencer Chemical Company Research Laboratories at Merriam, Kansas. Subsequent research and development efforts resulted in construction of a 50 tons per stream day (TPSD) SRC facility which was completed in 1974 at Ft. Lewis, Washington. This plant has operated successfully in test operations since that time. This extended research and development program has been funded by the U.S. Department of Energy; at the same time Gulf and P&M have funded coal liquefaction work in their own facilities.

The main products from the technically advanced SRC-II process are liquid and gaseous fuels. With SRC-II, high sulfur bituminous coals can be converted to quality fuels that are environmentally acceptable for use in industry, utilities, commerce and transportation.

3.2 ENGINEERING DESIGN

In 1975 P&M completed the first conceptual design of an SRC-II Demonstration Plant. It was designed to convert 6700 TPSD of coal to liquid and gaseous fuels. A conceptual design for a 33,500 TPSD commercial plant was also completed at that time. Additional engineering studies were conducted on these conceptual designs in 1976, 1977, and 1978. These engineering studies by P&M provided the design basis for the current SRC-II Demonstration Project. This current SRC-II Demonstration Plant is designed to process 6,700 TPSD of coal and could be expanded to a 33,500 TPSD commercial plant. The technical description of the SRC-II Plant in contained in Deliverable No. 1, Demonstration Plant Description.

3.3 TECHNICAL DESCRIPTION

The SRC-II process is the most advanced coal liquefaction process available and is designed to convert high-sulfur bituminous coal into liquid and gaseous products. The basic process includes solution of the coal in a recyle slurry, hydrogenation of the dissolved coal to remove sulfur and oxygen, and hydrocracking to liquid and gaseous products. The capability for carrying out these reactions is considerably enhanced by recycle of the product slurry and by the resulting increase in concentration of the in-situ catalytic mineral residue in the dissolver. Together with the undissolved mineral residue, the coal that is not converted to distillate and lighter products is pumped to a high pressure gasifier to produce hydrogen for the process.

The primary product from the process is a distillate fuel oil. This fuel oil is very low in ash and contains less than 0.3 percent sulfur. Additional products are pipeline gas, LPG, naphtha, tar acids, ammonia and sulfur. The process converts one ton of coal into products approximately equivalent to three barrels of fuel oil. The liquid products may be further refined to produce high quality unleaded gasoline as the primary product.

The products from the 6,700 TPSD Demonstration Plant and the approximate quantities per stream day are shown below:

PRODUCTS	ESTIMATED QUANTITY PER STREAM DAY
Fuel Oil	11,500 barrels
Liquid Propane	2,300 barrels
Liquid Butanes	1,600 barrels
Pipeline Gas	47 million standard cubic feet
Ammonia	30 tons
Sulfur	165 tons
Tar Acids	50 barrels
Naphtha	2,700 barrels

SECTION 4
MANAGEMENT SUMMARY

4.1 MANAGEMENT OBJECTIVES

P&M will establish a Project organization which will be responsible for managing all technical, schedule and cost aspects of the Project. This Project organization will coordinate the planning, work, and reporting of all Project participants. Management personnel with the required technical and business expertise will be selected. These people will direct the integration of cost, schedule and technical goals into a unified P&M Project management system.

P&M will employ sound management practices to direct the Project in an efficient and cost-effective manner. Accurate, timely and useful information will be provided to both internal management and DOE. An earned-value method of P&M's own design which conforms to generally accepted project management practices will be applied. These concepts will guide the implementation of a management system which maximizes decision-making capabilities. The complete Project Management Plan is contained in Deliverable No. 12, Plan and Estimated Costs for Phases I, II and III, Volume 2, Project Management Plan.

