COPY NO. 94

SRC-II DEMONSTRATION PROJECT
PHASE ZERO
TASK NUMBER 15

DELIVERABLE NUMBER 12

VOL. 2 OF 3

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

JULY 31, 1979

THE PITTSBURG & MIDWAY COAL MINING CO.
DENVER, COLORADO

PREPARED FOR

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

Cp

NOTICE

IN VIEW OF THE SUBSTANTIAL UNCERTAINTIES AND COMPLEXITIES OF THE MATTERS INVOLVED, NO STATEMENTS IN THE DOCUMENTATION OF THE PHASE ZERO TASKS, WHETHER PREPARED BY P & M, GULF OR THIRD PARTIES, ARE TO BE CONSIDERED AS DEFINITIVE REPRESENTATIONS OR WARRANTIES. ALTHOUGH THEY REPRESENT THE AUTHORS' BEST ESTIMATES AT THE TIME OF PREPARATION OF THE VARIOUS DOCUMENTS, ALL INFORMATION MUST BE CONSIDERED PRELIMINARY, SUBJECT TO CHANGE AS THE PROJECT PROGRESSES, AND NOTHING HEREIN SHALL BE CONSTRUED AS A MODIFICATION OF THE RIGHTS OR OBLIGATIONS OF THE PARTIES TO THE DEMONSTRATION PROJECT CONTRACT.

VOLUME 2 OF 3
TABLE OF CONTENTS

MANAGEMENT PLAN SUMMARY (Volume 1 of 3)

LIST OF FIGURES

LIST OF TABLES

SECTION 1
INTRODUCTION

1.1 SUMMARY

The Project Management Plan (PMP) describes procedures The Pittsburg & Midway Coal Mining Co. (P&M), (a wholly owned subsidiary of the Gulf Oil Corporation acting through Gulf Mineral Resources Co. [GMRC]), will use to manage the design, construction and operation of the SRC-II Demonstration Plant to produce liquid products using the Solvent Refined Coal Process known as SRC-II. P&M has administrative responsibility for the Project; however, Gulf Oil Corporation (Gulf) will support all facets of the Project.

The PMP is part of Deliverable No. 12, Plan and Estimated Costs for Phases I, II and III which has been prepared in three volumes: Volume 1 is the Management Plan Summary, Volume 2 is the Project Management Plan and includes the Technical and Commercial Considerations (Appendix A to the PMP) and Volume 3 is Project Baseline Plans (Appendix B to the PMP). Work during Phase Zero included a demonstration plant description; a capital and operating cost estimate; supplemental technical studies; long lead procurement planning; market and economic analyses; first commercial plant and grassroots commercial plant design and cost estimate; a cost sharing plan; environmental analysis; and the Plan and Estimated Cost for Phases I, II and III including the project Work Breakdown Structure (WBS), schedules, cost estimates and management approach. Subsequent Project phases are:

Phase I - Detailed/Final Design
Phase II - Procurement and Construction
Phase III - Operation and Evaluation

The key target dates for the SRC-II Project are a Phase I start on October 1, 1979; full authority for Phase II by July 15, 1980; and mechanical completion by December 1, 1983. The basis for these key target dates is the desire of the Department of Energy to demonstrate SRC-II technology in commercial size equipment as soon as possible.

The PMP is a policy document and a project planning document which delineates methods to be used by all personnel and organizations, including P&M and major subcontractors, involved in the management and control, design, construction and operation of the proposed SRC-II Demonstration Plant. These policies and procedures are consistent with P&M and DOE guidelines and directives. The PMP describes the P&M management system for defining and integrating cost, schedule and technical work scope (baseline). The integrated baseline allows objective measurement of progress using an earned-value performance measurement concept devised by P&M and to be employed by P&M and its major subcontractors.

The PMP will be the operating management plan throughout the life of the SRC-II Demonstration Project. As the Project progresses, the PMP will be updated as required to reflect the evolution and current status of project management techniques. The PMP and all revisions thereafter will be formally transmitted to DOE. The PMP is based upon a fully-funded government contract and may change if a contract is negotiated on a different basis.

1.2 PROJECT MANAGEMENT PLAN OBJECTIVES

The major objectives of the Project Management Plan are outlined below and discussed in detail in the following sections of the PMP.

1. Provide a concise description of the SRC-II Demonstration Project including project objectives, technology and product economics and marketability.
2. Describe the SRC-II Project organization, identify organizations and key participants and specify their interrelationships, responsibilities and authorities.
3. Describe the management systems and techniques to be used in managing work scope, schedules, costs and human and material resources to be employed on the Project and the methods for measuring project performance.
4. Describe the reporting requirements, document control procedures and organizational elements responsible for preparing technical and administrative reports.

5. Present the baseline plans and methodology for Phases I, II and III in terms of:
    - Work Breakdown Structure (WBS)
    - Schedule Milestones
    - Budgets

The PMP is the working document that will define for present and future participants, the what, where, when, who and how of SRC-II project management. It defines what the Project will produce in terms of products; where the products will be produced; where the resources to be mobilized for production will be found; when the resources must be available and when the products will be completed; who, in terms of specific organizations, positions and personnel, will be responsible for what products; and how the entire SRC-II program will be managed and costs controlled so that the Project goals are realized. The PMP is the master document that defines the SRC-II project management system.

SECTION 2
PROJECT OBJECTIVES

The objective of the SRC-II Demonstration Plant Project as stated by DOE is to demonstrate 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:

1. Design, construct and operate a safe, efficient, and environmentally acceptable 6,700 ton per stream day (TPSD) coal liquefaction plant using the SRC-II technology.
2. Verify the technical feasibility of the SRC-II process in commercially sized equipment by demonstrating performance, reliability, operability and maintainability. This includes:
   A. Confirmation of design criteria of process equipment units including the slurry preheater, dissolver vessels and coal/slurry blending equipment.
   B. Demonstration that various supporting processes including high-pressure gasification can be integrated into the coal liquefaction process.
   C. Identification of proper controls for any environmental, health and safety factors.
3. Assess the commercialization potential of the SRC-II process by:
   A. Producing large quantities of products including low-sulfur fuel oil, gaseous hydrocarbons and chemical by-products for long term testing by utilities and industry.
   B. Determining the economic, market and technical aspects of commercialization.
   C. Obtain operating cost experience for application to estimation of capital and operating costs of a commercial sized plant.

4. Establish a design basis for future commercial plants.
5. Promote the development of a commercial synthetic fuels industry utilizing technology based upon the SRC-II process through technology transfer programs.

SECTION 3
DEMONSTRATION PLANT DESCRIPTION

3.1 BACKGROUND INFORMATION

Development of the Solvent Refined Coal (SRC) Process began in 1962 at the Spencer Chemical Company Research Laboratories at Merriam, Kansas, and benchscale work has continued at that location. The initial benchscale work led to the construction and operation of a one-half ton per stream day (TPSD) pilot plant located in Kansas City, Missouri. This unit provided design and operating data for construction of the 50 TPSD facility located at Ft. Lewis, Washington. Construction was completed at Fort Lewis in 1974 and this plant has been in operation since that time.

This extended research and development program has been substantially funded by the U.S. Government. While initial work was directed at development of an ash-free solid product, development since 1973 has demonstrated the feasability and desirability of producing primarily liquid products. This technically advanced process producing liquid and gaseous hydrocarbon products is known as the SRC-II process.

3.2 DESIGN BASIS FOR CONCEPTUAL DEMONSTRATION PLANT

The conceptual SRC-II Demonstration Plant is designed to process 6,700 tons of coal per stream day (TPSD). It could be expanded to a 33,500 TPSD commercial plant. The proposed Plant will be located on a 2,400 acre site on the Monongahela River near Morgantown, West Virginia. Design coal for the 6,700 TPSD Demonstration Plant is Pittsburgh seam coal from the panhandle area of West Virginia, although other bituminous coals could also be processed.

3.3 SUMMARY TECHNICAL DESCRIPTION

The SRC-II process is an advanced coal liquefaction process 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 reactor. 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 (FOE). The liquid products may be further refined to produce high quality unleaded gasoline as the primary product.

The expected products from the 6,700 TPSD Demonstration Plant and the approximate quantity 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

Summary reports describing technical and commercial considerations for the Demonstration and commercial plants are contained in Appendix A Technical and Commercial Considerations.

3.4 SITE

Efforts to obtain a site suitable for an SRC-II plant began in 1975. Twenty-eight sites were considered in the states of Indiana,

Kentucky, Ohio, Pennsylvania, Tennessee and West Virginia. The list was narrowed to four potentially suitable sites for more thorough evaluations. In April 1977, the decision was made to begin acquiring a site about five miles north of Morgantown, West Virginia. The location of the site is shown in Figure 3-1.

The site is bounded on the north by the Pennsylvania state line, on the east by the Monongahela River and the Ft. Martin power station, on the south by the Monongahela River and county roads 53 and 53/2, and on the west by hills overlooking state route 100. The site presently consists of 28 parcels of land for a total of 2,430 acres.

3.5 EXPANSION TO COMMERCIAL

The ultimate objective of building and operating the Demonstration Plant is to establish an experience base for commercialization of the SRC-II process. The feasibility of moving into a commercial sized operation will be regularly reevaluated as new technical, economic and environmental information becomes available over the life of the SRC-II Demonstration Project. These evaluations will determine the feasibility and timing of expansion of the Demonstration Plant to commerical scale. The current concept for expanding the Demonstration Plant is detailed in the Phase Zero Deliverable No. 7, First Commercial Plant Description and Cost Estimate.

The commercial scale facility as perceived is a 33,500 TPSD plant and could be achieved by addition of four processing trains in parallel to the Demonstration Plant train. However, P&M's plan for the expansion of the Demonstration Plant to a full sized commercial plant is contingent upon future world energy markets and economics. If conditions favor commercial use of coal liquids, then P&M may request the Government to negotiate the sale of the Demonstration Plant to P&M.

Fig. 3-1. Site location SRC-II demonstration plant

SECTION 4
PROJECT ORGANIZATION

Successful management of the SRC-II Demonstration Project throughout Phases I, II and III will be accomplished through establishment and utilization of a structured project organization. This section provides descriptions of the P&M management structure, responsibilities, organizational interfaces, key position descriptions, key personnel and their relationships to DOE.

4.1 DOE ORGANIZATIONAL ELEMENTS

The U.S. Department of Energy (DOE) will continue to carry out coordination and overall management of the SRC Program as part of a balanced and comprehensive government funded energy development program. The major DOE organizational elements for the SRC Program include the DOE-HQ Office of Fossil Energy and the Oak Ridge Operations Office (ORO).

ORO is responsible for the contract and project management activities of the SRC-II Demonstration Project. Formal SRC Program and policy guidance is given to the ORO Project Office from the SRC Program Manager of the Division of Fossil Fuel Processing. The DOE organization for the SRC Demonstration Plant Program is shown in Figure 4-1.

4.2 P&M PROJECT ORGANIZATION

As the prime contractor to DOE for the SRC-II Demonstration Project, P&M will establish a management structure that supports integrated planning and control of all Project activities throughout Phases I, II and III. This organizational structure will provide for direction and management of the Project activities, uniformity of contract administration and completion of contractual requirements. The P&M project organization will also provide for the necessary coordination and communication with DOE and subcontractors. The P&M organizational elements for Phase I are presented in Figure 4-2. Some of the key personnel within the P&M organization are named on these organization charts. Conceptually, the Phase II

DOE ORGANIZATION

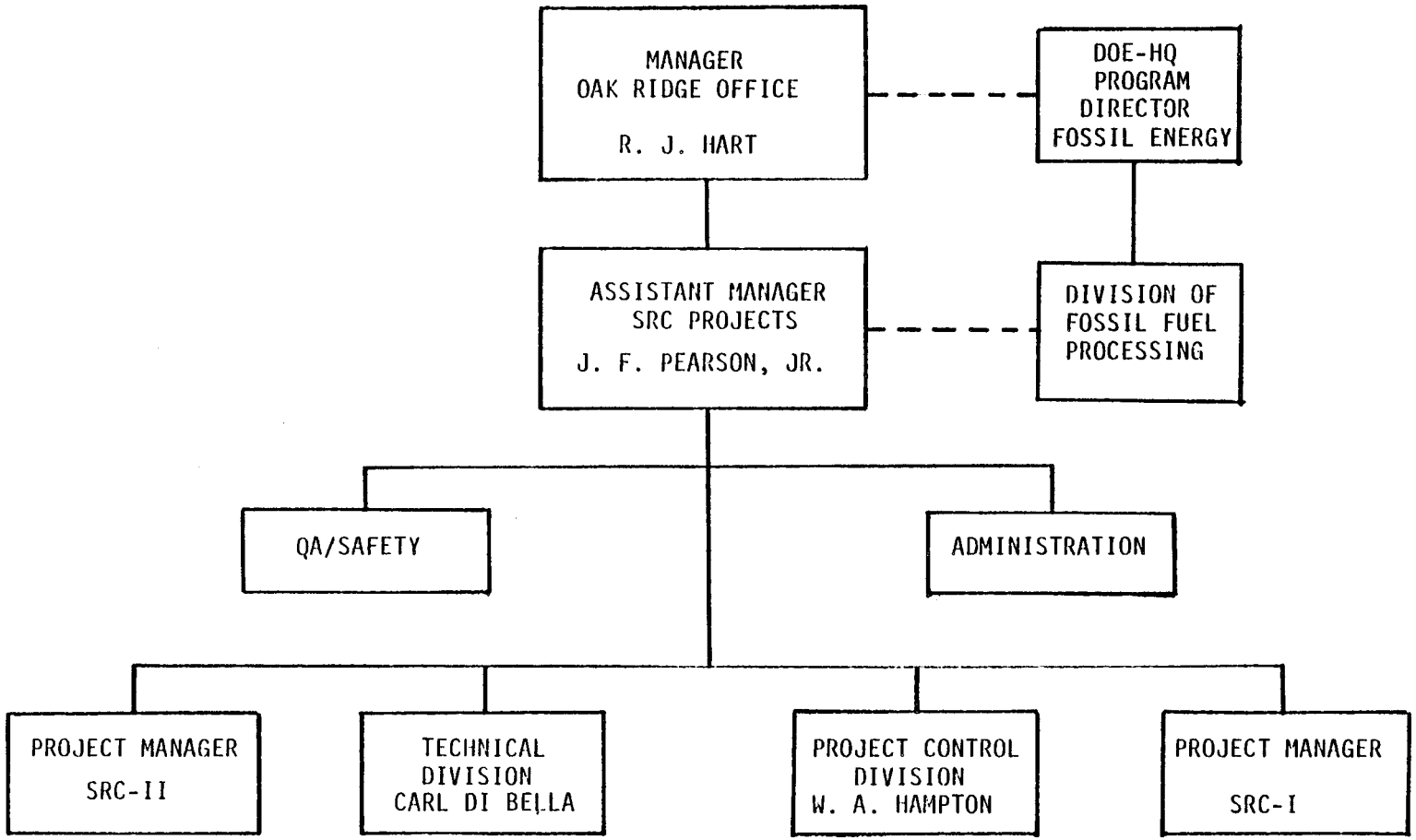

Fig. 4-1. DOE SRC demonstration plant program organization

and III organizations will be based on the Phase I organization with expansion of the plant construction and operation groups.

All corporate direction and ultimate authority for managing the Program resides with the GMRC/P&M Executive Vice President, S. A. Zagnoli. He will provide overall management direction and will assure that the resources needed for successful completion are made available to the Program. The Vice President of the Demonstration Plant Project, D. P. Lessig, is the P&M Project Manager who will be the controlling interface with DOE and major subcontractors, and official direction and authority for managing the Demonstration Plant Project is delegated to him. He will be responsible for the design, construction, and operation of the Demonstration Plant. The Demonstration Plant Project Division includes engineering, project control, technical coordination, construction activities and plant operations.

In addition to the Project Manager who is responsible for the Demonstration Plant, support of the overall SRC-II Demonstration Program will be provided by organizations under R. A. Flinn, Vice President for Development and S. A. Barnes, General Manager for Administration. The Administration Division includes financial control, contract administration and planning activities. The Development Division includes commercial development and program development, as well as economic and market analysis. The responsibilities of the Corporate Communication and Coordination Committee are indicated in Section 5.3, Management Policies.

4.2.1 P&M Project Organization Position Descriptions

The responsibilities, authorities and interfaces of the Executive Vice President and the level 2 and 3 managers in the Administration, Demonstration Plant Project, and Development Divisions are described in Table 4-1.

4.2.2 Project Staffing Policies

Support for staffing the SRC-II Project organization will be made available from Gulf Human Resource Groups. P&M will staff the organization using qualified Gulf personnel and subcontractors, and by hiring from the outside market. In addition, extensive use will be made of the