4.2 PROJECT ORGANIZATION

The Project management organization is outlined in Figures 4-1 and 4-2. The GMRC/P&M Executive Vice President will provide overall management direction for the SRC-II Program and assure that the resources needed for successful completion of the Project are made available. A Vice President of P&M has been assigned to the Demonstration Plant Project as the SRC-II Project Manager. He will have responsibility for organization, planning, technical direction and management control of the Project. The Project Manager will be responsible for the design, construction, and operation of the Plant. To assist him in the execution of his

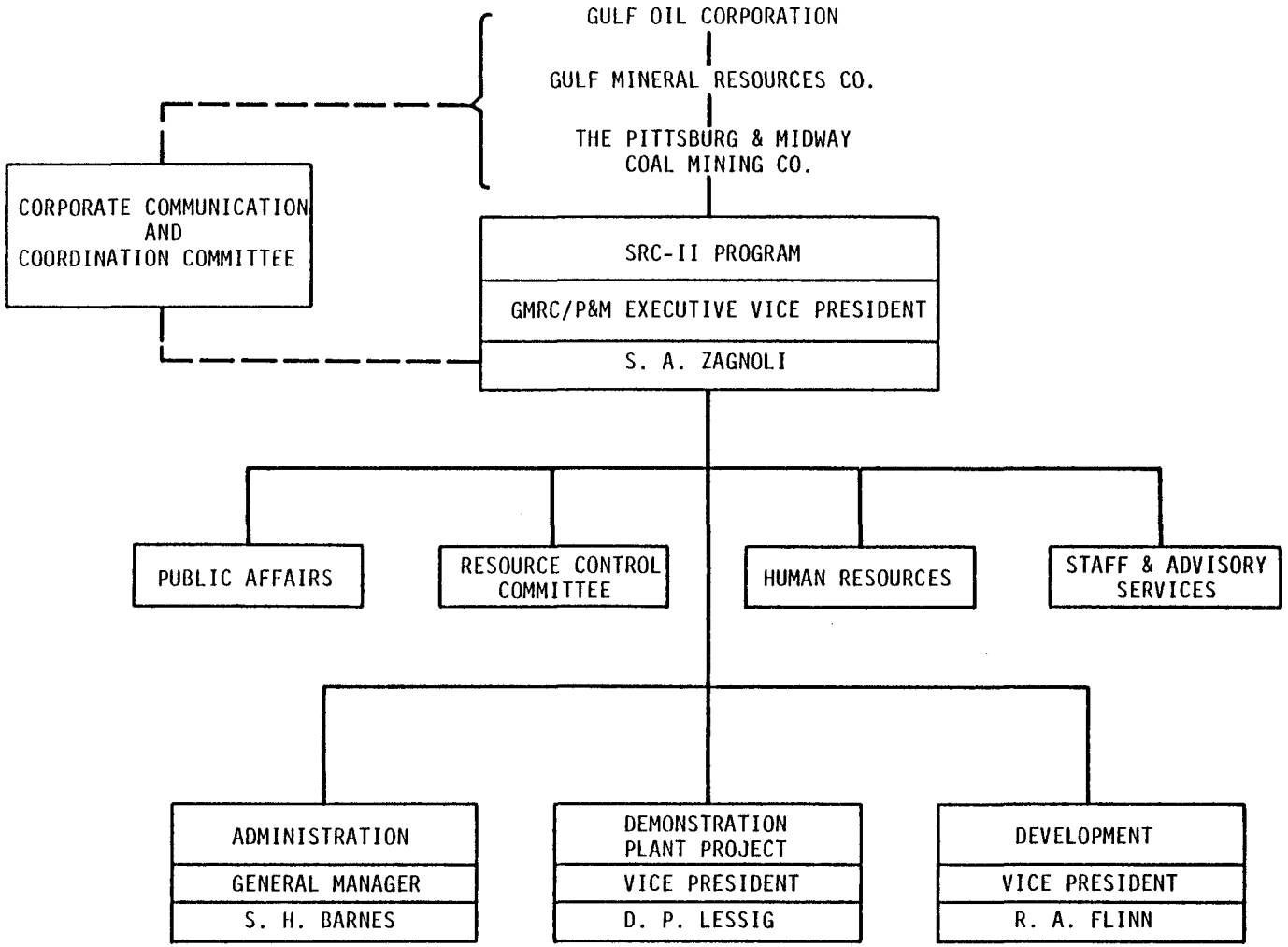
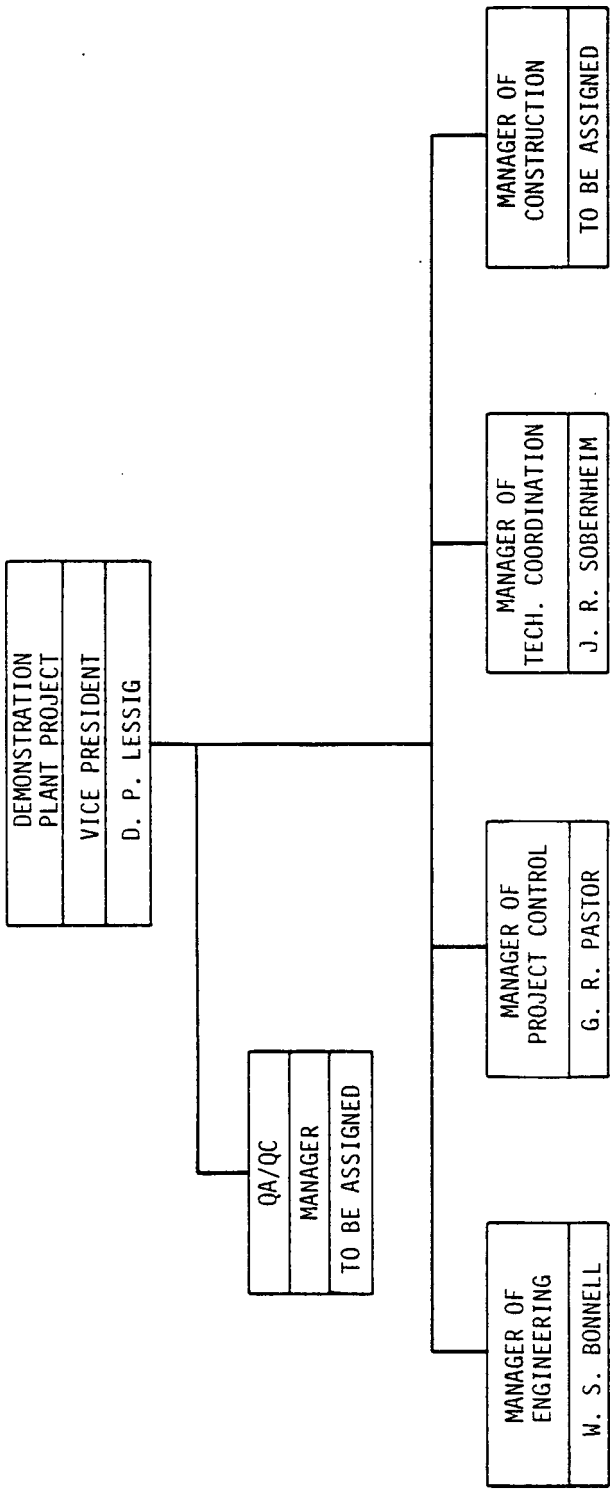


FIGURE 4-1
P&M PHASE I ORGANIZATION

FIGURE 4-2

P&M PHASE I ORGANIZATION



responsibilities he will have managers for such major areas as project control, engineering, technical coordination, construction and plant operation.

Support of the overall SRC-II Demonstration Program will be provided by organizations under the Vice-President for Development and the General Manager for Administration. The Development organization will be responsible for aspects such as commercial and technology development as well as the economic and market analyses. The Administrative organization will provide support in procurement and contracts, financial, and administrative services.

Primary DOE & P&M interfaces regarding the official direction of the SRC-II Demonstration Plant Project will be established between the P&M Demonstration Plant Project Vice President and DOE/ORO. Interfaces with the P&M Development Vice President and DOE/HQ for program development and commercialization will also be established. Formal contractual matters will be controlled with an interface between the GMRC/P&M Executive Vice President and the Manager of DOE/ORO. The interfaces between P&M and the Architect-Engineer will exist at various levels, both technically and administratively. Communications for overall program coordination will be maintained between the P&M SRC-II Demonstration Plant Vice President and the A/E Senior Project Manager. Technical interfaces will occur between the appropriate P&M and A/E technical managers.

4.3 PROJECT MANAGEMENT SYSTEMS

In the management of the SRC-II Demonstration Project, P&M will utilize project management control systems which are compatible with P&M policies. These management control systems are based on sound, tested management practices, and are designed to provide timely, accurate and complete information to management. Through these means the decision-making process can be aided immeasurably, so that managers are better able to identify problems and to control and direct the corrective actions for which they are responsible.