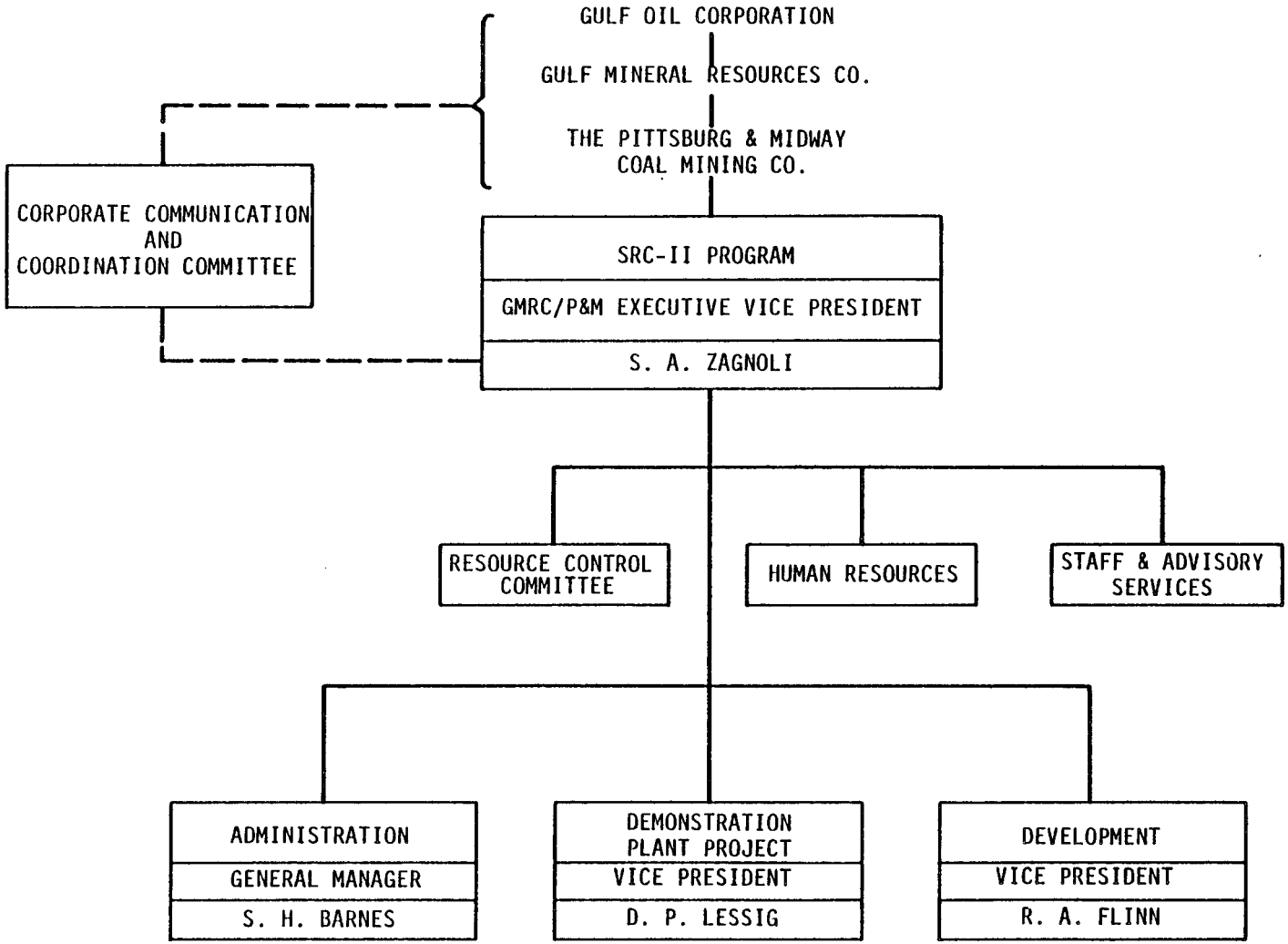

Fig. 4-2 (sheet 1 of 7). P&M phase I organization

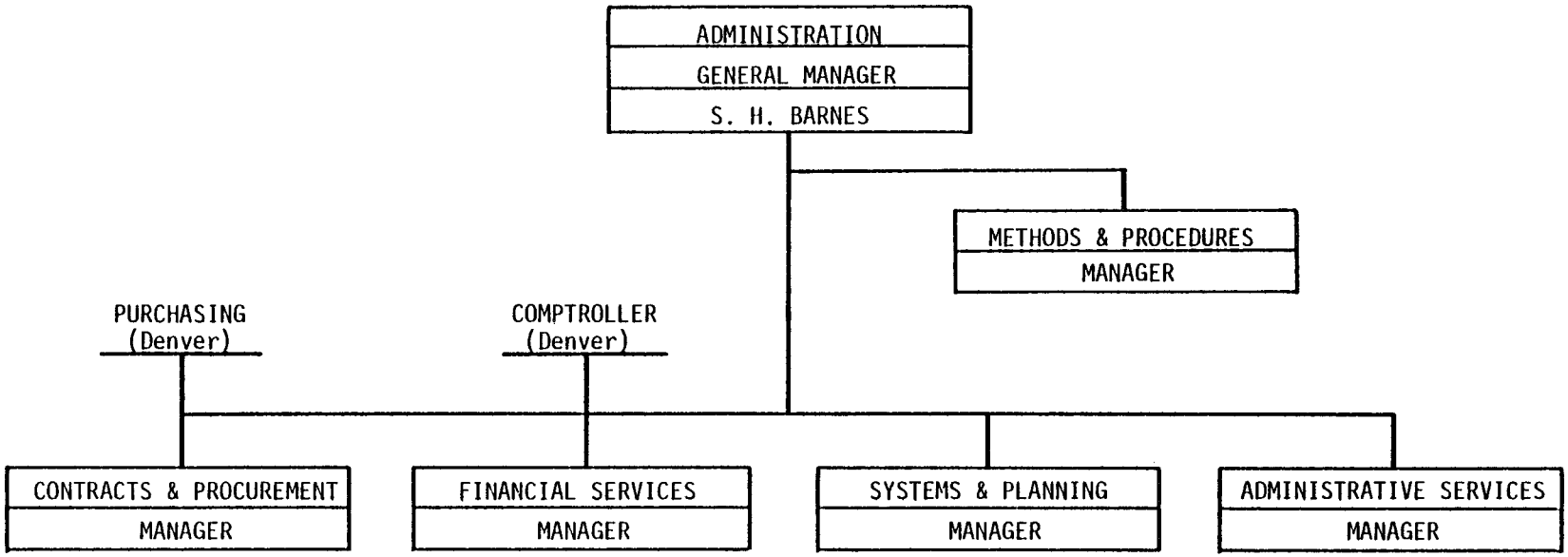

Fig. 4-2 (sheet 2 of 7). P&M phase I organization

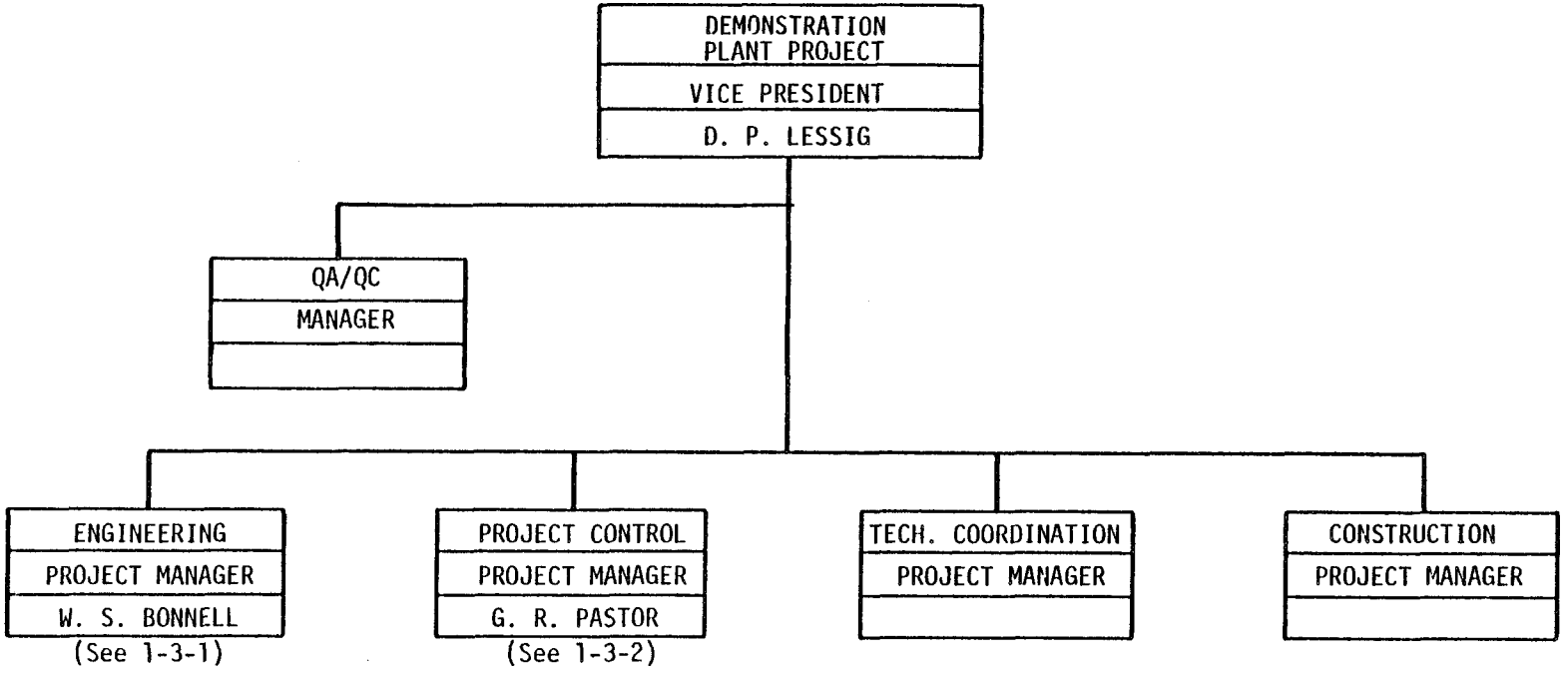

Fig. 4-2 (sheet 3 of 7). P&M phase I organization

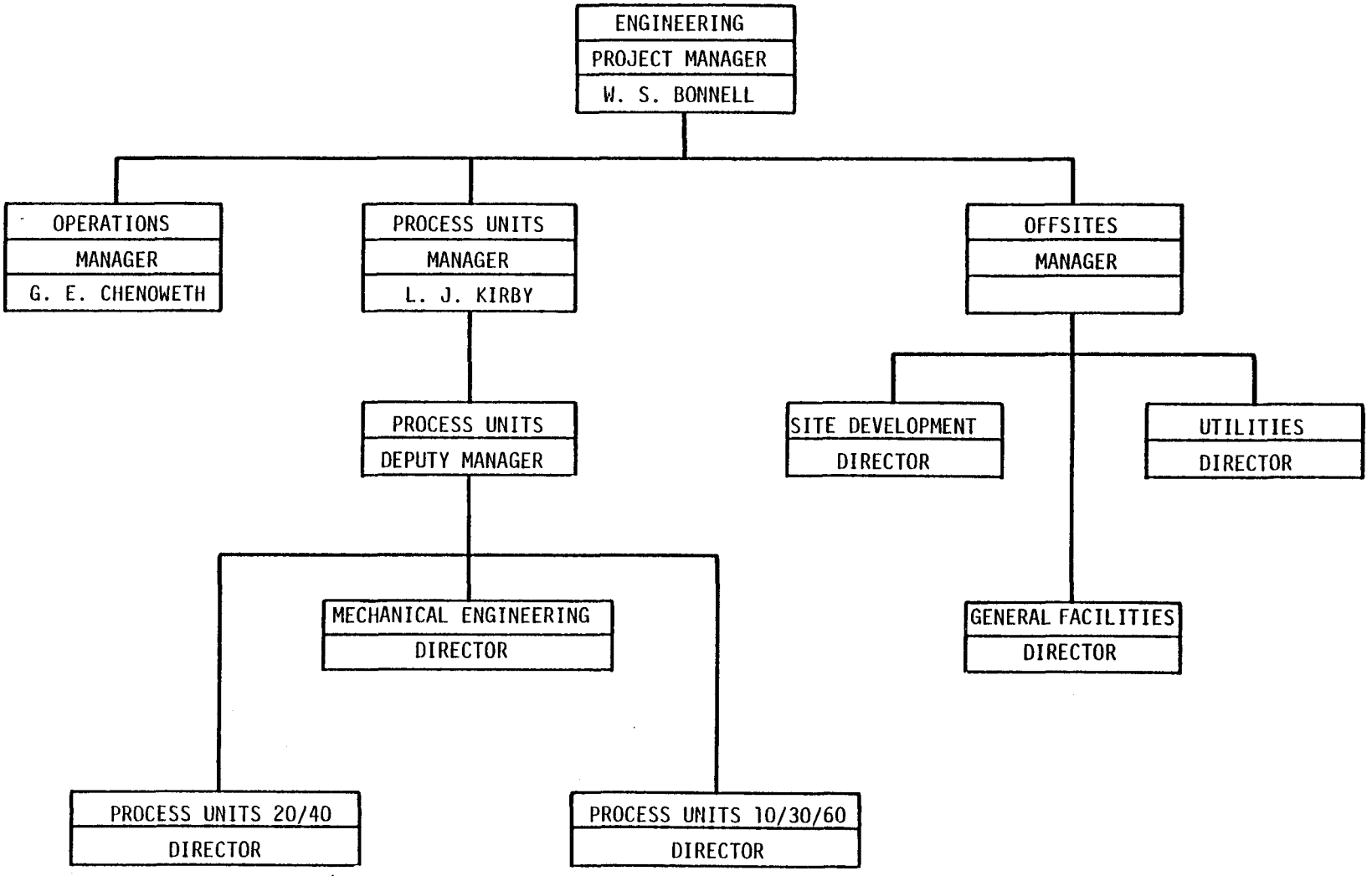

Fig. 4-2 (sheet 4 of 7). P&M phase I organization

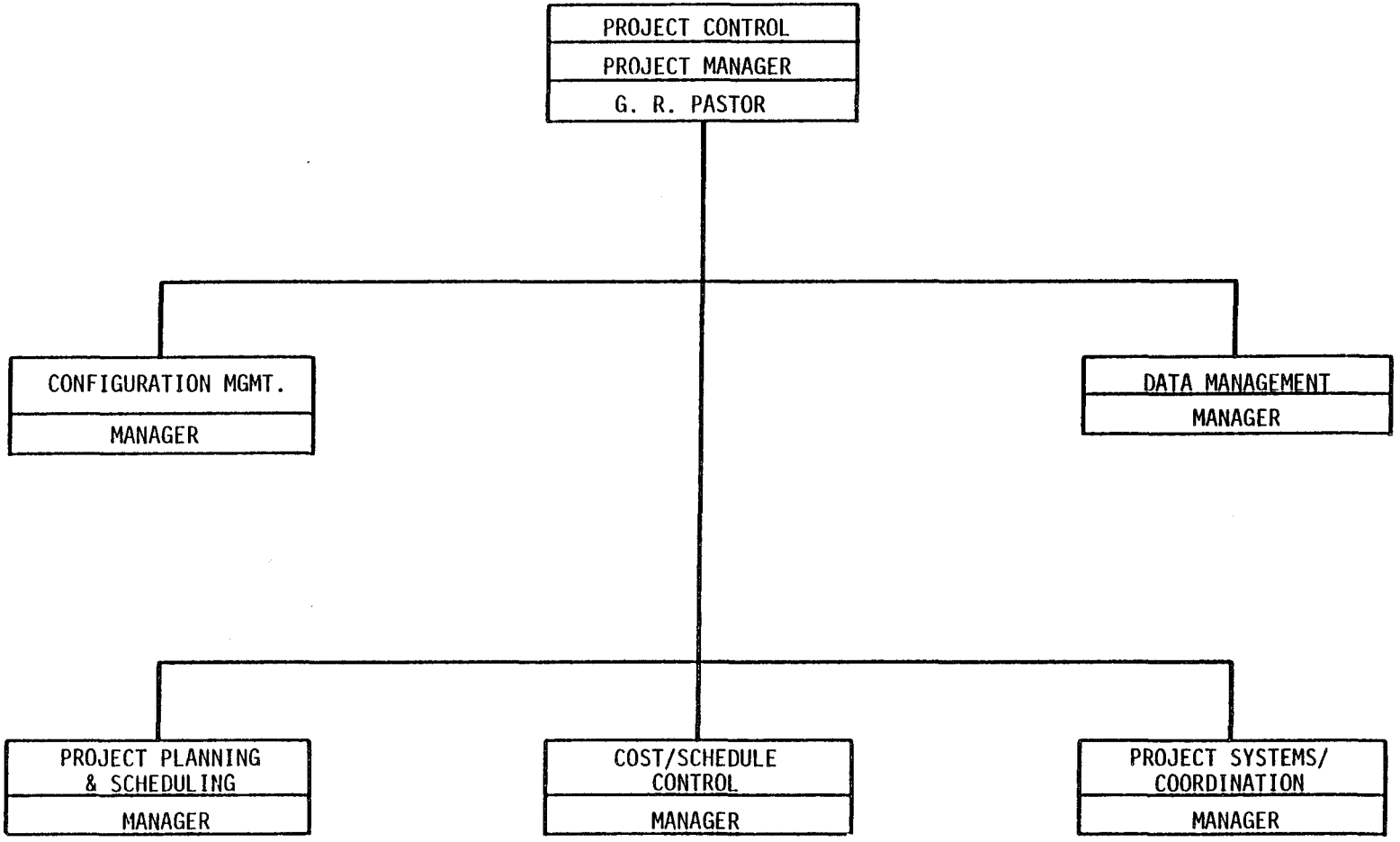

Fig. 4-2 (sheet 5 of 7). P&M phase I organization

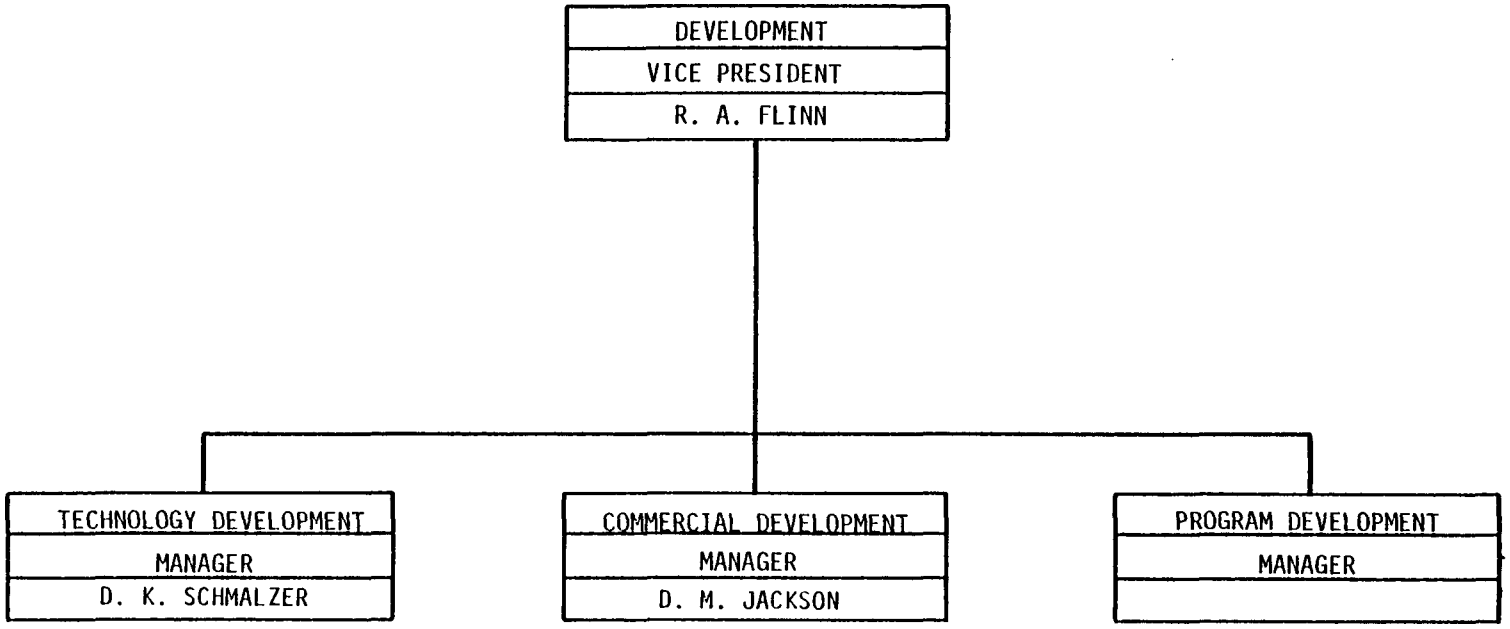

Fig. 4-2 (sheet 6 of 7). P&M phase I organization

(a)	(b)	(c)	(d)	(e)	(f)
LEGAL COUNSEL	TAX SERVICE	AUDITING	HUMAN RESOURCES	COMMUNITY/PUBLIC AFFAIRS	COMMITTEE REVIEW
GOC GMRC Outside Counsel	GOC GMRC	GOC	GOC GMRC	GOC Representative	Resource Control Corporate Review Foreign Participants Government Relations

(a) Legal Counsel reports directly to Corporate General Counsel
(b) Tax representative reports to GMRC Tax Manager
(c) Audit reports directly to Corporate Audit
(d) During Phase I most Human Resources functions will be provided by GMRC and/or GOC.
(e) Reports to Corporate Public Affairs V.P.
(f) Selected key managers within the project are assigned to the committee with corporate representatives

Fig. 4-2 (sheet 7 of 7). P&M phase I organization

TABLE 4 - 1
P&M PROJECT ORGANIZATION POSITION DESCRIPTIONS

POSITION	RESPONSIBILITIES/AUTHORITIES
1) DEMONSTRATION PLANT PROJECT DIVISION VICE PRESIDENT	Provide full-time management efforts as the Project Manager for the successful design, construction and operation of the SRC-II Demonstration Plant. Has responsibility for the direction of the Engineering, Project Control, Technical Coordination, Construction and operation of the Demonstration Plant within the confines of the contract. Insures that the QA/QC and project coordination efforts are consistent with the project requirements. Responsible for the overall performance of the engineering and construction subcontractors. Assures that the project activities are performed within the budget and on schedule. Makes evaluations and/or recommends changes to the design, workscope and contract. Is responsible to and receives direction from Executive Vice President, SRC-II Program. D. P. Lessig is designated Demonstration Plant Project Division Vice President. He has overall responsibility, authority and official direction of the SRC-II Demonstration Plant Project and will interface with J. F. Pearson, Jr., DOE Assistant Manager of SRC Projects, the Stearns-Roger Senior Project Manager and Construction Manager.
2) DEVELOPMENT DIVISION VICE PRESIDENT	Manage technical support programs, commercial development, marketing and economic analysis programs, and liaison and coordination with DOE and potential foreign participants. Direct efforts of technical development on supporting R&D programs at Fort Lewis, Merriam and Harmarville. Supervise commercial development to provide a market for the end products. Direct program development, including working relations and agreements with DOE and foreign industrial participants. Supervise and coordinate all patent activities and proprietary licensing arrangements for the project. Direct site acquisition and coal supply aspects of the project. R. A. Flinn is designated Development Division Vice President. He is responsible for program development and commercialization and interface for information exchange and guidance with DOE-HQ Division of Fossil Fuel Processing. He will also interface with the foreign participants, Gulf Oil Corporation R&D Groups and product utilization customers and consultants.