Project visibility will be achieved by the use of integrated management control systems which provide information on cost, schedule, and technical

data to all managers. Reporting will be consolidated and simplified. Managers at each level in the Project will receive information in sufficient detail to meet their management and planning needs.

Earned-value methods of P&M's own design will be used. The system provides a way of comparing the actual costs incurred with the planned schedule and costs for that task. Tolerance levels will be established for variances to accommodate errors in planning. Variances will be examined and corrective actions taken only when they exceed the tolerance thresholds.

The management tools required for Project visibility will be used in conjunction with management and technical reviews throughout the life of the Project. These management tools or management control systems are described in the Project Management Plan. The systems prescribe procedures for the following:

- 0 Baseline Planning
  - Including work definition, schedule definition, budgeting, and their integration.
- 0 Operating
  - Including work authorization, progress assessment, reporting, variance analysis, corrective action planning, and Estimates-at-Completion.
- 0 Configuration Management
  - Including design control, change control, and document control.

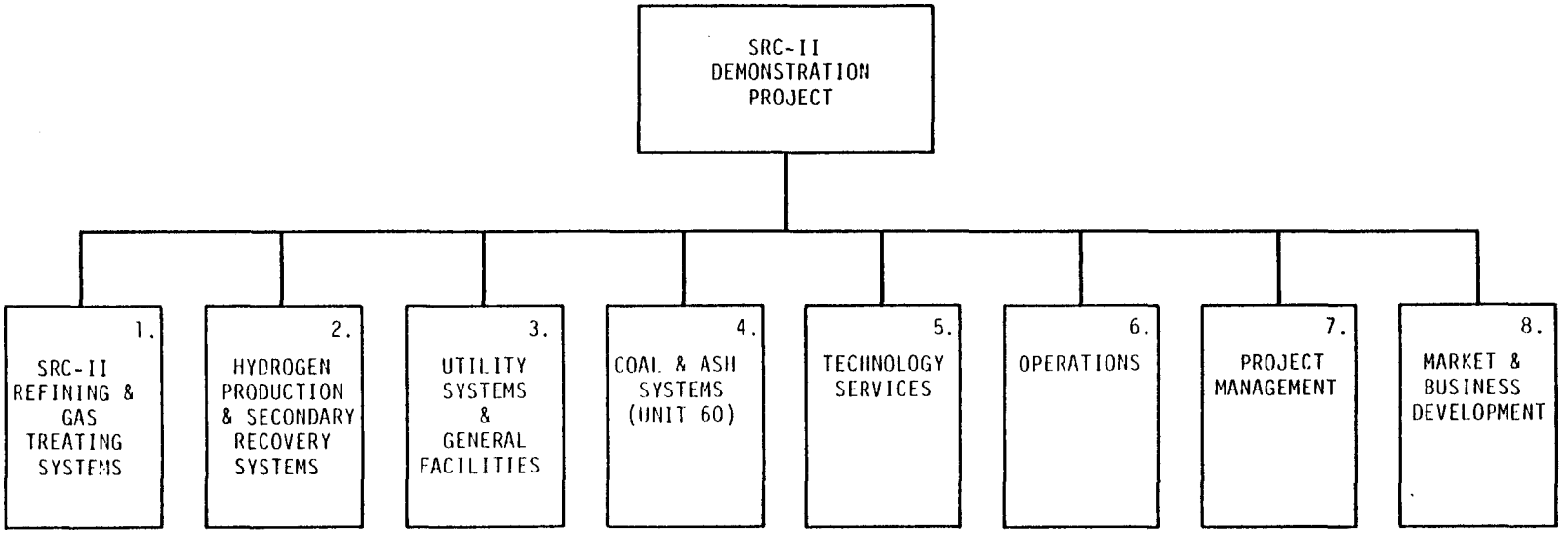
4.4 PROJECT WORK BREAKDOWN STRUCTURE

The tool for integrating the work to be done within the budget and schedule constraints will be the Work Breakdown Structure (WBS), which divides the Project into manageable components organized into a tiered set of related functions and services.

In order to identify all Project work, the Project Summary Work Breakdown Structure (PSWBS) shown on Figure 4-3 was established as a project management tool. This PSWBS identifies the eight major product areas in which all Project work has been defined and categorized. The

FIGURE 4-3

PROJECT SUMMARY WORK BREAKDOWN STRUCTURE



PSWBS will be required for subcontractor planning of all work they are assigned, thus fitting the common framework for the accumulation of costs and performance reporting.

Schedules and costs have also been subdivided by WBS element to permit complete integration of work, schedules and costs. Such integration provides for excellent performance measurement and control of the Project.

4.5 PROJECT SCHEDULE

A schedule has been established to achieve the DOE target of mechanical completion by 12/1/83. Significant schedule risks exist from the following sources:

- Engineering Design - The scheduling presumes that there will be an early fix of the basic process design. Necessary design revisions early in Phase I - Detailed/Final Design may result in a schedule extension. Until the process design configuration can be resolved, P&M's best estimate for mechanical completion is the second quarter of 1984.
- Schedule Concurrency - The concurrent efforts in design and construction also increase the risk of schedule slip.
- Timely P&M and DOE Management Actions - Adherence to schedule requires timely actions on:
  - Major milestone decisions.
  - Approval for purchase of long lead items.
  - Approval of the final Environmental Impact Statement.
  - Review of technical and managerial documents must be completed promptly by DOE, preferably within 30 calendar days after receipt.

4.6 ESTIMATED COSTS

Estimated costs for the 6,700 TPSD SRC-II Demonstration Plant were derived from the Stearns-Roger Engineering Corporation estimate for direct engineering and capital costs for construction as presented in

Deliverable No. 2, Demonstration Plant Capital and Operating Costs. In addition, P&M has estimated project, technical support and operating costs. The costs summarized in this section are discussed fully in Volume 3, Project Baseline Plans of Deliverable No. 12.

4.6.1 Phase I and II Costs.

The estimated costs for the Project technical and schedule baseline for Phases I and II are shown in summary in Table 4-1 (4Q78$). Certain costs for Phase I and II have been shown separately as "Potential Exclusions" in Table 4-1. These "Potential Exclusions" to the estimate include changes for an industrial-type Engineering, Procurement, Construction (EPC) approach to project management; land acquisition; and recommended equipment modifications for the Ft. Lewis SRC Pilot Plant to develop necessary design data for this Project. These items could result in a cost reduction. These costs are, however, included in the project baseline presented in Volume 3, Project Baseline Plans of Deliverable No. 12.

TABLE 4-1

SRC-II DEMONSTRATION PLANT ESTIMATED COSTS
(MILLIONS OF NOVEMBER 1978 DOLLARS)

	P&M	ARCH.ENGR./ CONST. MGR.	TOTAL
PHASE I	52	53	105
PHASE II	75	682	757
TOTAL	127	735[c]	862
POTENTIAL EXCLUSIONS	17[a]	90[b]	107
TOTAL	$110	$645	$755

(a) Includes $11 million for Ft. Lewis pilot plant modifications and $6 million for site acquisition.

(b) Incorporating a modified engineering, procurement, construction (EPC) approach could result in capital savings of up to approximately $90 million to the Phase I and II total estimated costs.

(c) Accuracy of this estimate is ±20% or approximately ±$150 million. An independent study of this estimate resulted in an expected accuracy range of -10% to +30% or approximately -$75 million to +$220 million. (Refer to Deliverable No. 2, Demonstration Plant Capital and Operating Cost Estimates).

Other factors may also affect the Phase I and II costs. Escalation of the costs in Table 4-1 due to inflation could be substantial (for example, an annual inflation rate of 6% would add $170 million to the total costs). A series of design decisions yet to be made by P&M and DOE will affect the construction cost. The present list of such changes is shown in Table 4-2.