POSITION	RESPONSIBILITIES/AUTHORITIES
3) ADMINISTRATION DIVISION GENERAL MANAGER	Overall responsibility for SRC-II financial, contractual, accounting and administrative operations. Responsible for financial data and cost accounting. Ensure implementation of accounting procedures to adequately satisfy DOE and Gulf Oil Corporation management requirements. Evaluate, develop and implement proper policies and procedures to operate within DOE and Corporate guidelines. Responsible for contract and subcontract language, review, and application. Develop procurement and material control plans and procedures. Provide project management with financial long range planning. Supervise financial and accounting systems design, coordination and maintenance. S. H. Barnes is designated Administration Division General Manager. He is responsible for secondary interface for information exchange and guidance with W. A. Hampton, DOE Project Control Division and will also interface with major subcontractors.
1.1) QA/QC MANAGER	Ensure that appropriate procedures are established and implemented in order to provide an SRC-II Demonstration Plant which will function as intended. Provide a high degree of assurance for quality of the process facility design, procurement, construction, safety of plant personnel and the public, and reliability of components. Responsible for ensuring that all subcontractors, vendors, etc. establish and enforce quality assurance and control procedures. Assure that the QA/QC Procedures Manual and Policies are implemented. Responsible for ensuring that the design drawings and/or specifications contain appropriate requirements and/or procedures in conformance with the QA/QC Procedures Manual and Policies. Responsible for ensuring that subcontractors and equipment and material vendors establish and implement QA/QC procedures in accordance with specifications including acceptance inspections, testing, record keeping and certification. Responsible as secondary interface for information exchange and guidance with DOE QA/Safety.

POSITION	RESPONSIBILITIES/AUTHORITIES
1.2) MANAGER OF ENGINEERING	Primary responsibility is for the overall engineering and design of the Demonstration Plant. Directs the SRC-II engineering efforts to ensure a coordinated design. Responsible for ensuring overall plant operability. Review and approval of engineering drawings in final form. Provide direction for offsite activities including site development, utilities, and general facilities. Conduct design and tradeoff studies related to critical areas of design, recommend evaluation of potential operational problems and recommend solutions. Responsible for incorporating all approved design changes into the demonstration plant design. W. S. Bonnell is designated Manager of Engineering. He is responsible for secondary interface for information exchange and guidance with Carl DiBella, DOE Technical Division, DOE SRC-II Project Management Division, and will also have close interface with major engineering subcontractors and SRC-II development group.
1.3) MANAGER OF PROJECT CONTROL	Responsible for establishing management systems, performance measurement standards and systems and monitoring and reporting project progress. Responsible for overall project planning, budgeting, human resource planning and scheduling. Establish cost estimating procedures, evaluate cost and schedule performance, and conduct performance analysis. Accountable for establishing configuration management procedures and coordination of change control activities. Provide a central file system with appropriate document control procedures. Coordinate project technical and management reviews and prepare technical status reports as required. Provides support and actively partcipates in contract/subcontract negotiations. G. R. Pastor is designated Manager of Project Control. He is responsible for secondary interface for information exchange and guidance with W. A. Hampton, DOE Project Control Division. He will also interface with subcontractor project systems groups.

TABLE 4 - 1
(Page 3 of 7)

POSITION	RESPONSIBILITIES/AUTHORITIES
1.4) MANAGER OF TECHNICAL COORDINATION	Provides technical coordination and direction relating to logistics, environmental, technical coordination, systems engineering and safety and health programs. Establish and monitor systems design for cost effectiveness. Ensure that a proper medical/safety program is established for employees. Coordinate and interface as necessary to insure proper and timely material handling systems. Responsible for coordination of the acquisition of appropriate permits and licenses. Establish and coordinate proper waste disposal procedures and programs in compliance with all federal, state and local environmental regulations. J.R. Sobernheim is designated Manager of Technical Coordination. He is responsible for interface with appropriate government agencies, suppliers, Corporate medical, safety and legal departments, and has responsibility for secondary interface for information exchange and guidance with Carl DiBella, DOE Technical Division.
1.5) MANAGER OF CONSTRUCTION	Responsible for the overall construction program for the demonstration plant within the budget and schedules established. Direction and coordination of all construction subcontractors. Establish internal inspection and audit programs. Coordinate and supervise material and equipment supply. Act as Project Liaison Manager with vendor for deliveries of major process equipment. Provide technical liaison with Engineering and Design Departments and subcontractors. Interface with all subcontrators, vendors, engineers, and has responsibility for secondary interface for information exchange and guidance with DOE SRC-II Project Management Division Director.

POSITION	RESPONSIBILITIES/AUTHORITIES
2.1) TECHNOLOGY DEVELOPMENT MANAGER	Develop and manage R&D activities related to the SRC-II Demonstration Project. Responsible for R&D work on equipment and process tests for design configuration. Coordinate application of data from SRC-II development work with engineering. Maintain liaison with DOE technical respresentatives, and R&D managers for the Fort Lewis and Harmarville facilities. Manage Fort Lewis contracts/subcontracts and related activities. Responsible for technical liaison with foreign participants in SRC Demonstration Project. Provides support for reviewing and acquiring patents, proprietary data and licensing agreements. D. K. Schmalzer is designated Technology Development Manager and will interface with R&D managers, Carl DiBella, DOE Technical Director and Gulf Oil Corporation engineers.
2.2) COMMERCIAL DEVELOPMENT MANAGER	Responsible for commerical marketing and marketing research for all SRC-II products and by-products. Responsible for commerical and demonstration plant economics and marketing analysis, and product and by-product utilization studies. Maintains and develops liaison with potential industrial and utility customers to determine acceptability of product fuels. Responsible for product testing, application, and upgrading programs conducted and coordinated with other firms and industry and government organizations. Responsible for conceptual commercial (grass roots) plant design and cost estimates. Identify potential coal supply sources and arrange to secure coal supply. Arrange for product and by-product disposition. Participate in product specification and acceptability testing. Coordinate disposition and transportation of products. D. M. Jackson is designated Commercial Development Manager and will interface with prospective customers, production and engineering personnel, consultants, R&D groups and Carl DiBella, DOE Technical Director.

POSITION	RESPONSIBILITIES/AUTHORITIES
2.3) PROGRAM DEVELOPMENT MANAGER	Responsible for developing and maintaining contractual and working relationships with Germans, Japanese and any other potential industrial participants and foreign government representatives to the SRC-II Project. Responsible for relations and activities with DOE - Washington office as well as other Administration and Congressional contacts. Responsible for project site acquisition and disposition. Participate in cost-sharing contract negotiation and related negotiations with prospective joint venture participants.
3.1) CONTRACTS/PROCUREMENT MANAGER	Responsible for project contract administration and procurement and material control operations. Assure implementation of government contract procedures and compliance with applicable regulations. Supervise the administration of all project contracts and purchase orders and provide necessary management reports. Monitor contract/subcontract change orders. Ensure all expenditures are covered by authorized scope of work and related funding. Direct all project subcontract purchasing activities. Provide management with an overall Material Planning program. Supervise the operation of Warehouse/Stores operations. Interface with subcontractors, DOE contract administration staffs, and Corporate Legal Department.
3.2) FINANCIAL SERVICES MANAGER	Responsible for proper implementation of accounting, budgeting and cash management operations within the guidelines established by Gulf Oil Corporation. Direct the operation of the general accounting section to ensure that proper accounting and cost reporting procedures are followed. Provide management with financial reports as required. Responsible for control and reporting on status of all financial budgeting activities. Supervise fund and cash management and reports to management. Provide payroll allocations on all project activities. Interface with Gulf Oil Corporation, DOE and subcontractors financial staffs.

POSITION	RESPONSIBILITIES/AUTHORITIES
3.3) DEVELOPMENT SYSTEMS MANAGER	Responsible for providing the project with long range planning and data processing system capabilities. Establish and direct a meaningful and effective long range planning program. Supervise project data processing systems design with appropriate coordination and maintenance. Interface with Corporate Planning Group and Corporate Computer Science Group.
3.4) ADMINISTRATIVE SERVICES MANAGER	Provide project with all necessary administrative services. Responsible for providing SRC-II Project with all necessary office and building services.

TABLE 4 - 1
(Page 7 of 7)

expertise available on a service basis from throughout Gulf. The various managers will determine their manpower requirements and the Human Resource Groups will have the responsibility for:

1. Developing formal position summaries.
2. Evaluating both local and national labor markets.
3. Implementing the normal Gulf hiring procedures and policies (EEO, Affirmative Action).

It is the intention of P&M to staff the organization using in-house personnel and the outside labor market. Job requisitions will be prepared describing job responsibilities and education and experience requirements. Following management approval of the job requisitions, P&M will use the Gulf Personnel Information & Retrieval System (PIRS) to identify qualified personnel within the Corporation. PIRS is a Corporate-wide personnel data bank and the primary source used to fill corporate positions. Appropriate candidates will then be given the opportunity to transfer into the SRC-II Project. Subsequent to the determination of availability and acceptance by these identified personnel, P&M will utilize State Employment Commissions, local and national advertising and search firms to locate personnel for those positions which cannot be filled from within Gulf or those positions traditionally filled on a local basis.

4.2.3 Manpower Training

Formal training programs will be established subsequent to the acquisition of personnel and as needed for project employees. As needed, employees will receive training regarding management systems, health and safety aspects, as well as general orientation to plant operations. Specialized technical and non-technical training needs will be identified and appropriate training programs developed. The design and implementation of training programs will be conducted by P&M personnel with appropriate utilization of outside resources as the need arises. Training personnel will draw upon past training programs such as those provided at the Fort Lewis Pilot Plant and Gulf refineries and chemical plants.

4.3 ORGANIZATIONAL INTERFACES

The primary organizational interfaces that will be established and maintained will be between ORO and P&M, and between P&M and the architect/engineering and construction subcontractors. Both technical and administrative communications will be maintained. Official communications will be maintained between the Assistant Manager SRC Projects at the DOE Oak Ridge Office and the Project Manager.

The interfaces between P&M and the Architect-Engineer (Stearns-Roger Engineering Corporation [SRENCORP]), and for purposes of this document (S-R) 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 S-R Senior Project Manager. Technical interfaces will occur between the appropriate DOE, P&M and S-R technical managers.

Figure 4-3 provides an interface matrix summarizing primary responsibility/authority/communication relationships between DOE and the P&M organization. For example, D. P. Lessig, Demonstration Plant Project Vice President and Project Manager, has overall responsibility, authority and official direction of SRC-II Demonstration Plant Project and will interface with J. F. Pearson, Jr., DOE Assistant Manager for SRC Projects. Detailed descriptions of responsibilities and authorities within the P&M organization were previously noted in Table 4.1.

P&M ORGANIZATION \ DOE ORGANIZATION	DOE-HQ DIVISION OF FOSSIL FUELS PROCESSING	MANAGER OAK RIDGE OFFICE R.J. HART	ASST. MANAGER SRC PROJECTS J.F. PEARSON JR.	PROJECT MANAGER SRC-II	PROJECT CONTROL DIV. W.A. HAMPTON	TECHNICAL DIVISION CARL DI BELLA	ADMINISTRATION	QA/SAFETY
SRC-II PROGRAM EXECUTIVE VICE PRESIDENT S. A. ZAGNOLI	A	C						
DEMONSTRATION PLANT PROJECT VICE PRESIDENT D.P. LESSIG			1					
DEVELOPMENT VICE PRESIDENT R.A. FLINN	2							
ADMINISTRATION GENERAL MANAGER S.H. BARNES							3	
CONSTRUCTION PROJECT MANAGER				3				
PROJECT CONTROL PROJECT MANAGER G.R. PASTOR					3			
TECHNICAL COORDINATION PROJECT MANAGER						3		
ENGINEERING PROJECT MANAGER W.S. BONNELL						3		
QA/QC MANAGER								3

A = ADVISORY CAPACITY AND INFORMATION EXCHANGE

C = RESPONSIBILITY AND AUTHORITY FOR CONTRACT CHANGES/MODIFICATIONS

1 = OVERALL RESPONSIBILITY, AUTHORITY AND OFFICIAL DIRECTION OF THE SRC-II DEMONSTRATION PLANT PROJECT

2 = RESPONSIBLE FOR PROGRAM DEVELOPMENT AND COMMERCIALIZATION

3 = SECONDARY INTERFACE FOR INFORMATION EXCHANGE AND GUIDANCE

Fig. 4-3. DOE-P&M organizational interfaces

P&M ORGANIZATION \ DOE ORGANIZATION	DOE-HQ DIVISION OF FOSSIL FUELS PROCESSING	MANAGER OAK RIDGE OFFICE R.J. HART	ASST. MANAGER SRC PROJECTS J.F. PEARSON JR.	PROJECT MANAGER SRC-II	PROJECT CONTROL DIV. W.A. HAMPTON	TECHNICAL DIVISION CARL Di BELLA	ADMINISTRATION	QA/SAFETY
SRC-II PROGRAM EXECUTIVE VICE PRESIDENT S. A. ZAGNOLI	A	C						
DEMONSTRATION PLANT PROJECT VICE PRESIDENT D.P. LESSIG			1					
DEVELOPMENT VICE PRESIDENT R.A. FLINN	2							
ADMINISTRATION GENERAL MANAGER S.H. BARNES							3	
CONSTRUCTION PROJECT MANAGER				3				
PROJECT CONTROL PROJECT MANAGER G.R. PASTOR					3			
TECHNICAL COORDINATION PROJECT MANAGER						3		
ENGINEERING PROJECT MANAGER W.S. BONNELL						3		
QA/QC MANAGER								3

A = ADVISORY CAPACITY AND INFORMATION EXCHANGE

C = RESPONSIBILITY AND AUTHORITY FOR CONTRACT CHANGES/MODIFICATIONS

1 = OVERALL RESPONSIBILITY, AUTHORITY AND OFFICIAL DIRECTION OF THE SRC-II DEMONSTRATION PLANT PROJECT

2 = RESPONSIBLE FOR PROGRAM DEVELOPMENT AND COMMERCIALIZATION

3 = SECONDARY INTERFACE FOR INFORMATION EXCHANGE AND GUIDANCE

Fig. 4-3. DOE-P&M organizational interfaces

SECTION 5
PROJECT MANAGEMENT SYSTEMS

5.1 INTRODUCTION

This section defines the approach that P&M will utilize in managing the work of Phases I, II and III of the SRC-II Demonstration Project. This approach is based on the applicable policies of DOE and P&M, and the contractual commitments between these organizations. The adaptation and implementation of these policies and procedures to the SRC-II Project constitute P&M's Project Management System.

P&M management will implement the policies, procedures and systems outlined in this management plan. These tools provide a system which conveys timely and accurate information to managers and enhances the decision-making process. While these policies and procedures alone will not guarantee that the Project goals will be met, they will provide methods that promote efficient management of the Project work. The policies and procedures explained below will be implemented on an incremental basis and will be tailored to fit planned P&M management control systems. Manual procedures will be implemented initially and followed by computerized systems in appropriate areas. These management policies and procedures will provide DOE with information and data that are necessary to allow DOE to effectively monitor and manage the Project.

5.2 OBJECTIVES OF THE PROJECT MANAGEMENT CONTROL SYSTEM

The purpose of any management control system is to provide information to managers so that they can identify, direct and control the activities for which they are responsible. The management process is one of communications among people engaged in some enterprise. The intent of the project management approach is not to replace human judgment and skill, but rather to enhance them by assuring that the information sent, received, processed and fed back is controlled, conveyed on schedule and is clearly understood by all involved in the process. From this broad purpose comes several objectives and techniques which P&M project management will employ. Each of these is discussed briefly below.

A first priority is to provide visibility of cost, schedule and technical data to responsible managers regardless of their level of responsibility in the Project. The most efficient method which will accomplish this is a tiered system of information. That is, a manager at the lowest level of the Project must have very detailed information on his work in order to manage day-to-day activities. But to merely give the compilation of detail data to higher level managers would be an unnecessary burden. Thus, detailed information is summarized for each higher level of management. This system of tiered information allows managers to develop budgets, schedules and work definitions to the detail appropriate for their respective levels of management.

The visibility provided by a tiered system of information assists project management in controlling the Project. Higher-level constraints, such as schedule milestones, budgets and technical performance requirements, can be imposed on all levels of planning. In order to accomplish the objective of project control, a baseline (schedule, costs and work-scope) of integrated plans will be established and proper authorization will be provided to start, stop or change work.

The tool for integrating the work to be done within the schedule and budget constraints will be the Work Breakdown Structure (WBS), which divides the Project into manageable components by organizing it into a tiered set of related products and services. Using the WBS as a base, detailed definitions of work, integrated with schedules and budgets, will be developed and approved. Once they are approved, they become the baseline for measuring future schedule and budget performance. The WBS will be used to consolidate and simplify the reporting as much as possible. The detailed WBS to be used in this Project is contained in Deliverable No. 12, Volume 3, Appendix B - Project Baseline Plans. Reports to DOE will be made to level 2 and selected level 3 of this WBS.

The WBS system provides a common basis for communications and reporting. In order to monitor progress of the jobs within the WBS, a progress measurement system using the earned-value concept designed by P&M will be used. Using the earned-value method, comparisons will be made between cost and performance, schedule and performance, and current

and forecast budgets. Monthly reports of the project progress using the earned-value method will be prepared for use by P&M and DOE.

In addition to the earned-value system, P&M will use a management-by-exception system to provide assurance that the baseline schedules and costs are being met. Tolerance levels will be created around the baselines to accommodate for small errors in planning and insignificant events. Variances will be examined formally when they exceed the tolerance thresholds on a management-by-exception basis. At that time, causes for variance and potential corrective actions will be documented and assembled for formal reporting to management and to DOE.

The project management approach to be implemented on the SRC-II Project will provide procedures for the following processes:

1. Baseline Planning:
   - Work definition
   - Schedule definition
   - Budget definition
   - Integration of work, schedules and budgets
2. Operating:
   - Authorization and close-out
   - Progress assessment
   - Reporting
   - Variance analysis and corrective action planning
   - Estimates-at-Completion
3. Configuration Management:
   - Design Control
   - Change Control
   - Document Control
   - Document Files

P&M has conducted the planning for definition of work, deliverables, schedules, budgets, manpower, reports, and engineering designs and has begun to develop the procedures for implementing a coordinated project management control system which integrates the project management tools with product-oriented goals.