TABLE 4-2

MUTUAL DESIGN DECISIONS THAT ARE EXPECTED TO AFFECT CAPITAL COSTS

- Modify Plant Capacity to 6,000 TPSD
- Reconsider Pre-investment for Possible Commercial Expansion
- Adjust Hydrogen Partial Pressure
- Revise the Number and Size of Partial Oxidation Units
- Consider Alternate Syngas Use
- Produce Untreated LPG, Naphtha, and Light Fuel Oil
- Modify Gas Cleanup System
- Modify Cryogenic Unit
- Revise Coal Storage from 60 to 30 Days
- Design for Range of Coal Properties
- Modify Hydrogen Compression
- Decouple Process Units
- Provide a Pump for Each Preheater Pass
- Revise the Number and Size of Oxygen Plant Trains

4.6.2 Phase I and II Project Management Approach

P&M intends to proceed with the EPC management approach for design and construction as follows:

- P&M intends to retain an architect-engineer supported by a process design subcontractor to perform the detailed design, procurement of major long lead equipment items, and inspection of major equipment fabrication and manufacture as appropriate.
- P&M intends to retain a construction manager/constructor to manage all construction efforts including the scheduling of all construction activities, procurement of construction materials and equipment, inspection of construction (P&M to perform QA/QC audit), awarding and control of all construction subcontracts and management of other appropriate construction activities. To the maximum extent possible, the construction manager will accomplish the work by use of competitively bid subcontracts using unit prices, award fees, incentives, etc. In addition, if circumstances warrant - such as maintaining schedule - the construction manager/constructor may use the services of some subcontractors who will not be selected on a competitive basis. However, some of the work will have to be performed by the construction manager's own forces, such as mechanical, piping and electrical.

Only with the above EPC management approach can the second quarter 1984 mechanical completion be expected.

4.6.3 Phase III Costs and Funding

The estimated costs and net funding requirement for the SRC-II Demonstration Plant baseline for Phase III are shown in summary in Table 4-3 (4Q78$). The costs and funding requirements include 6 years of operation. These costs include working capital, training costs, start-up costs, and operating and maintenance costs (including coal costs at $24.91 per ton) but do not make provision for any major plant modifications. Revenues were estimated using a price of $22.47 per FOE barrel.

TABLE 4-3

PHASE III ESTIMATED COSTS AND NET FUNDING REQUIREMENTS
(MILLIONS OF NOVEMBER 1978 DOLLARS)

	PHASE IIIA (START-UP) FY 82 TO FY 85	PHASE IIIB (PRODUCTION) FY 86 TO 1Q FY 90	TOTAL
CAPITAL	103	0	103
OPERATING AND MAINTENANCE COSTS (Incl. Coal)	152	491	643
EST. REVENUES*	(79)	(542)	(621)
EST. NET PHASE III FUNDING	176	(51)	125

*Assumes the following operating rates:

YEAR	CAPACITY %	THERMAL EFFICIENCY %
3Q & 4Q FY84	30	46
FY85	45	50.5
FY86	65	57
FY87	75	62
FY88	82.5	65
FY89	85	65
1Q FY90	85	65

4.6.4 Project Funding Requirements

An SRC-II Demonstration Project funding requirements analysis based on the capital and operating cost estimates presented above has been prepared. The funding requirements analysis is intended to provide estimates of the timing and magnitude of expenditures, revenues and net funding requirements (expenses less revenues) for the Demonstration Project.

Costs and revenues for the Project Baseline were estimated in November 1978 dollars as presented in Section 4.6.3, and were escalated to current year dollars as shown in Figure 4-4. Also shown for reference purposes is the overall project schedule. Key assumptions in the development of the estimate were:

- Escalation (per DOE) at an annual rate of 6%.
- Coal costs of $24.91 per ton.
- Product sale price of $22.47 per FOE barrel.
- Plant production starting in April of 1984.

For the base case shown in Figure 4-4, total funding requirements peak in FY 82/FY 83. Plant revenues sufficient to cover expenses would be generated during the last two years of the Project with the result that no outside funding would be required for this time period.

4.6.5 Sensitivity Analysis

Sensitivity cases for 12 variations of the base case were performed. Table 4-4 summarizes the cumulative Demonstration Project net funding requirements for the 12 cases. The base case is most sensitive to SRC product price and overall inflation and least sensitive to operating costs.