Stearns-Roger Engineering Corporation (S-R) systems for management control of the Project will be utilized to meet their technical, cost and schedule objectives for the SRC-II Project. These systems will feed performance data on schedule, technical progress, manning and budgets into the P&M project management system. The cost, schedule and manpower plans contained in Appendix B - Project Baseline Plans, Volume 3 of Deliverable No. 12 comprise the baseline against which accomplishment will be measured.

The approach outlined above will form a closed loop of recurring management functions which supply information to operating personnel in the form of workscope, schedule and budget, and feed information back to project management in the form of progress assessment, variance analysis and corrective actions to be implemented. Project management then will use the information as required to adjust the course of the Project.

5.3 MANAGEMENT POLICIES

5.3.1 The Pittsburg & Midway Coal Mining Co.

P&M is a wholly owned subsidiary of Gulf Oil Corporation. Policy guidance to P&M originates with Gulf. P&M is subject to Gulf policies and procedures which are defined in the Corporate Policy and Procedure Manuals. These Corporate requirements will be complied within the SRC-II Demonstration Project.

5.3.2 Corporate Communications and Coordination Committee

It will be the policy of Gulf to provide technical and administrative support to the SRC-II Project. This policy will be implemented through the SRC-II Corporate Communications and Coordination Committee. The Committee will monitor the status of the Project and of all major technical and management questions. The Committee will assure that significant issues are adequately considered at the Corporate level and will make recommendations of appropriate courses of actions to Corporate Senior Executive, GMRC Senior Management, and Project Management. Furthermore, the Committee will assure that Corporate management is cognizant of the human and capital needs of the Project.

The Committee will provide status reports as required to the Corporate Senior Executive and GMRC Senior Management. The Committee will assess, support and take action to facilitate the flow of communications between Gulf and GMRC. The Committee has no authority or responsibility for implementation and control of the SRC-II Project. Such authority resides solely with P&M.

Contractual task responsibilities will reside with organizational departments within P&M. These organizations will serve to direct and manage the Project, assure uniformity of administration and provide interfaces with DOE, S-R and other subcontractors.

5.3.3 Department Of Energy

DOE has given P&M policy guidance through the following document to which the reader is referred:

No.	Title	Date
CR-0001/2	DOE Uniform Contractor Reporting System (VOLUME I)	September 1978

In addition, DOE program management guidelines are delineated in the DOE document Industrial Partner Management Plan (IPMP). P&M's Project Management Plan has been developed so that each topic covered by the IPMP is discussed. Figure 5-1 shows the relationship of subject matter between the IPMP and the P&M Project Management Plan Outline.

5.3.4 Subcontractors

It is the policy of P&M to utilize subcontractors whenever specialized capability, or expertise required. S-R has specialized capability and background in the SRC-II process and will perform engineering services for the Project. Subcontractors to S-R will provide proprietary process technology and expertise to the Project. S-R will integrate these processes into the overall plant designs in conformance with DOE and P&M policies, procedures and objectives. Construction management will be provided by a major subcontractor to P&M.

STANDARD IPMP CONTENTS / P&M PROJECT MANAGEMENT PLAN OUTLINE	MANAGEMENT PLAN SUMMARY	1. INTRODUCTION	2. PROJECT OBJECTIVES	3. DEMO PLANT DESCRIPTIO	4. PROJECT ORGANIZATION	5. PROJECT MANAGEMENT SYSTEM	6. REPORTING REQUIREMENT & DOCUMENT CONTROL	7. PROJECT BASELINE METHODOLOGY	8. GLOSSARY	APPENDIX A - TECHNICAL & COMMERCIAL CONSIDERATIONS	APPENDIX B - PROJECT BASELINE PLANS
1. INTRODUCTION	●	●									
2. PROJECT SCOPE AND DESCRIPTION	●		●	●						●	
3. TECHNICAL ASSESSMENT AND R&D EFFORTS	●			●						●	
4. ORGANIZATION/PERSONNEL	●				●		●	●			●
5. INTERFACE MANAGEMENT					●	●	●	●			
6. WORK BREAKDOWN STRUCTURE, CODE OF ACCOUNTS AND EARNED VALUES	●					●		●			●
7. PROJECT EXECUTION EXECUTIVE PLAN (PEEP)											●
8. SCHEDULES AND MILESTONE DATES	●					●	●	●			●
9. BUDGET, FUNDING AND COST ESTIMATES	●					●					●
10. APPLICABLE CODES AND STANDARDS				●							●
11. QUALITY LEVEL											●
12. CONTROL/SURVEILLANCE	●					●	●				
13. COMMUNICATION AND REPORTING	●				●	●	●				
14. COORDINATION PROCEDURES	●				●	●					
15. IMPLEMENTATION AND MAINTENANCE	●					●					
16. AUTHORITY/RESPONSIBILITY CASCADE	●				●			●			
17. APPENDIX				●				●	●	●	●
18. SUPPLEMENTAL DOCUMENTS				●						●	●

Fig. 5-1. IPMP and PMP matrix

5.3.5 P&M Project Control Summary

P&M is refining its management control policies and procedures that will be utilized in performance of work under Phases I, II and III. These policies and procedures will address both Corporate and DOE guidelines. Additional control policies and procedures that will be developed and implemented are as follows:

- Administrative

  P&M will be responsible for ensuring that all contractual provisions concerning administrative matters are followed.

- Technical

  Control of technical concepts and designs will be achieved by P&M review and application of P&M and Gulf expertise in the SRC-II technologies and other project related technologies. Control procedures for this Project will include review, evaluation and approval of all design drawings, monitoring of task progress and approval of the work performed. Configuration management procedures will be developed to implement these controls.

- Cost

  Cost estimates and baselines have been developed for the Project and will serve as a basis for monitoring cost performance. Manpower utilization will also serve as a basis for monitoring and controlling performance.

- Manpower

  The manpower plans and baselines will serve as the basis for the monitoring and controlling of personnel resources necessary to complete the Project. Personnel assignments and time charges will be monitored. Review systems have been developed to compare actual versus planned manpower expenditures by Project Summary Work Breakdown Structure (PSWBS) element on a monthly basis. These reviews will serve as a means for the effective control of manpower and for assessing the progress of each activity.

- Schedule

  Major milestones, intermediate events and deliverables will be utilized as the basis for monitoring and controlling

project performance. Schedules showing major milestones and intermediate events by WBS element have been prepared under Phase Zero. These will be used as baselines to monitor the work progress on each WBS element.

- Implementation

  P&M will provide manpower in conformity with the contract for completion of its portion of the Project and for direction of the architect-engineer, construction manager and other subcontractors. P&M project management will provide for monitoring, technical input, review and direction of Project activities to ensure that a high standard of technical achievement is maintained.

5.4 BASELINE PLANNING

The SRC-II Demonstration Plant Project will utilize the baseline approach to control the Project. The three major baselines will be definition of work, schedule and budget. These baselines will become the benchmarks for measuring progress on the work to be accomplished.

5.4.1 Work Definition

P&M will use the work definition function to assure that all contractual work has been defined and assigned to responsible organizations. Work definition is an iterative process that will continue as the Project progresses. However, work must be initially defined at least to a level of detail that communicates baseline goals, schedules and budgets to all participants. Deliverable No. 12, Volume 3, Appendix B - Project Baseline Plans contains the initial work definitions and the assigned responsibilities to be used in this Project.

Work definitions will be based on terminal elements of the WBS which describe the work to be done and functions which must be undertaken in order to accomplish the work. WBS elements down to level 4 are graphically depicted on WBS Charts. A WBS Index that lists all WBS elements identified by level of detail and WBS task number has also been prepared. The combination of WBS Index, Charts and terminal element descriptions is called the WBS Dictionary. This dictionary will serve

as the basic document describing the work that must be performed in order to meet contractual requirements. A summary-level WBS Dictionary for Phases I, II and III of the SRC-II Project is contained in Appendix B, Volume 3, Project Baseline Plans.

The Organizational Responsibility Matrix for each phase is also shown in Appendix B (Figure B.2-4). This matrix depicts work to be done along with the responsible organizational element or individual. By placing the work breakdown structure elements, or work to be done, along the one axis and the organizational element responsible for the work along the other axis, work assignments can be made. The responsibility matrix will be used to assign activities throughout the life of the Project. This matrix will be the basis for authorization and control. Subcontractors will also be required to develop responsibility matrices for task and responsibility assignments within their organizations. In the matrix, all major contractual tasks are identified and related to functional groups responsible for completion of tasks.

5.4.2 Schedule Definition

P&M will use the scheduling function to aid in assuring that all work defined in the WBS can be accomplished within the time constraints of the contract.

The scheduling function will result in several levels of schedules, each level providing more detail than the tiers above it. The Control Milestone Network and the Control Milestone Log, shown in Appendix B, represent the key control documents for deriving lower level planning schedules and for maintaining schedule control. The logical relationships between major work activities are shown in the Control Milestone Network (Figure B.3-2). Also, several sequences of work activity have been analyzed for probable critical paths (Figure B.3-24). Intermediate schedules will be constructed with the Control Milestone Network and Control Milestone Log as a basis as for use by task or work managers. To assure that interfaces between departments and participants have been accounted for, network schedules will also be developed. Detail schedules, which will expand the information to include specific activities, will be made for each WBS element identified in the Responsibility Matrix

described in Section 5.4.1 and shown in Appendix B (Figure B.2-4). Other schedules for activities such as long lead procurement and maintenance, and schedules highlighting areas of special interest, will be developed where appropriate.

Two types of milestones are shown on the schedules. Major Milestones define overall project schedule objectives while Controlled Milestones support the Major Milestones.

5.4.3 Budget Definition

P&M will use the budgeting function to estimate project costs and to establish monetary goals for WBS elements. The estimated project costs will form the Contract Budget Base (CBB).

Baseline budgets have been developed from the WBS and schedule, (see Appendix B). A target budget has been developed for each terminal element identified in the WBS. These lowest level target budgets have been summed to equal a budget baseline for successively higher level WBS elements. Each unit of work will thus have its own budgetary baseline against which performance can be compared.

The Performance Measurement Baseline (PMB) will be the sum of WBS element budgets. The PMB will provide the basis for tracking cost and schedule performance by WBS element and organizational unit.

The entire CBB will not be allocated to managers at the beginning of the contract. A portion of the CBB will be reserved by the Project Manager as an internal cost control technique. This portion of CBB is called Management Reserve.

For effort which cannot be, or has yet to be, defined and scheduled, an Undistributed Budget may be held. Undistributed Budget will exist primarily in the early stages of authorized work and will normally be distributed within 30 to 60 days after the work definition is refined.

The budgeting function will incorporate appropriate performance measurement methods to be used by P&M project management in measuring progress. Methods which may be used as appropriate include the Milestone Method in which budgets are assigned to events and credit is accumulated as the events occur, the Percent Complete method which is tied to schedule accomplishment, and Level-of-Effort work which is used for unspecified work.

5.4.4 Integration of Work, Schedules and Budgets

Work, schedules and budgets will be integrated at the working level using the Work Account as a framework. A Work Account is defined as a specific and finite piece of work which is the responsibility of an organizational unit. This is indicated on the Organizational Responsibility Matrix presented in Appendix B (Figure B.2-4). There may be more than one organization assigned to each terminal element; thus, there may be more than one Work Account at the terminal WBS level. The person assigned responsibility for accomplishing a Work Account effort will be called the Work Manager. This person will be the foundation for successful operation of the system. Performance will be measured at the work account level and charge numbers will be issued at this level.

5.5 OPERATING

In order to perform the work, operating procedures will be developed to define work authorization and close-out activities, progress assessment, reporting, variance analysis and corrective action planning, and estimates at completion. These procedures will provide management with the control necessary to manage the application of resources to the work elements.

5.5.1 Authorization and Close-Out Activites

P&M will use the work authorization to provide a control mechanism to initiate and stop work. The authorization process will consist of a formal set of actions documenting the work to be performed and the budget against which costs will be incurred and performance measured. To accomplish this, two types of authorizations will be necessary. The first type approves the planning of work. The resulting work plan will contain the schedule and budget constraints within which the work will be accomplished. Authorization to actually proceed with the planned work will be given after the work plans have been approved and funding confirmed. Charge numbers for specific Work Accounts will be issued at this time. Records of these authorizations will be maintained. Charge numbers will be closed upon completion of a work account. The authorization documents that have been closed will be stamped accordingly. Close-out approval from the Work Manager's supervisor will ensure that

the work planned has been completed and that appropriate documentation has been prepared, distributed and retained in the project files.

5.5.2 Progress Assessment

P&M will use the progress assessment function to provide management and DOE with a realistic assessment of work progress. Impartial assessment will be necessary to cross-check information received from various sources. Schedule status will provide one set of data. Technical review will provide another set of data. Measurement using earned-value methods will provide a third set of data and will verify that schedule and technical review information are compatible. Formal progress assessment for both cost and schedule information will be done monthly in accordance with contractual reporting requirements. Progress will be assessed on an informal basis as often as necessary to ensure proper evaluation.

P&M will also use the progress assessment system to provide information sufficient for each level of management to review and evaluate progress in their area of responsibility. This tiering of information will provide the first line supervisor and upper management with the appropriate level of detail to effectively control the Project.

Each Work Account will have values assigned to both cost and schedule baselines. With these assigned values, it will then be possible to compare budgeted cost to actual cost and baseline schedule to actual completion dates to determine the earned value of any Work Account at any level of the Project.

Acceptable techniques for calculating earned value will include the Milestone Method, the Percent Complete method and the Level-of-Effort method. Earned value will be measured once per month and entered into the reporting system.

5.5.3 Reporting

As plans are created and approved for Work Accounts, the time-phased Performance Measurement Baseline for each Work Account will be entered into the records. Each month, progress will be measured and actual costs collected. Comparisons between performance and cost, between performance and schedule, and between budgets and Estimates at Completion

will be made. Reports will be issued to each Work Manager and will show current status of each Work Account. Schedule status reports will also be issued to the Work Managers. The reports will allow analysis of variance from plans.

5.5.4 Variance Analysis and Corrective Action Planning

P&M will use variance analysis and corrective action planning to provide management with an assessment of why performance differs significantly from plan and what alternative problem solutions exist. Monthly reports will be issued on actual schedule and budget status and all variances exceeding established tolerance levels.

Cost, schedule and Estimate-at-Completion (EAC) variances will be calculated and analyzed. A cost variance is the difference between the budget for completed or in progress work and the actual costs for that work. A schedule variance is the difference between work planned and actual work completed. The EAC variance is the difference between the total budget and the latest EAC. These variances can be expressed in dollars, manpower or percentage terms and unfavorable variances will always be negative. The variances will be calculated on a cumulative Project basis and current fiscal year period.

To ensure that valuable management time is not spent in evaluation of minor variances, tolerance levels applying to both cost and schedule data will be developed. These tolerance levels will be designed to accommodate small planning errors, insignificant events, and negligible fluctuations between actual and planned performance. Management efforts can then be applied on areas of significant variance.

Each analysis will include a review of the cause of the variance, a record of actions taken to correct the variance, and an explanation for any indicated changes in the EAC. Also included in the analysis will be an evaluation of the impact of the variance on other project activites and on the overall project schedule and budget.

5.5.5 Estimate-at-Completion

The Estimate-at-Completion (EAC) will be used on a regular basis to determine budget status. The EAC is defined as the funds expended to

date plus the expected funds required to complete remaining work. EAC may be calculated for Work Accounts, any collection of WBS elements or for the entire Project.

The EAC will be updated periodically to reflect current information. This updating or re-estimating may be required for reasons which cannot be anticipated in advance. For example, extended favorable weather conditions may result in certain construction milestones being met ahead of target dates. Conversely, a problem with terrain, such as discovering an uncharted mine shaft, may cause a deteriorating trend as work falls behind schedule and additional resources are required.

When calculating the EAC it will be necessary to assure that all incurred costs are properly reflected in the actual costs recorded. Then an estimate of work remaining will be made. Such considerations as whether or not the original plan for the work can still be accomplished, rate increases due to postponing of work until a later period, recalculated equipment costs, labor negotiations, resource mix, and so forth will be considered in updating the EAC.

5.6 CONFIGURATION MANAGEMENT

Configuration Management procedures will be developed during Phase I of the Project to manage the plant configuration. These will include procedures for design control, change control, document control and document files.

5.6.1 Design Control

Control of the SRC-II Demonstration Plant detailed design as it develops from the Phase Zero baseline conceptual design will be through: 1) Formal review and approval of design documents by the P&M engineering organization, 2) Formal, scheduled technical reviews of system designs and changes to the physical and functional baseline characteristics with participation by DOE as desired, 3) Informal technical reviews/audits by P&M management and, 4) Conformance to applicable codes and standards in effect at the date of the contract. Design control procedures will be developed in Phase I to define responsibilities and levels of approval authority for configuration changes.

5.6.2 Change Control

Change control procedures for changing physical and functional characteristics, design documents, work definitions, budgets and schedules will be developed during Phase I of the Project. The change control plan will define responsibilities for action, provide procedures for implementation, and designate the authority for control of proposed changes. All proposed changes will be reviewed for cost, schedule and plant configuration impact prior to approval. Due to the developmental nature of the SRC-II Demonstration Plant design, many changes are expected to be processed. In order to direct management emphasis toward significant changes, minor changes, as defined by procedure, shall be reviewed and approved by the lowest possible level of P&M management. Major changes will be reviewed and approved by a Resource Control Committee composed of representatives from P&M and DOE. The exact composition of this Committee will be determined during Phase I.

Revisions to work plans and schedules which affect budget and cost may occur only from contractual changes, DOE redirection within the scope of the contract, replanning activities authorized by the Project Manager, or they may be requested by the Work Manager to reflect changes in the scope of his Work Plan. In all cases, changes will be controlled and documented in a way which will preserve the Project baseline for assessing progress.

5.6.3 Document Control

During Phase I P&M will finalize systems and procedures to control the issuance of design documents including approved changes thereto. Design documents are those drawings, specifications, etc. that prescribe the physical and functional characteristics, design, construction and operation requirements of the SRC-II Demonstration Plant.

These systems and procedures will assure that design documents including approved changes are approved for release by authorized personnel and are distributed to and used at the locations where the design, construction and operation of the SRC-II Demonstration Plant are performed. These procedures will also include methods for assuring that all approved changes are properly reflected in all affected design documents and that

design document originals and controlled files are maintained under strict control. P&M and all subcontractors will conform to the requirements of these document control procedures. A document control group will be established to implement these procedures.

5.6.4 Document Files

A central file will be established within the Project for use and retention of deliverable documents, correspondence, design documents, reports, project procedures and reference material. A standard filing and index system will be utilized to ensure retrievability of documents.

SECTION 6
REPORTING REQUIREMENTS & DOCUMENT CONTROL

6.1 REPORTING REQUIREMENTS

Reports will be produced by P&M and submitted to DOE on a established schedule. Reports will be completed on a WBS level 2 or level 3 basis depending on the detail required and the desired visibility. Standard DOE forms and format will be used when appropriate.

6.1.1 P&M REPORTS

The following reports will be prepared by P&M and presented to DOE at the frequency listed:

TYPE OF REPORT	FREQUENCY*
Management Plan	A
Milestone Schedule & Status Report	ACM
**Cost Plan	AC
**Manpower Plan	AC
Cost Performance Reports (Formats 1-5)	M
Work Breakdown Structure (Format 1)	M
Organizational Categories (Format 2)	M
Baseline (Format 3)	M
Manpower (Format 4)	M
Problem Analysis (Format 5)	M
Manpower Management Report	M
Conference Record	R
Hot Line Report	R
Contract Funds Status Report	Q
Notice of Energy RD&D Project (SSIE)(Form DOE 538)	AC

Technical Progress Report	MA
Topical Report	R
Final Technical Report	F

*FREQUENCY CODES

F-Final	M-Monthly
A-Annually	C-Change in Agreement
Q-Quarterly	R-Only When Required

**-May be replaced by submittal of performance measurement baseline logs during Phase I.

6.1.2 Subcontractors

P&M will require subcontractors to submit data and reports in a timely and appropriate format for integration into P&M reports to DOE. Criteria for imposition of reporting requirements upon subcontractors will be in accordance with the Uniform Contractors Reporting System (UCRS) guidelines. This requirement will apply to both routine reports and any nonroutine reports requested by P&M. Standard DOE forms will be used where applicable. Regular reports that will be required include Milestone Schedules and Status Reports, Cost Performance Reports (Formats 1 - 5) and Contract Funds Status Reports. Monthly reporting will be required for cost and schedule reports, and quarterly reporting will be required for funds status. Technical and other reporting requirements will be determined at a later date.

The Architect-Engineer, Stearns-Roger, will submit monthly reports to the third level and to the fourth level of the WBS as required by P&M. Construction Manager reporting requirements will be determined at a later date.

6.2 DELIVERABLE DOCUMENTS

Phase Zero Deliverable Documents have been described in the Phase Zero Management Plan issued December 8, 1978. Deliverable documents for

Phase I and a conceptual listing for Phases II and III are listed in Appendix B. Detailed lists for Phases II and III will be developed during Phase I.

6.3 PLANS TO BE DEVELOPED

The following outline summarizes the types of plans that will be developed by P&M during subsequent phases of the Project:

A. Project Control Plans
    1. Contingency
    2. Project Control/Coordination
    3. Quality Assurance/Quality Control
    4. Principal Subcontractor Plans
    5. Configuration/Management Plan

B. Human Resource Plans
    1. Manpower Acquisition
    2. Training
    3. Project Staffing
    4. Organization

C. Environmental Plans
    1. Environmental Analysis
    2. Health and Safety
    3. Community Relations

D. Operational Plans

E. Supplemental Plans

Final copies of agreed-upon plans will be included in subsequent updates of the PMP.

SECTION 7
PROJECT BASELINE METHODOLOGY

Control of the SRC-II Demonstration Plant Project during planning, design, construction, start-up and operation requires the establishment of baseline controls. This section defines the methods which have been used in developing these controls. These controls consist of baseline plans for work descriptions, schedules and budgets. The WBS serves as the baseline description of contractual work and as the basis for development of the project schedules and costs. The baseline WBS work descriptions, schedules and cost plans for the Project have been developed to be consistent with the methodology described below. Deliverable No. 12, Volume 3, Appendix B - Project Baseline Plans contains summaries of the baseline plans for work, schedule, cost, manpower and deliverables.

7.1 WORK BREAKDOWN STRUCTURE

The WBS assures that contractual work has been defined and assigned to responsible organizations. The WBS is a product-oriented display of hardware and services which defines all work to be accomplished over the life of the Project. The total scope of work is divided and subdivided until basic work elements are obtained that describe basic units of work. Each WBS block or element is defined as completely as possible in terms of technical content, work to be performed and cost elements to be included. A graphic display of the Project Summary WBS which has been developed by P&M during Phase Zero is shown in Appendix B. The collection of WBS element descriptions is referred to as the WBS Dictionary and the list of the element titles is known as the WBS Index. WBS element descriptions, index forms and chart are shown in Appendix B.

The WBS describes the work to be performed by all organizations including P&M, Stearns-Roger, the construction manager, vendors, subcontractors and other Gulf organizations. The WBS will function as an evolutionary tool throughout the Project as it changes to reflect refinement of project requirements.

The WBS is product oriented in that it specifies the hardware and services necessary to complete the SRC-II Demonstration Project. All project participants have classified and segregated their work into the appropriate elements. Schedules and costs have also been developed by WBS element by the various project participants. Complete integration of the work, schedules and costs can be attained for the total Project by utilization of this approach. P&M will maintain and control the overall Project with each participant providing lower level services and hardware in conformance with the WBS. Individual Contract Work Breakdown Structures (CWBS's) will be developed by each subcontractor and submitted to P&M for approval. The CWBS, in conjunction with the P&M WBS, will comprise the total integrated project WBS to be utilized for project control.

The WBS also reflects an operational point of view and contains eight level 2 elements. The first four level 2 elements are technical in nature and pertain to the physical plant. The last four elements are managerial and service-oriented in nature and include Technical Services, Operations, Project Management, and Market and Business Development. The Conceptual Plant Design and the P&M management approach served as guidelines in developing the WBS.

7.2 SCHEDULES

The Demonstration Plant Project is controlled by one overall schedule which contains the activities of DOE, P&M and the subcontractors. Several different formats have been used by P&M to present the schedule information. These include milestone schedules, network diagrams, long lead procurement schedules and deliverable data schedules. This schedule information has been developed by P&M and S-R and is contained in Appendix B, along with the methodology and assumptions used in preparing the schedule information.

The major steps in developing the overall schedules were:

- Technical Support and Definitive Data Input Plans
- Engineering and Long Lead Procurement Plans
- Construction and Mechanical Installation Plans
- Establishment of Major Control Milestones

Major project milestones control schedule development, and set time constraints for the entire Project. Any changes in control milestone dates will require approval of DOE and P&M Project Management. The schedules are more detailed for Phase I and less detailed for Phases II and III to be consistent with the work scope descriptions and contract requirements. DOE has set the key major milestone to be completion of construction by December 1, 1983. P&M has developed all schedules based upon this December 1983 date; however, scheduled overtime was required in order to meet the December 1983 completion date and there are several potential major factors which could cause the completion date to slip.

The following paragraphs describe the primary formats on which schedule information is presented.

7.2.1 Milestone Schedules

The milestone schedules are structured from the work defined by the WBS and establish a schedule baseline for the entire Project. This provides for the development of a master schedule for WBS level 1 and intermediate schedules for WBS level 2, with detailed schedules developed for lower WBS levels.

These milestone schedules are in bar chart format structured by Phase and by the WBS. These formats summarize both top-down constraints and bottom-up milestones.

7.2.2 Network Diagrams

The scheduling process followed by P&M has been an interactive process in which milestone schedules (see above) and network analysis were both done in order to verify the schedule relationships, identify schedule contraints, specify activity timelines, and define dates for the control milestones. The results of this process has been the development of a summary level network, the Control Milestone Network (shown in Appendix B, Figure B.3-2), and a hierarchy of network diagrams. A network has been developed that relates schedules for WBS elements to determine the preliminary critical path tasks. All schedules include activity time and approval cycles for DOE, P&M and the subcontractors. Approximately 1,000 events have been defined for Phase I, 500 events for

Phase II and 50 events for Phase III. During Phase I, refined schedules will be developed that could yield 3,000 events for Phase I, 5,000 for Phase II, and 1,000 for Phase III. The scheduling function will be computerized during Phase I.

7.2.3 Long Lead Procurement Schedules

To meet the December 1983 construction completion date, phase overlap to allow for long lead procurement will be required. Orders for equipment requiring long lead procurement times must be placed according to the long lead procurement schedule. Long lead procurement schedules detailing all items by process area which require a minimum of six months lead time, have been prepared and are contained in Appendix B (Figure B.3-18). These schedules indicate that equipment and procurement for Areas 11 (Dissolver System) and 54 (Misc. Distribution Systems) are critical in meeting the desired construction completion date. However, DOE approval is required before plant equipment may be purchased in Phase I.

7.2.4 Deliverable Data Schedules

Deliverable data schedules shown in Appendix B (Figure B.3-19) list due dates for reports and design considerations that are critical to the planning, authorization and construction of the Demonstration Plant. These schedules will identify data gaps and project requirements. Some specific items to be included in these schedules are the Design Basis Report, the Definitive Cost Estimate and Construction Bid Packages.

7.3 SCHEDULE ASSUMPTIONS AND CONSTRAINTS

The schedules developed during Phase Zero are based on the construction completion date of December 1983 and some of the major assumptions and constraints are listed below.

1. The Bridging Task effort of Phase Zero and the initial effort of Phase I will result in a Design Basis Report by 3/1/80.
2. Phase I start date is 10/1/79.
3. Detailed design work will start in July 1979 on such items as coal unloading, handling and storage and tank farms.

4. Limited Authority for Phase II (Long Lead Procurement) will be granted by 3/1/80 to allow for purchase of vendor engineering with an option for equipment purchase. Release of request for bids will contain the qualification that funds are not presently available for equipment purchase but are expected to be authorized.
5. The Environmental Impact Statement (EIS) will be issued by 7/1/80.
6. Full authority for Phase II and corresponding fund release for equipment fabrication and site preparation will be obtained by 7/15/80.
7. DOE review of technical and managerial documents will be completed within 30 calendar days after receipt by DOE. In the absence of written disapproval within 30 calender days, approval is to be considered as granted.
8. P&M subcontract awards will be accomplished within:
   a. 90 calendar days for sole source awards.
   b. 120 - 150 calendar days for competitive awards.
9. All proposed changes submitted to P&M by subcontractors will be reviewed and decided on within 30 calendar days after their receipt. When DOE approval is required, the review and decision time will be extended an additional 15 calendar days.
10. No allowance has been made for major modifications resulting from changes in engineering design or construction installation.
11. No allowance or contingency has been provided for major perturbations such as strikes, acts of God, etc.

These schedule assumptions are presented in more detail in Appendix B.

7.4 SCHEDULING GUIDELINES

The primary inputs used to develop the SRC-II schedules and network are:

1. PSWBS presented in Appendix B - Project Baseline Plans.

2. Deliverable No. 1, Demonstration Plant Description (commonly known as the White Book).
3. "White Book" Capital Cost Estimate, rev., dated April 5, 1979.
4. Stearns-Roger Statement of Work for Phase I and CWBS.
5. DOE Uniform Contractor Reporting System, Volume 1, September 1978.

7.5 BUDGETS

Budgets have been established for each WBS element. These budgets will be rolled up to level two and selected level three elements for reporting purposes. The budgeted costs will be time phased to correspond to the Phase I, II and III designation. Actual costs during the life of the Project will be accumulated on a basis consistent with the budgets so that performance and earned value can be measured and reported to DOE.

The cost estimates were developed in November 1978 dollars and were escalated to current year dollars using a 6% per year rate of escalation as requested by DOE. The direct field costs were developed using the S-R Computer-Aided Preliminary Estimating System (CAPES). CAPES uses basic equipment design information and preliminary conditions of service to develop the total installed cost for each piece of equipment through simulation based on a volumetric model technique. Direct field accounts include process equipment, foundations, structures, structural supports, piping, electrical, instrumentation, insulation and painting. The accuracy of the capital cost estimate is thought at present to be ± 20%.

An allowance of indeterminate costs of 18% of total estimated capital cost has been included, however, no allowance factor has been included in the P&M management costs. This allowance is defined as additional funds available to a work element to provide coverage for items not identified in the estimate.

The basis for the cost estimate is the Demonstration Plant conceptual design. Craft, operating and maintenance wages are used which reflect current union contracts and for 45 hour work weeks in the Morgantown area. The total construction labor effort is estimated to require about 11.1 million craft man-hours. This includes installation of all equipment,

materials and support facilities. Stearns-Roger engineering costs were generated from a man hour estimate based on Deliverable No. 1, Demonstration Plant Description. The total estimate includes approximately 2.5 million engineering hours. The total Project cost estimate is comprised of each Project participant's estimated costs by phase and is reported accordingly by WBS element.

SECTION 8
GLOSSARY

8.1 DEFINITIONS

BASELINE: Documented reference base serving as a standard for controlling the design and engineering of the SRC-II Demonstration Plant and the costs and schedules associated therewith.

BUDGETS: Planned expenditures for the total element under discussion, whether it be a Work Account or the entire SRC-II Project. Budgets are not necessarily equal to incremental funding requirements. Budgets will be for the entire length of the element under discussion, and not necessarily for a fiscal year period.

CONTRACT BUDGET BASE: The negotiated contract cost plus the estimated cost of authorized unpriced work.

CONTROL MILESTONES: Secondary milestones which support the most significant milestones, or Major Milestones, in the project cycle.

ESTIMATE-AT-COMPLETION: Direct costs, plus indirect costs allocated to the contract to date, plus the estimate of costs (direct and indirect) for authorized work remaining.

LEVEL OF EFFORT: Support type effort that does not readily lend itself to measurement of discrete accomplishment. It is generally characterized by a uniform rate of activity over a specific period of time.

MAJOR MILESTONES: Significant milestones in the project cycle, representing major accomplishments or decision points.

MANAGEMENT RESERVE: The portion of the contract total allocated budget withheld for contractor management control purposes rather than for the accomplishment of a specific task or tasks. It is not part of the Performance Measurement Baseline.

MASTER SCHEDULE: The Project schedule from contract start to finish with Major Milestones and key decision points indicated.

MILESTONE METHOD: Performance measurement system in which Budgets are assigned to specific contract events and credit is accumulated as the event occurs.

ORGANIZATIONAL REPONSIBILITY MATRIX: The Matrix used to assign organizational responsibilities throughout the life of the Project.

PERCENT COMPLETE: Performance measurement system in which Budgets are assigned to specific time frames on the schedules and credit is accumulated as time elapses.

PERFORMANCE MEASUREMENT BASELINE: The time phased budget plan against which contract performance is measured. It is formed by the budgets assigned to scheduled work elements and the applicable indirect budgets. For future effort not planned, the Performance Measurement Baseline also includes budgets assigned to higher level contract WBS elements and Undistributed Budget. It will reconcile to the Contract Budget Base. It equals the total allocated budget less Management Reserve.

PROJECT MANAGEMENT PLAN: Describes the management methods, control systems, and procedures that will be used by the contractor to perform the effort identified in the contract.

PROJECT SUMMARY WORK BREAKDOWN STRUCTURE: A summary WBS tailored by project management to the specific Project with the addition of the elements unique to the Project. Generally, the PSWBS will identify project elements through the third level.

RESOURCE CONTROL COMMITTEE (RCC): A committee composed of representatives from P&M and DOE. The committee reviews and approves or rejects changes to the contract baseline in accordance with established configuration management procedures.

SCHEDULE MILESTONES: Establishes the contractor's time schedule for accomplishing the planned events and milestones of each reporting category identified in the contract.

SOLVENT REFINED COAL PROCESS: The conversion of solid coal to a liquid in the presence of a solvent and a gas containing molecular hydrogen and at elevated temperatures and pressure in the absence of an externally added catalyst.

SRC-II DEMONSTRATION PLANT PROJECT: All activities carried out pursuant to the P&M-DOE contract, DE-AC05-78OR03055.

UNDISTRIBUTED BUDGET: Budget applicable to contract effort which has not yet been identified to contract WBS elements at or below the lowest level of reporting to the government.

WBS CHART: A graphical display of all WBS elements down to a specified level.

WBS DICTIONARY: Contains descriptions of all WBS elements.

WBS INDEX: Lists the titles of all WBS elements.

WORK ACCOUNT: A specific and finite piece of work which is the responsibility of an organizational unit. Work Accounts are shown as the intersection of a WBS element with an organizational unit.

WORK BREAKDOWN STRUCTURE: A product-oriented family tree division of hardware, software, facilities, and other items which organizes, defines, and displays all of the work to be performed in accomplishing the Project objectives.

8.2 LIST OF ABBREVIATIONS

A/E	Architect/Engineering Firm
CAPES	Computer Aided Preliminary Estimating System
CBB	Contract Budget Base
CPM	Critical Path Method
CWBS	Contract Work Breakdown Structure
DOE	(United States) Department of Energy
EAC	Estimate-at-Completion
EIS	Environmental Impact Statement
FOE	Fuel Oil Equivalent
GMRC	Gulf Mineral Resources Co.
GULF	Gulf Oil Corporation (GOC)
G&A	General & Administrative Expense
IPMP	Industrial Partner Management Plan
LPG	Liquefied Petroleum Gas
ORO	Oak Ridge Operations
P&M	The Pittsburg & Midway Coal Mining Co.
PIRS	Personnel Information and Retrieval System
PMB	Performance Measurement Baseline
PMP	Project Management Plan
PSWBS	Project Summary Work Breakdown Structure
QA	Quality Assurance
QC	Quality Control
S-R	Stearns-Roger Engineering Corporation (SRENCORP)
SRC	Solvent Refined Coal
TPCD	Tons Per Calendar Day, equivalent to 90% of TPSD
TPSD	Tons Per Stream Day
UCRS	Uniform Contractor Reporting System
WBS	Work Breakdown Structure

SRC-II DEMONSTRATION PLANT PROJECT
APPENDIX A
TECHNICAL AND COMMERICAL CONSIDERATIONS
TABLE OF CONTENTS

MANAGEMENT PLAN SUMMARY (Volume 1 of 3)

APPENDIX B PROJECT BASELINE PLANS (Volume 3 of 3)

LIST OF FIGURES

LIST OF TABLES

APPENDIX A
TECHNICAL AND COMMERCIAL CONSIDERATIONS

1.0 BACKGROUND INFORMATION AND DESCRIPTION OF THE DEMONSTRATION PLANT AND ITS DESIGN

1.1 DESIGN BASIS

The conceptual SRC-II Demonstration Plant is designed to process 6,700 tons per stream day TPSD of Pittsburgh seam coal, with the possibility of expansion to a 33,500 TPSD commercial plant. The proposed Plant would be located on a 2,400 acre site on the Monongahela River near Morgantown, West Virginia. The river would be the source of makeup water as well as a means of transporting materials and major equipment. Rail facilities are available and would be the primary method of transportation for Demonstration Plant coal feed and products.

The coal analysis and dissolver yields used for the conceptual design are shown in Tables A.1-1 and A.1-2, respectively. These values are estimates of those which are expected to be obtained since only limited experimental data on Pittsburgh seam coal were available when the design basis was set.

Based on results of the Pittsburgh seam SRC-II experimental program, coal from the "Panhandle Area" has been selected as the design coal for the SRC-II Demonstration Plant. Figure A.1-1 shows the data from P-99 runs which were made near the Demonstration Plant design conditions with "Panhandle Area" coals with four levels of ash content. Design yield points are shown for the Phase Zero Conceptual Demonstration Plant and for the planned definitive design of Phase I. The planned design range of ash content is 9% to 14%.

Data also are plotted on Figure A.1-1 which shows the substantially lower reactivity of coals which are located closer to the Plant site --Blacksville No. 2 and Robinson Run mines. Additional details regarding the Phase Zero and Phase I bases of design are included in the following Phase Zero Deliverables:

Table A.1-1

Coal Analysis Used in SRC-II Demonstration Plant Conceptual Design, Moisture Free Basis

Component	Mineral Matter Basis Wt. %
Carbon	72.6
Hydrogen	5.1
Nitrogen	1.4
Pyritic Sulfur	---
Organic Sulfur	1.0
Oxygen	7.1
Ash	12.8(1)
	100.0

(1) Ash contains 1.6% sulfur, 11.2% mineral matter. Sulfur occurs as FeS_2.