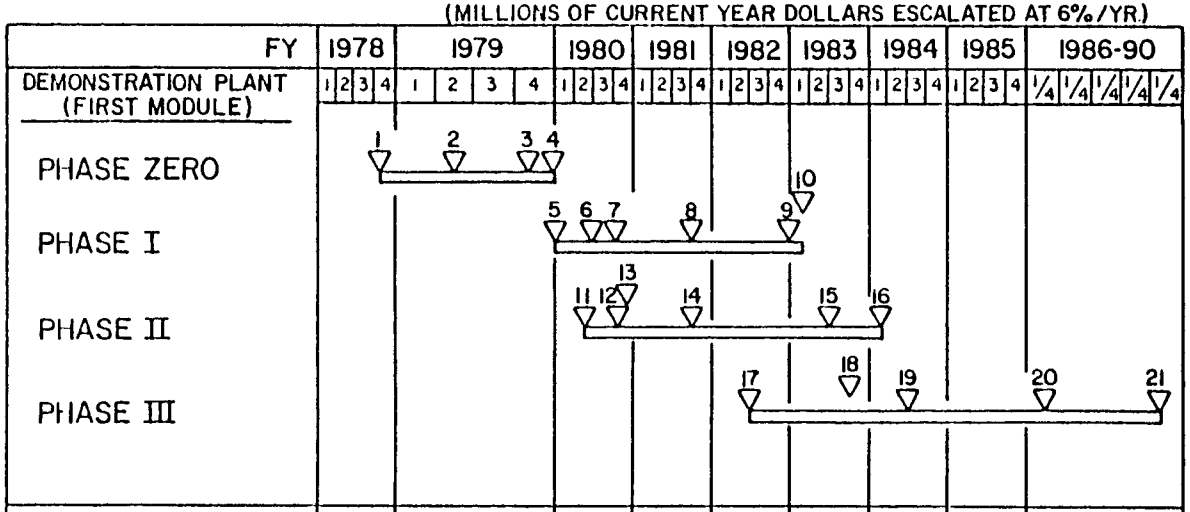
Using Sherman Clark petroleum pricing data (Deliverable No. 9, Market Assessment) to determine the SRC-II product price (case 1, Table 4-4) or the same price plus the expected utility premium of $2 per barrel (case 1A, Table 4-4), net funding requirements for the base case would be reduced, respectively, by about $460 and $510 million. The difference in the funding requirements between the pessimistic and optimistic operating rates is $320 million.

It is clear that the ultimate cost of the Demonstration Project is importantly dependent upon successful operation of the plant and upon the future price of petroleum. The first factor will determine how much salable product is made during Phase IIIB (Production) and the second factor will determine the selling price received for that product.

FIGURE 4-4

SRC-II DEMONSTRATION PLANT[1] TARGET SCHEDULE AND FUNDING ESTIMATE

(MILLIONS OF CURRENT YEAR DOLLARS ESCALATED AT 6%/YR)



	1978	1979	1980	1981	1982	1983	1984	1985	1986-90
INCREMENTAL FUNDING	2	13	44	185	436	413	156	146	834
REVENUES	0	0	0	0	0	0	(25)	(90)	(949)
CUMULATIVE FUNDING	2	15	59	244	680	1093	1224	1280	1165

MILESTONES

NO.	TITLE	DATE
1	CONTRACT AWARD PHASE ZERO	10 JUL 78
2	START BRIDGING TASKS	15 FEB 79
3	SUBMIT PHASE ZERO DELIVERABLES	31 JUL 79
4	COMP. BRIDGING TASKS	30SEP79
5	ISSUE PHASE I NTP	1 OCT 79
6	DESIGN STATUS REPORT	1 APR 80
7	FINAL EIS	1 JUL 80
8	DEFINITIVE ESTIMATE	1 JUL 81
9	FINAL 90% DES. REV.	30SEP82
10	P&M/DOE MUTUAL AGREEMENT TO PROCEED TO PHASE II	30NOV82
11	ISSUE PHASE II LIM. NTP	29FEB80
12	ISSUE FULL PHASE II NTP	15JUL80
13	START SITE PREP.	1 SEP80
14	START CONSTRUCTION	1 JUL81
15	FINAL EQUIP. DELIVERY	1 APR83
16	MECHANICAL COMP.	1 DEC83
17	ISSUE PHASE III NTP	1 APR82
18	START COMMISSIONING	1 JUL83
19	START PLANT OPER.	1 APR84
20	60% DES. CAPACITY	1 APR86
21	COMPLETE PROJECT	31 DEC89