Table A.1-2

Dissolver Yields Used in SRC-II

Demonstration Plant Conceptual Design

Component	Yield, Wt.% Feed Coal
Methane	6.6
Ethane	4.2
Propane	3.3
Butane	1.9
Distillate:	
150°F to 350°F	6.0
350°F to 600°F	17.6
600°F to 900°F	10.0
900°F plus	26.9
Insoluble Organic Matter (IOM)	7.0
Ash	12.0(1)
H_2S	1.6
NH_3	0.5
H_2O	5.2
CO	0.3
CO_2	0.9
	104.0
Hydrogen consumption	4.0
	100.0

(1) Ash contains 0.8% sulfur, 11.2% mineral matter. Sulfur occurs as FeS.

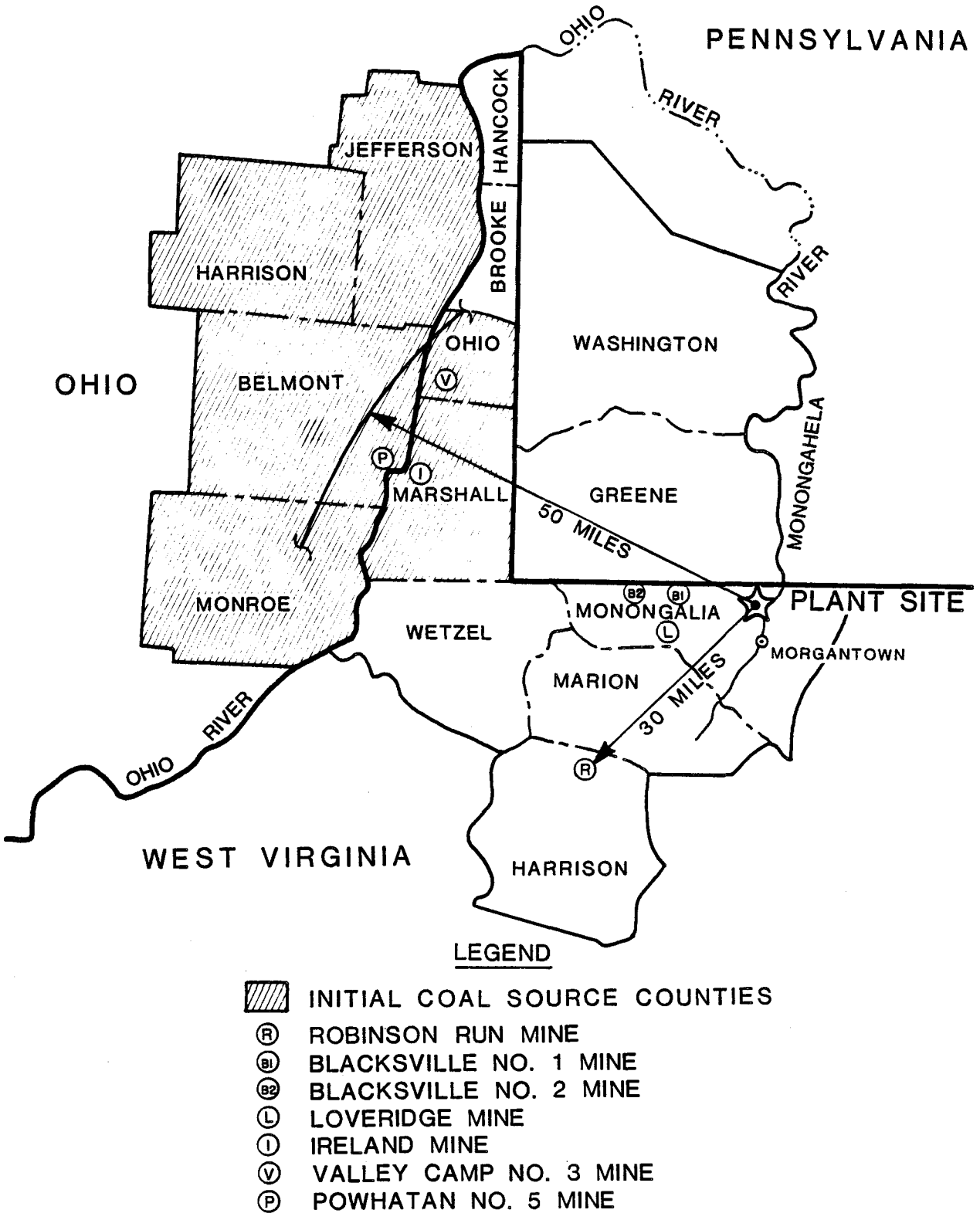

Fig. A-1-1. SRC-II demonstration plant-mines providing coal for SRC-II test program and primary coal source counties

Deliverable No.	Title
1	Demonstration Plant Description
3	Demonstration Plant Supplementary Technical Studies ---Section 2, Raw Material Sources and Section 8, Data Base.

1.2 PRODUCT AND BY-PRODUCT SLATE

The product and by-product slate for the Conceptual Demonstration Plant is shown in Table A.1-3.

1.3 AREA AND PLANT DESCRIPTION

Figure A.1-2 is a schematic flowsheet of the Conceptual SRC-II Demonstration Plant. Coal is received by rail and stored in chevron-type piles in order to provide a uniform coal feed to the Plant. It is recovered from the storage pile and conveyed to the coal preparation area where it is dried and ground. It is mixed with hot recycle slurry, pumped to reaction pressure and then mixed with hydrogen. This coal slurry-hydrogen mixture flows through a fired preheater where it is heated to reaction temperature.

The dissolver effluent goes first to a hot high pressure separator. The liquid (slurry) from the hot high pressure separator, after flashing to lower pressure, is split into two major streams. One of these streams goes to the vacuum flash system while the other comprises the recycle slurry for the process. This recycled slurry, which is unique to the SRC-II process, contains substantial concentrations of ash which is a catalyst for the process.

The hot overhead vapor stream from the high pressure separator is cooled in a series of heat exchangers and additional vapor-liquid separation steps. Water injection is required to solubilize ammonium compounds to prevent their deposition as solids with resulting plugging and possible corrosion. The condensed hydrocarbon liquid from these separators goes to the fractionation system. The noncondensed gas consists of hydrogen, methane and other light hydrocarbons, plus H_2S and CO_2. The gas is first sent to an oil wash tower to remove heavy

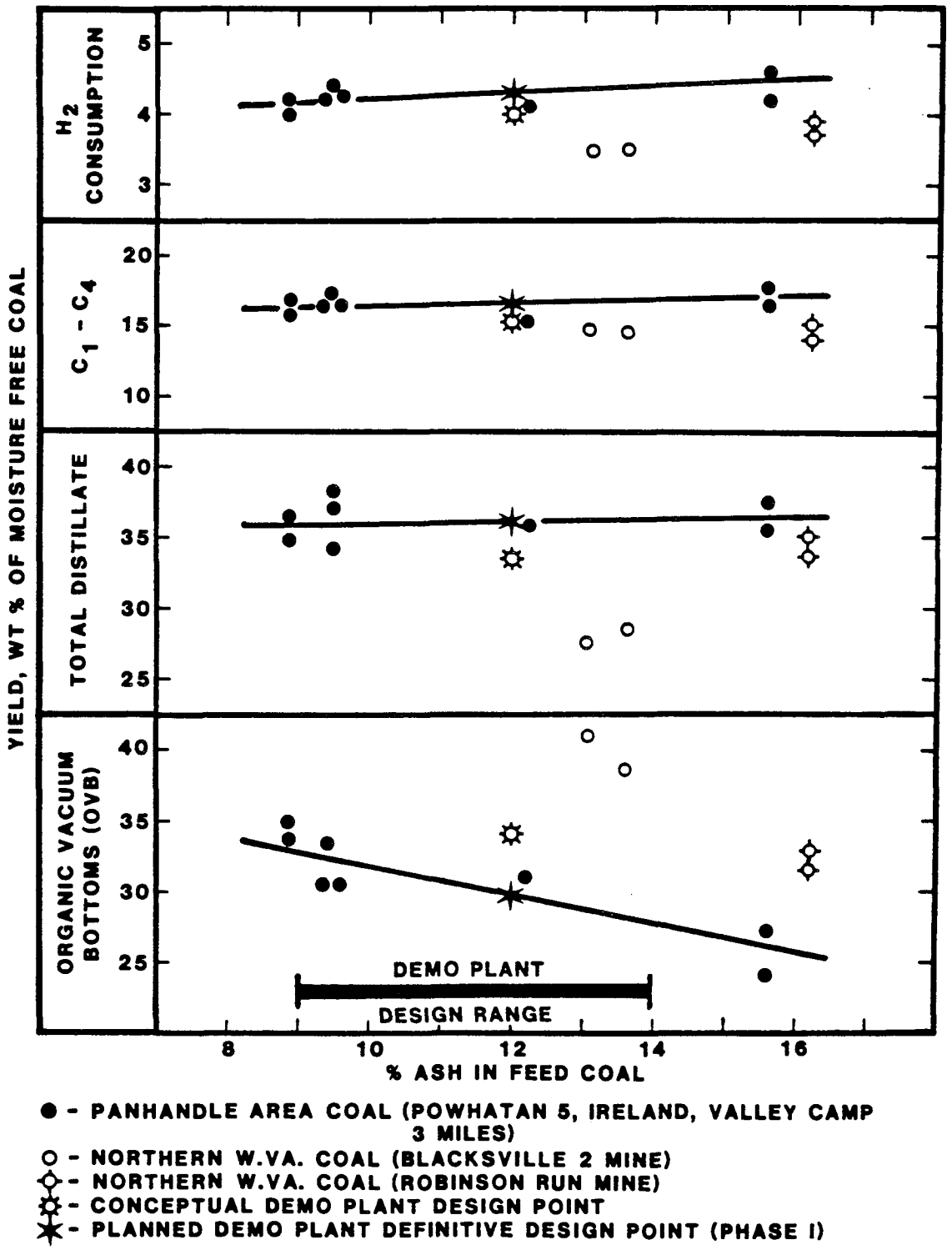

Fig. A-1-2. P-99 SRC-II yields, % of moisture free Pitt Seam Coal near demo plant design conditions

Table A.1-3

Stream Day Production Rates for SRC-II

Conceptual Demonstration Plant

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

hydrocarbons and then to an acid gas treating unit for removal of H_2S and CO_2. The treated gas then is further processed in a cryogenic unit for removal of argon, nitrogen, methane and other light hydrocarbons. The recovered hydrogen is mixed with fresh make-up hydrogen from the gasifier train and comprises the hydrogen feed to the process.

A mixture of methane and ethane recovered in the cryogenic unit is processed through a methanator for sale as pipeline gas, while propane and butane are recovered as separate streams. The H_2S removed in the acid gas treating unit is converted to elemental sulfur in a sulfur recovery unit equipped with a tailgas treating unit to ensure compliance with environmental standards.

In the vacuum flash system, distillate is separated as an overhead product from the high boiling organic components and the mineral residue bottoms. The bottoms stream goes to an oxygen-blown gasifier where the hydrocarbon content is converted to synthesis gas and the ash is converted to slag. The synthesis gas produced in the gasifier is split into two streams. One goes through a shift conversion step for conversion of steam and carbon monoxide to hydrogen and carbon dioxide, then to an acid gas removal step for removal of carbon dioxide and hydrogen sulfide. The hydrogen then is compressed and fed as make-up hydrogen to the preheater-dissolver. The other stream of synthesis gas, the excess of that necessary to provide make-up hydrogen, is processed to remove acid gases and then is used as plant fuel.

The overhead product from the vacuum flash system and the condensed liquid streams from the various flash vessels downstream of the high pressure, high temperature separator are combined and fed to a fractionation system for separation into fuel oil product, naphtha for fuel and a hydrocarbon gas stream which flows to a methanator for conversion to pipeline gas.

The various sour water streams throughout the Plant are combined and processed to remove ammonia and tar acids. The water is further processed, after which the major portion is recycled to the process and the remainder, which contains a high solids content, is incinerated.

1.4 SITE DISCUSSION

Gulf's efforts to identify and select a site for the SRC-II Demonstration Plant which also would be suitable for expansion to commerical-size began in 1975. Since that time, twenty-eight sites have been considered in the states of Indiana, Kentucky, Ohio, Pennsylvania, Tennessee and West Virginia. Many were quickly discarded due to serious shortcomings. More thorough evaluations were made of four sites. Some were rejected due to physical features, geotechnic shortcomings and/or difficulty in purchase agreements. In April 1977, the decision was made to begin acquiring a site about five miles north of Morgantown, West Virginia. Among the factors influencing the selection of this particular site were:

- Proximity to market for liquid product
- On a navigable stream (Monongahela River)
- Adjacent to existing railroad
- Adequate manpower for construction and operation of the plant
- Favorable state government support
- Favorable local business climate
- Adjacent to an existing 1150 MW electrical generation station
- Rural location
- Proximity to pipeline for delivery of product pipeline gas
- Apparent availability at reasonable cost
- No identifiable environmental conditions that would prohibit the construction of either the demonstration or first commercial plant.

The site is bounded on the north by the Pennsylvania state line, on the east by the Monongahela River and the Ft. Martin power station, on the south by the Monongahela River and county roads 53 and 53/2, and on the west by hills overlooking state route 100. The eastern portion of the site is intersected by county road 53. The specific property is outlined on the attached site map, Figure A.1-3. It consists of 2430 acres.

Topographically, most of the site is gently rolling upland lying at an elevation ranging from 1050 to 1200 feet. At the base of the hills,

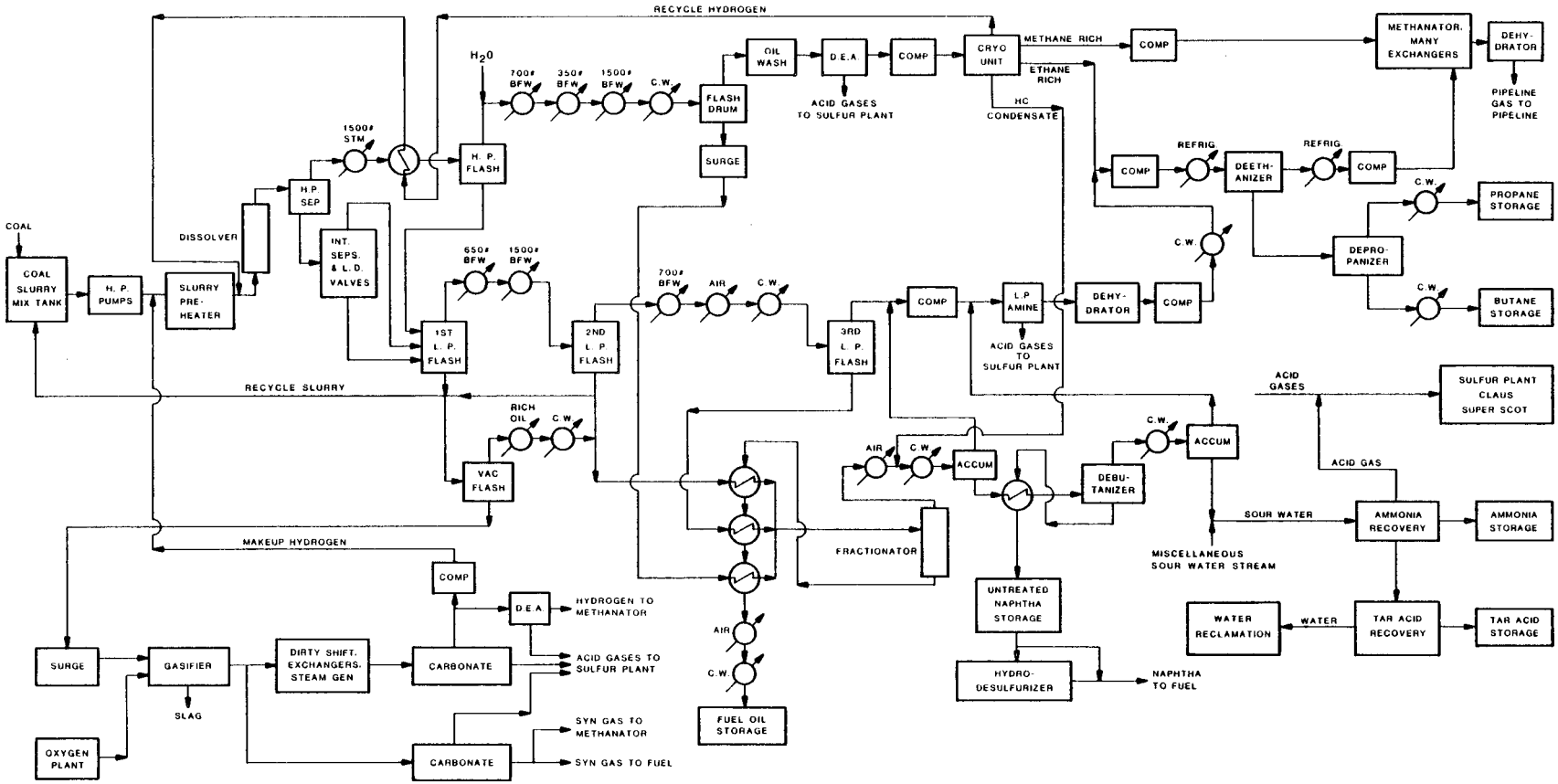

Fig. A-1-3. Simplified flowsheet SRC-II demo plant

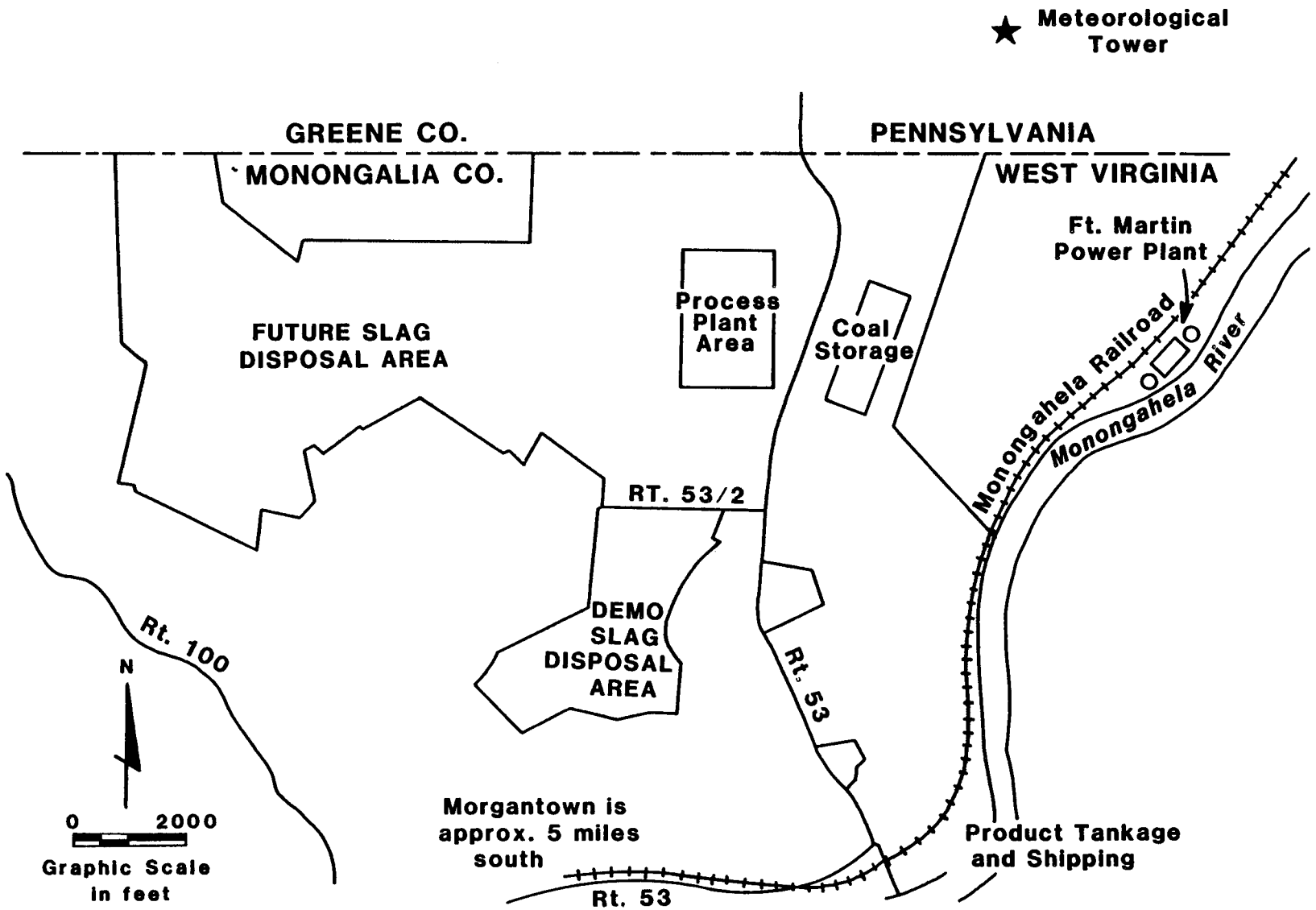

Fig. A-1-4. Proposed site for SRC-II demonstration plant

a narrow strip of river terrace land, generally less than 200 feet wide, parallels the river. A single track of the Monongahela Railway Co. follows this terrace along the west bank of the river. This railroad connects with major lines at Fairmont and Brownsville, both about 30 miles distant to the south and north respectively.

At both the northern and southern ends of the site the alluvial river terrace expands to a width of about 600 feet. The southern terrace will be used for tankage and rail facilities to ship product from the Plant. The Ft. Martin electric generating plant occupies the northern terrace.

The main process area of the Plant is about one mile from the river where the elevation ranges from 1050 to 1150 feet. The plant site will be leveled at an elevation of about 1100 feet. Coal will be stored in the area east of county line road 53 which is between the Plant and the river where the elevation is about 1100 feet.

Slag, the mineral waste from the gasification process, will be disposed of by a landfill operation in gullies west of the main process area.

Also shown on Figure A.1-3 is the location of a meteorological tower which has been in operation since July 1978, monitoring baseline air quality. The tower location is about one mile downwind (northeast) from the main process area of the plant at an elevation of about 1080 feet. The Monongahela River, south and east of the site, is navigable, having a 300 ft. wide channel and a minimum depth of 9 feet. Lock and Dam No. 8, located about 2 miles north of the site, handles 7 million tons of freight (mostly coal) annually, about half its rated capacity. The river flow normally is more than 340 cubic feet per second (cfs). During drought conditions this rate is maintained by the Corps of Engineers through release of water from the Tygart Dam.

Three seams of coal are on the property and have been extensively mined. No interference is indicated relative to the planned location for the Demonstration Plant. More detailed information on the site is included in Phase Zero Deliverable 16, Site Suitability Report.

1.5 COAL SUPPLY

The shaded area on Figure A.1-4 shows the counties from which the primary coal supply is expected to be obtained. As shown by Table A.1-4, the Pittsburgh seam coal production in these counties was 17.8 million tons in 1976. The indicated excess capacity of 14.0 million tons per year should be more than adequate for providing the two million tons per year requirement for the SRC-II Demonstration Plant. Adequate rail facilities are available for its delivery.

More detailed information on coal supply is contained in Phase Zero Deliverable No. 3, Demonstration Plant Supplementary Technical Studies, Section 2, Raw Material Sources.

1.6 ENVIRONMENTAL STATUS AND PLAN

Prior to and in anticipation of a DOE/P&M contract to design and construct the SRC-II Demonstration Plant, Gulf Mineral Resources Co. (P&M), in conjunction with Stearns-Roger, undertook the following environmental tasks:

- Identified applicable federal and state regulations.
- Prepared an environmental and engineering analysis to show probable compliance with regulations.
- Gathered existing applicable environmental data.
- Prepared an environmental baseline program in detail.
- Purchased, installed and initiated operation of a fully instrumented 60-meter meteorological tower and continuous ambient air monitors for all pollutants regulated by a national ambient air quality standard. DOE subsequently leased this equipment from P&M.

After signing of the Contract, a detailed Environmental Work Plan was developed and discussed with environmental personnel from Oak Ridge National Laboratory (ORNL) in August 1978. Throughout the development of the environmental program, close contact has been maintained with personnel from DOE/ORO and ORNL, including site visits, and their recommendations have been incorporated into the program.

TABLE A-1-4

DATA ON "PANHANDLE AREA" PITT SEAM MINES
WITH PRODUCTION EXCEEDING 100,000 TONS PER YEAR EACH.
THESE MINES POTENTIALLY COULD SUPPLY THE TWO MILLION TONS PER YEAR OF COAL
REQUIRED FOR THE SRC-II DEMONSTRATION PLANT
(From Keystone Coal Industry Manual, 1978 Edition)

State	County	Company	Mine	Underground (U) or Strip (S)	Millions of Tons: Annual Capacity Based on 240 Days/Yr.	Millions of Tons: 1976 Production	Yrs. of Reserves at 1976 Production Rate	Present Method of Shipment
W. Va.	Ohio	Valley Camp Coal Co.	No. 1	U	1.4	1.0	10 Est.	Barge, Rail (PC)
W. Va.	Ohio	Valley Camp Coal Co.	No. 3	U	0.9	0.5	50	Rail (B & O)
W. Va.	Marshall	Valley Camp Coal Co.	Alexander	U	0.7	0.4	10 Est.	Barge, Truck
W. Va.	Marshall	Consolidation Coal Co.	Ireland	U	3.2 Est.	1.8	40	Captive to Utility
W. Va.	Marshall	Consolidation Coal Co.	McElroy	U	3.1	1.2	40	Captive to Utility
W. Va.	Marshall	Consolidation Coal Co.	Shoemaker	U	3.2 Est.	1.6	40	Barge
Ohio	Belmont	No. American Coal Co.	Powhatan 1	U	1.6	1.1	25	Barge, Truck
Ohio	Belmont	No. American Coal Co.	Powhatan 3	U	1.6	1.2	25	Barge, Truck
Ohio	Belmont	No. American Coal Co.	Powhatan 5	U	1.1	0.8	8	Barge, Rail (PC)
Ohio	Belmont	NACCO Mining Co.	Powhatan 6	U	2.4	1.4	35	Rail, (PC)
Ohio	Belmont	Oglebay Norton Co.	Saginaw	U	1.1	0.7	25	Rail (N & W)
Ohio	Belmont	Y & O Coal Co.	Allison	U	2.4	0.7	30	Rail (PC)
Ohio	Jefferson	Zimnox Coal Co.	Salt Run	S	0.1	0.1	7	Truck
Ohio	Jefferson	Anthony Mining Co.	No. 43	S	0.3	0.2	6	Truck
Ohio	Jefferson	Boich Mining Co.	Betsy	S	0.6	0.3	10	Rail (N & W)
Ohio	Jefferson	Ohio Coal & Const. Co.	Nos. 36/37	S	0.2	0.2	5	Barge
Ohio	Jefferson	R & F Coal Co.	Rice 6	S	0.3	0.3	10	Rail
Ohio	Monroe	Quarto Mining Co.	Powhatan 4	U	1.8	1.2	30	Barge
Ohio	Monroe	Quarto Mining Co.	Powhatan 7	U	2.0	0.3	30	Barge
Ohio	Harrison	Bedway Coal Co.	Amber	S	0.3	0.3	15	Barge, Rail (N&W)
Ohio	Harrison	Consolidation Coal Co.	Bradford 16	S	0.6	0.4	10 Est.	Rail (PC, N & W)
Ohio	Harrison	Consolidation Coal Co.	Georgetown 24	S	1.4	0.9	10 Est.	Rail (PC, N & W)
Ohio	Harrison	Consolidation Coal Co.	Franklin 125	U	1.2	0.9	10 Est.	Rail (PC, N & W)
Ohio	Harrison	Consolidation Coal Co.	Franklin 65	U	0.3	0.3	10 Est.	Rail (PC, N & W)
			TOTAL		31.8	17.8		

A Meteorological and Air Quality Station has been in operation since July 1978. Eight surface and four groundwater sampling points were selected on the Monongahela River, Crafts Run and Crooked Run. Sampling for terrestrial and aquatic ecology has also been done on a quarterly basis, employing techniques such as mist nets and trapping of small mammals. Special attention has been given to the potential presence of rare or endangered species. The four seasonal groundwater samplings have been completed.

Background levels of noise were measured in January 1979 and June 1979. A report on these findings and assessment of the noise impact of the plant is planned for September 1979.

In the areas of geology and geohydrology, a considerable amount of existing data has been collected. In addition, on-site geohydrology and infiltration studies are being performed in the slag disposal and coal storage areas.

Historical and archeological studies have been performed by the State Archeologist.

P&M has participated with DOE in federal, state and local meetings for the purpose of defining the scope and content of the Environmental Impact Statement.

More detailed information on the environmental activity and status is included in Phase Zero Deliverable No. 14, Environmental Analysis Status Report.

Subsequent to Phase Zero, a continuation of the monitoring program will begin after a thorough analysis of the baseline monitoring data and the latest engineering design information. This program will have as its main objectives the following:

- Elimination of any inappropriate sampling locations or parameters and the addition, if appropriate, of new locations and parameters.
- Continued monitoring of any unusual biotic or abiotic trends if discovered during the baseline monitoring program.
- Monitoring the construction and operation activities, especially as they relate to soil erosion, surface and ground water quality, habitat modification, air quality, and socioeconomic impacts.

- Providing construction engineers with the necessary information as to compliance with appropriate regulations and supplying information on potential significant environmental impacts and the mitigative measures to lessen the severity of those impacts.
- Obtaining available data in an attempt to define the health and ecological effects of the SRC-II process. These data would include both screening and definitive biomedical analyses for mutagenicity, oncogenicity, teratogenicity, and effects on the flora and fauna. The intent of the program would be to provide the basic information necessary for designing suitable controls and an effective industrial hygiene program for the Demonstration Plant.

1.7 TECHNICAL SUPPORT

An ongoing Technical Support R&D Program is recommended for Phases I, II and III to provide basic information needed for design of the Demonstation Plant and subsequent optimization. This work has been included for the Project and is defined in the WBS listed in Appendix B, Project Baseline Plans.

1.8 MODIFICATIONS AND CHANGES

Changes which have been included in the Project Design Phase Zero work are:

- A coal storage revision which results in the replacement of the radial stacker with a long pile stacker-reclaimer. The alternate design expands the storage to 30 days of active from the 12-1/2 day active storage.
- The addition of coal pulverizing and drying system, and a vortex mixing tank in which the pulverized coal and recycle slurry are mixed and fed to the slurry mix tank, plus the addition of a recycle slurry cooling system to heat balance the coal slurry charge stream.
- A revision which redesigns the slurry charge heater. The recycle hydrogen and makeup hydrogen heating services were removed from the charge heater convection section. Two heaters

per dissolver have been added; one to heat the recycle hydrogen, and one to heat the makeup hydrogen.

- A revision to redesign the cold box to handle greater capacities and higher rejection rates to achieve a higher hydrogen purity.
- A fractionation revision to include a rerun tower and the redesign of the vacuum flash system to increase the solvent recovery and eliminate solids contamination of the heavy oil product.

Since "freezing" of the conceptual design for the Phase Zero Deliverables which include the above changes, work has continued in the Bridging Tasks toward defining possible changes to be made prior to the establishment of the final design basis. Among the changes under consideration are:

- Changing to "Panhandle Area" coal for the design basis and changing the dissolver design yields accordingly.
- Increasing the number of slurry pumps to one for each preheater pass to ensure reliable slurry flow control and to make possible the development of high pressure differentials across individual preheater tubes in order to "blow out" an incipient plug.
- Providing additional liquid and slurry surge to improve operability.
- Providing additional cooling and/or dilution for certain storage to alleviate coke formation and viscosity growth.
- Replacing as much naphtha as practical as plant fuel with synthesis gas and utilizing the naphtha as a plant product.
- Eliminating synthesis gas feed to the methanator to improve controlability.
- Increasing naphtha HDS severity to produce reforming grade naphtha.
- Replacing the two 100% gasifiers (one onstream and one standby) with three installed 50% gasifiers, with possibly an uninstalled shell which can be relined at a remote location. This modification will decrease the potential of total loss of hydrogen production and will provide more operating flexibility during startup, shutdown and reduced rate operations.

- Replacing the diethylene glycol dehydration of pipeline gas with the Dow Dn30 process.
- Replacing the one 100% oxygen plant with two 50% plants to provide insurance against total loss of oxygen and, thus, of synthesis gas production.
- Replacing the hot carbonate acid gas removal system with Selexol to improve the selectivity of H_2S removal. This would provide a more desirable feed to the sulfur recovery plant and reduce the cost of the overall sulfur removal and recovery facilities, but may decrease operability.
- Expanding the solvent flushing system based on the needs developed at the Ft. Lewis Pilot Plant.
- Providing chemical cleaning facilities to prevent polythionic acid and chloride attack on austenitic stainless steel piping and vessels during maintenance.
- Replacing the single gas purification and cryogenic system with two - one for each dissolver train.

It will be necessary to make additional modifications and changes as work progresses to bring the Conceptual Demonstration Plant design to a final design basis.

2.0 MARKET ANALYSIS AND DEVELOPMENT

Market analysis activities for Phase Zero have had as their objective a preliminary overview and investigation of applications and market segments for which SRC-II fuels might provide alternatives for current petroleum uses. These studies have explored, in a conceptual manner, how the spectrum of distillates and light hydrocarbons recovered from the conversion of high-sulfur bituminous coal with the SRC-II technology might best be economically and readily utilized in utility, industrial, transportation and chemical applications.

During Phases I and II of the SRC-II Project, these various marketing opportunities will be investigated on a more definitive basis. This will include the application of raw hydrocarbon product from the SRC-II technology for fuel and the potential for up-graded products particularly suitable as transportation fuels. Emphasis will be placed not only on economic competitiveness but also on environmental acceptability, ease of physical product acceptance in a particular application and applicable testing in the area of product acceptance standards including the need for development thereof. Emphasis will also be placed on investigating requirements for engine modifications, alteration to engine control systems, and on refinery process configuration modifications to improve product yield quality and competitiveness. A major report of market segment opportunities and product development status will be completed and submitted to DOE.

These studies will be broader, however, than just a technical and economic evaluation of the products from SRC-II coal refining. Additional activities will include the education of customer groups and engine manufacturers concerning product technology and the various product applications, including the development of specification acceptance testing procedures and other relevant standards applicable to proper product definition. Contractual selling methods related to transportation and product disposition requirements will be addressed. Applicable regulations and handling provisions will be identified, as appropriate, along with the assembly of relevant analytical and physical data to provide a basis for determination of regulatory requirements and standards.

Process design and economic studies will be conducted for the purpose of evaluating product up-grading requirements and the suitability of intermediate feedstocks for conventional and nonconventional refinery application. Geographical factors will be systematically evaluated with particular attention to raw material sources, market centers, transportation methods and economics so as to identify site location regions for maximizing the coal refining competitive position.

The market development and analysis studies described above that would be conducted during Phases I and II will involve close interaction with end-user firms and associations, engine manufacturers, academic institutions engaged in developmental activities, and with government agencies, particularly DOE. These various programs, ranging from fundamental work to major field prototype tests, will involve coordination and participation to the extent necessary to maximize the understanding for the most appropriate use of products to be derived from SRC-II coal conversion. Included will be recommendations to DOE for managing the disposition and utilization of products to be derived from the demonstration facility and those available from the pilot facilities of P-99 and the Pilot Plant in Ft. Lewis, Washington.

Successful pursuit and accomplishment of these market analyses and development activities will not only enable DOE to assess the opportunity for coal liquids to best serve the national interest, but also to assess the strategic impact of providing a viable alternative to current uses of petroleum. It will also enable DOE to continue to assess and guide the direction of the demonstration program to achieve these ends in the most expeditious and efficient manner. Reports on these activities will also enable industry and consumers to prepare for the use of the products of coal liquefaction in a timely and nondisruptive manner.

Figure A.2 - 1 shows a conceptual summary of the products, both raw and upgraded, that can be expected from the refining of high-sulfur bituminous coal with the SRC-II technology. Figure A.2 - 2 shows a summary of the relationship of the intermediate and final products that can be derived from the SRC-II conversion process and their relative impact in displacing, augmenting and replacing products of petroleum

refining. Figure A.2 - 3 summarizes conceptual marketing direction for coal liquids as viable alternatives to refined petroleum products with various end applications.

In summary, the activities of the market analysis and development task will involve the pursuit, assessment and preparation of the industrial and commercial infrastructure to support the commercialization of coal conversion.