OPEX	2	6	8	15	14	7	79	139	834	1104
P&CE	0	7	36	170	422	406	77	7	0	1125

[1] SEE TABLE 4-4 FOR OTHER FUNDING SCENARIOS

TABLE 4 - 4

CUMULATIVE DEMONSTRATION PROJECT NET FUNDING REQUIREMENTS FOR SENSITIVITY ANALYSIS CASES

(MILLIONS OF CURRENT YEAR DOLLARS - ROUNDED TO NEAREST $10 MM)

Case	Cumulative Net Funding Requirements $ MM	Deviation From Base Case $ MM	Parameter Varied From Base Case
Base	$1,160	-0-	
1	700	-$460	SRC Tracks Oil Price
1A	650	- 510	SRC Tracks Oil Price + $2/FOE BBL Premium
2	990	- 170	Constant 11/78 Dollars
3	1,450	+ 290	12% Inflation
4	1,350	+ 190	Capital = +20%
5	970	- 190	Capital = -20%
6	1,320	+ 160	Pessimistic Operating Rates
7	1,000	- 160	Optimistic Operating Rates
8	1,150	- 10	Schedule Slippage = 1 Year
9	1,200	+ 40	Coal = +10%
10	1,170	+ 10	Operating Labor = +10%
11	1,150	- 10	Operating Labor = -10%

SECTION 5
ECONOMIC AND TECHNOLOGY CONSIDERATIONS

The subjects summarized in this Section are discussed fully in Deliverable No. 12, Plan and Estimated Costs for Phases I, II and III, Volume 2, Appendix A, Technical and Commercial Considerations.

5.1 MARKET ANALYSIS AND DEVELOPMENT

Market analyses activities for Phase Zero have had as their primary objective an investigation of applications and markets for which coal-derived liquids might be applicable. These studies have explored how the distillates and light hydrocarbons recovered from the processing of high-sulfur bituminous coal using SRC-II technology might best be utilized in utility, industrial, transportation and chemical applications. During Phases I and II of the SRC-II Project, investigation of these various marketing opportunities will be continued. Emphasis will be placed not only on economic competitiveness but also on environmental acceptability and liklihood of physical product acceptance in a particular application.

In summary, the activities of the market analysis and development task will involve close cooperation with potential customers to provide industry with the basis for assessing the role they can play in supporting commercialization of liquid fuels from coal.

5.2 ECONOMIC EVALUATION

In Phase Zero an economic analysis based on DOE guidelines was performed using the conceptual commercial plant cost estimate to determine the required selling price for coal liquids to provide a 15% rate of return on investor equity. This analysis indicates that if the demonstration program is successful and commercial growth occurs as projected, coal liquids in general could be available at prices in the order of $25 per barrel (expressed in 1978 dollars).

A complete investment analysis will be conducted near the end of Phase I, reflecting the definitive design basis and estimate. During Phase I, sensitivity studies will be performed to determine the incentive for process and equipment alternatives as well as the incentive for related development programs. Also during Phases I and II, Commercial plant economic trade-off studies will be performed. They will evaluate not only the competitiveness of SRC-II products on a commercial basis, but also will evaluate the various individual processing schemes in the commercial plant with respect to their effect on capital and operating costs.

5.3 COMMERCIALIZATION

The New York harbor spot price for low-sulfur fuel oil comparable to SRC-II fuel oil was about $23 per barrel in July of 1979. A group of eastern utilities has offered support to DOE for the SRC-II Demonstration Project by product purchases at premium prices now proposed as the market price plus $2 per barrel. At present it is expected that most of the products from the Demonstration Plant will be sold by DOE to these utilities at such a price.

5.4 TECHNOLOGY TRANSFER

Projects such as the SRC-II Demonstration Plant Project which are funded by the U.S. Government require the Contractor to report the technical results of the Project to the Government which in turn makes such technical results available by publication. Further, P&M will continue its current practice of discussing the Project and the SRC-II Process regularly at various public technical meetings with DOE approval. In addition, through the written Project reports, reasonably open facilities, and participating sub-contractors, the SRC-II technology will become widely understood.