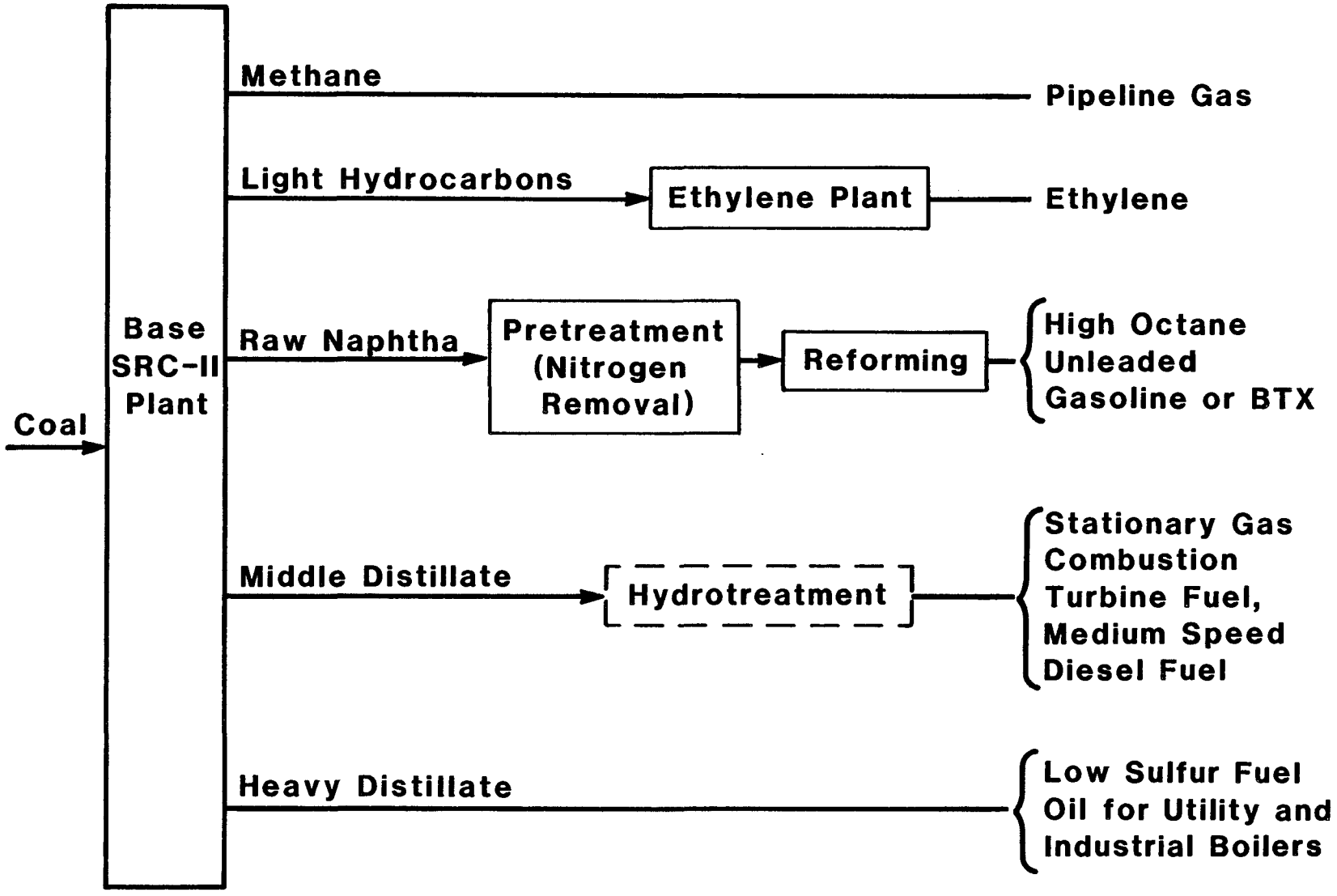

Fig. A-2-1. Products from conceptual commercial SRC-II plant

From the SRC-II Plant		Impact on Petroleum Refining and Marketing	
Raw Production	Final Product	Substitution & Displacement	Available Refined Products
Methane	Pipeline Gas		
Syngas	Chemicals, High Cetane Diesel Fuel	Diesel	
Light Hydrocarbons	Ethylene	Petroleum Naphtha & Gas Oil Feedstocks	Gasoline
Naphtha	High Octane Unleaded Gasoline		
Middle Distillate	Medium Speed Diesel Fuel Stationary Gas Combustion Turbine Fuel	Substitute for No. 2 Fuel Oil	Home Heating Oil Aviation Turbine Fuel Automotive Diesel Fuel
Heavy Distillate	High Quality Boiler Fuel	Displacement for No. 6 Oil	Gasoline No. 2 Fuel Oil

Fig. A-2-2. SRC-II coal liquifaction supplying petroleum product markets

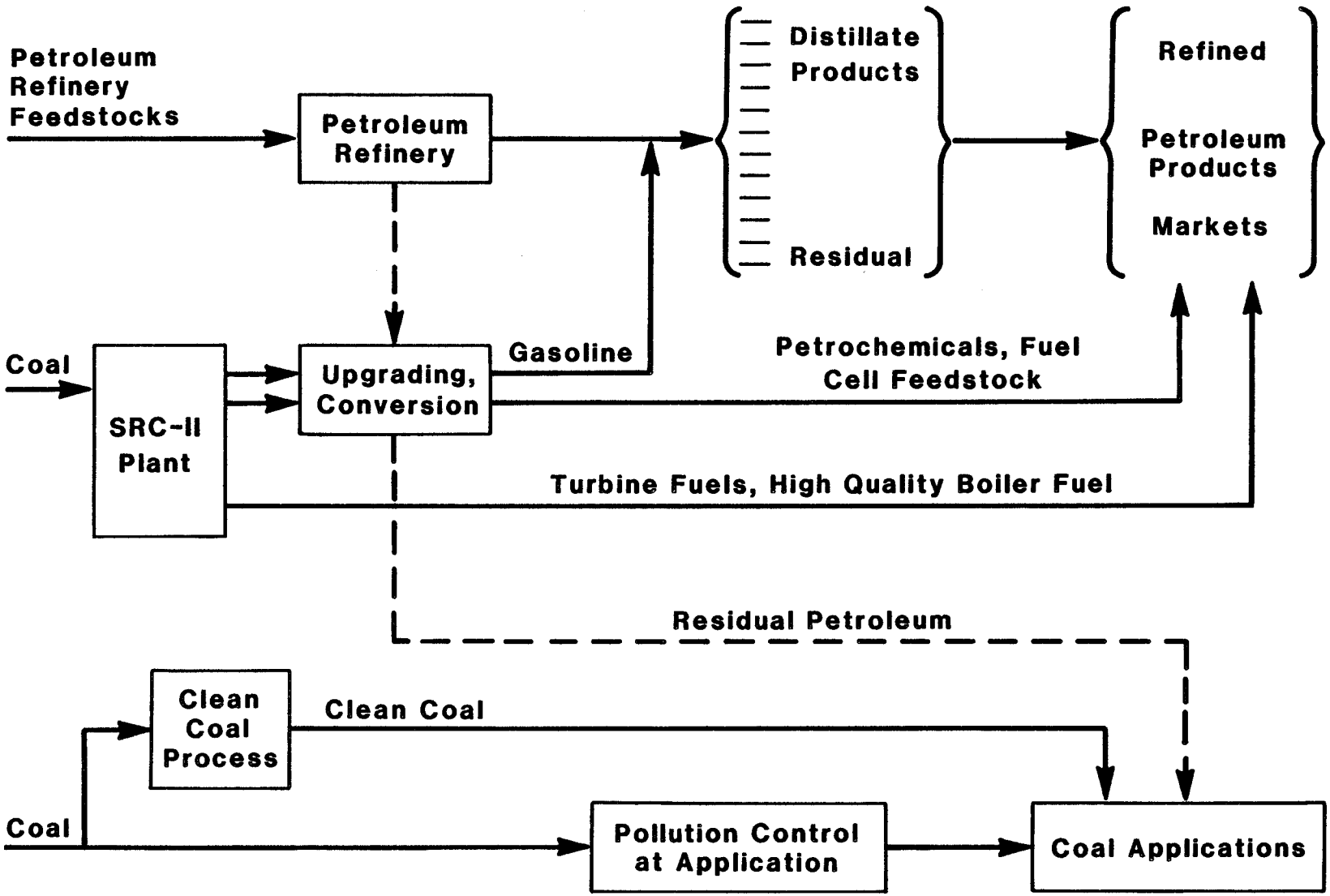

Fig. A-2-3. Market directions for SRC-II coal liquids

3.0 ECONOMIC EVALUATION

In Phase Zero an economic analysis of the conceptual commercial grass roots plant cost estimate was performed to determine the required selling price for coal liquids from a commercial SRC-II plant to provide a 15% rate of return on the investor's equity. This simplistic analysis for the conceptual commercial design is useful in addressing the question, "Will coal liquids from SRC-II be competitive?". The analysis indicates that if the demonstration program is successful and commercial growth occurs as projected, coal liquids in general should be available at prices in the order of $25 per barrel (expressed in 1978 dollars).

This economic analysis effort, while significant, falls far short of that required to prepare for a commercial business following a demonstration program, or in identifying where economic incentives exist. During Phases I and II, economic evaluations will be conducted on the design and estimates for both demonstration and commercial schemes in order to provide more accurate evaluations and feedback to those design activities where economic incentive for development modification and process improvement is indicated. These evaluations will be performed at several levels.

The complete investment analysis for both the demonstration and commercial plant will be conducted during Phase I, reflecting the definitive design basis and estimate. During Phase I, sensitivity studies will be performed to determine the incentive for pursuing 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 to evaluate not only the competitiveness of coal liquid products on a commercial scale, but also to evaluate the different processing schemes in the commercial plant taking into consideration their environmental effect on capital and operating costs, reliability, operability, maintainability and safety.

A major part of the work will be to conduct process economic studies. These involve assessing the incremental economics of further upgrading coal liquid products into transportation fuels and chemicals. The

results of these evaluations will not only provide direction for the development program, but identify the incentive for process development and experimental programs to further define and prove the potential for producing high value transportation fuel products from coal liquefaction. In addition, evaluations of financing approaches to capital formation, leveraging, project financing, and financing through product sales will also be examined during Phase I.

Market development as described in the preceding section involves working with engine manufacturers to determine and develop the modifications required for engines to utilize coal liquid fuels. The economics of these engine changes must be related to the economics of further refining of coal liquids to meet existing engine requirements. These systems economic evaluations will be conducted in parallel with the market development program during Phases I and II.

Finally, systematic evaluation of the economic optimization of siting coal refineries represents another task that will be performed during Phases I and II. This involves an assessment not only of the cost and economic consequences of raw material and finished product dispositon and transportation, but also the resource constraints that may impinge upon commercial growth of the coal liquefaction industry. It will include an evaluation of major materials, goods and services, and the industrial infrastructure if necessary, to sustain rapid expansion of the coal liquefaction industry. It will also address where economic incentives may be necessary in the areas of material, supply, fabrication, capacity, labor resources and coal production to achieve certain levels of coal liquids production within given time frames.

Economic evaluations of the Demonstration Plant itself provide an indication of the relative diseconomy of the first coal liquids production facility compared to a future commercial size SRC-II refinery and thus provide an indication of the potential for cost reduction and learning that is provided through the Demonstration Project. Economic evaluation of the Demonstration Plant will also provide, when considering all cost factors and revenues through anticipated product sales, a revised indication of the cash flow and cost performance of the Demonstration Plant on a current basis.

4.0 TECHNOLOGY TRANSFER

Projects such as the SRC-II Demonstration 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 to the public via the Freedom of Information Act. Further, P&M will continue its current practice of discussing the Project and the SRC-II Process regularly at various public technical meetings. In addition, through the written Project reports, reasonably open facilities, and participating sub-contractors, the SRC-II technical know-how will become widely understood.

It is therefore anticipated that, if the Project is successful in demonstrating the technical and economic feasibility of SRC-II, many qualified firms will be able to engineer, build and operate plants in the United States.

Further, P&M (and Gulf) has agreed to license its proprietary data and background Patents at reasonable terms and conditions to responsible U.S. third parties to further aid the spread and commercialization of this technology in the United States.

In addition to the government-owned SRC-II technology, P&M and Gulf have a substantial amount of proprietary background technical information they are contributing to the Demonstration Project. P&M and Gulf have agreed to deliver such proprietary information to DOE, at DOE's request, at the completion of Phase I.

In order to aid the Government in its goal of maximizing commercialization of the SRC-II process technology in the United States, and to enable the U.S. Government to offset a portion of its R&D expenditures by receipt of licensing revenues from its patent rights in the United States, P&M proposes to act as the Government's exclusive agent in the licensing of the SRC-II process technology and DOE patent rights in the world. Licensing royalties in the United States - net of licensing expenses and fees for technical assistance - would be shared by the U.S. Government and P&M. The licensing under Government patent rights would,

of course, be in conjunction with commercial licensing of an SRC-II process technology package, including Contractor's Background Patents and proprietary technology.

5.0 EXPANSION TO COMMERCIAL

P&M's plan for the expansion of the 6,700 TPSD Demonstration Plant to a full-sized 33,500 TPSD commercial plant is contingent upon world market and economic events. Trends in the market place and the world economic picture will be monitored during the Demonstration Project. If conditions favor commercial use of coal liquids, P&M may then request the Government to negotiate the purchase of the Demonstration Plant.

5.1 BACKGROUND INFORMATION

Expansion to commercial size consists of adding multiple trains of equipment to the Demonstration Plant. Where commercial train capacity is different from that in the Demonstration Plant, equipment will be re-sized for cost estimating. Increases in equipment sizes will be checked with vendors to make certain that they can be built at the time of plant construction. The expanded plant described in this document provides a representative description for expanding the plant to commercial size. Greater detail is provided in Deliverable No. 7, First Commercial Plant Description and Cost Estimate.

The philosophy to be followed in design of the expansion facilities is to scale up by employing additional processing trains or by using processing technologies similar to those installed in the Demonstration Plant. Areas similar in process configuration to the Demonstration Plant will be scaled up directly without extensive re-evaluation.

Discussions were held with some of the process licensors of proprietary systems to define criteria for the expanded first commerical plant. This information was then used by Stearns-Roger to prepare the designs and performance estimates for those proprietary processes. These include the mineral residue slurry gasification, shift conversion and methanation, SUPERSCOT gas treating, and cryogenic hydrogen purification.

Process changes to the Demonstration Plant systems will be made to present more representative designs and costs for the expanded first commercial plant. These changes anticipate that the Demonstration Plant operation will prove the technical processes and allow a more optimistic

commercial design. A revised plant fuel use basis will be applied and measures will be taken to reduce the relative plant water consumption.

The commercial design will include several equipment services that are not currently commercially proven. For example, the dissolvers are large, thick-walled vessels which would today present some design and fabrication problems. Some compressor and pump services are also beyond the present state of the art. These items will be included in the design because their successful development is expected by the time the expansion construction commences.

5.2 EXPECTED MARKETS

The markets for the SRC-II products which will be produced in the expanded commercial plant are expected to be the east coast utilities and industry, although refining to gasoline is a possibility.

5.3 DISTRIBUTION MECHANISMS

Transportation of SRC-II fuel products is planned to be by railroad tank car, pipeline, and barge. Small quantities may be transported by tank truck where appropriate.

5.4 SCHEDULE AND COSTS

Present plans indicate that the Demonstration Project should conclude in the late 1980's. Prior to this completion date, detailed design and engineering of the expansion to commercial could be undertaken. This might commence as early as 1985. Construction on the additional trains to the plant could then begin in the late 1980's.

The direct capital costs for the commercial expansion have been estimated using the Stearns-Roger CAPES computer cost estimating program. This program uses basic design information to develop purchased equipment costs and volumetric modeling to generate installed equipment costs. These models are used to produce appropriate takeoffs for bulk materials. Piping, foundations and structures are determined as well as labor requirements for installation. Estimated costs of the additional 26,800 TPSD expansion of the Demonstration Plant to commercial size are as follows:

	November 1978 $
Direct Capital Costs	1,395,000,000
Indirect Capital Costs	95,185,000
Estimated Total Capital Costs	1,490,185,000
Estimated Total Annual Operating Costs (Without Plant Overhead)	128,210,000

The accuracy of the direct capital cost estimate, with an 18 percent contingency included for errors and ommissions, is in the range of ± 20 percent.

5.5 CONSTRAINTS TO CCOMMERCIALIZATION

Some of the possible impediments to successful commercialization, which will be extemely important in determining whether to proceed to commercialization, are discussed below:

Technology Risk

Although the SRC-II process is the most advanced of the coal liquefaction processes currently under development, the technical risks of the Project remain significant due to the complex nature of the Plant, the large scale-up factor and its pioneering nature. Additional technical problems which are not part of the SRC-II process itself may result from process steps required for the Project. Integration of the various process steps, which is an important part of the Project, increases these technical risks appreciably.

During Phase I of the Project, it is expected that these technical risks will be reduced by engineering and development work, but will not be eliminated. The mutual decision to be made by DOE and P&M during the early part of Phase I to proceed with the Project will be based, among other things, on an assessment of the technical risks remaining. Only if the combined technical risks involved in the Project are mutually acceptable should the demonstration proceed, and ultimate commercialization be undertaken.

Energy Events

The economics of the energy situation that will develop in the 1980's is one of the least predictable but more important factors that could impede or augment the commercialization of synthetic fuels. The prices of petroleum, natural gas, coal and other energy sources relative to SRC-II costs, along with the availability of each, will play a major role in determining when synthetic fuels from SRC-II will become commercial. Technical success of the Demonstration Project is a prerequisite for commerical success, but successful commercialization will only result if the aggregate product costs, including return on capital, are competitive with the prices of other fuels.

Utility Participation

An important aspect of the Project is the proposed purchase and use of the fuel products from the Demonstration Plant by the utility industry. Long-term testing of the liquid fuels in commercial facilities by utilities is an important part of the Demonstration Project. DOE is working with electric and gas utilities to have them buy the liquid and gaseous products at prices which are expected to be at a premium above the current market price for comparable petroleum and natural gas fuels.

Mining Regulations

Increasingly restrictive mining regulations are causing substantial increases in the cost of producing coal. Continuing efforts to tighten regulations will further decrease productivity, increase cost and aggravate the current shortage of skilled labor. In recently issued versions of the Surface Mining regulations, attempts have been made to extend their applicability to underground coal mines by regulating surface work, subsidence and other surface effects. Should this trend continue, the cost of coal could rise to such a point that the economics of coal liquefaction would be unattractive because of raw material costs, even though a high process efficiency may be achieved.

Infrastructure

The existing engineering, fabrication facilities and raw material supply are adequate for constructing and operating the Demonstration Project. A 6,700 TPSD Demonstration Plant will require about two million tons of coal per year, which is comparable to the total output

of one of the larger Appalachian bituminous mines. A 33,500 TPSD commercial plant would require the total output of about six such mines operating without interruption. Production and delivery to a commercial plant of such a quantity of coal will require extraordinary transportation, handling and storage provisions. The complexities of producing and delivering this volume of coal need to be thoroughly studied and resolved during the Demonstration Project if full-scale commercialization is to follow.

Commercialization on a multi-plant scale would severely strain the capabilities of the qualified engineering, fabrication and construction industries. Earlier analyses by P&M indicated that, if it were desirable to install ten coal liquefaction plants of 33,500 TPSD capacity each (a total of about 1,000,000 equivalent barrels of fuel per day), bottlenecks could develop not only in coal mining and delivery but also in reactor fabrication, compressor availability, oxygen plant construction and capital funds. These and similar constraints pose potential limitations on the rapid commercial expansion of Demonstration Project results. Further analysis is required to foresee and minimize such potential bottlenecks.

Demonstration Site

The SRC-II Demonstration Project is now planned to occupy a site in West Virginia which is also expected to be adequate for subsequent commercialization. Of the physical attributes of the site, only water availability appears now to be a potential impediment to commercialization, although others could develop as the Project proceeds. Environmental approval of the site is an important early goal of the Demonstration Project and must be accomplished on schedule to avoid delay and the resulting cost increases.

Railroad Transportation

Railroad transportation in the Appalachian coal mining region is becoming increasingly unreliable due to deterioration of track and equipment and the shortage of cars and locomotives. For a major new coal consuming facility such as coal liquefaction to develop successfully, railroad transportation of coal and equipment to the Plant must be available and dependable. The extent to which government action can aid

this situation is unknown. Products are likely to be shipped by rail, which could compound the currently over-extended and deteriorating rail situation.

Environmental and Industrial Hygiene Aspects

Operation of the several SRC facilities by Gulf has been accompanied by extensive analysis of the effects on the environment and the employees. No unusual problems have been encountered in adequately protecting employees and the environment, but study is continuing.

The processes are similar to those used in the petroleum refining, utility and coal tar industries, so applicable prior experience is available to supplement the pilot plant experience. The products are similar to coal tar products. As a result, the necessary industrial hygiene practices will benefit from the extensive work that has already been done in the coal tar industry. Similarly, the standards previously developed for distribution and combustion of coal tar products should have considerable applicability to fuels from coal liquefaction.

However, due to the fact that the specific processes and products of SRC have not been used on this scale in the past, both demonstration and commercialization could be delayed until specifically applicable data for handling and use are available and environmental acceptability is firmly established. It is important that all prospective environmental and health questions related to the process and the products be studied, and that acceptable control procedures be established and utilized in the Project.

Commercial Equipment

To achieve maximum operability and economy in full-scale commercial SRC-II plants, the design of numerous pieces of equipment must be improved. Pump, valves, heat exchangers and reactors are several items that would profit from further technical advances. Workable, but not optimized, solutions for these applications in the Project can be devised from present technology. However, concurrent with development of the Project, manufacturers should be encouraged by DOE to work on resolving technical limitations of present equipment for the purpose of providing improved designs for subsequent commercial plants.

Insurance and Liability

Commercial synthetic fuel plants and products may involve large potential liabilities to the owners and operators that will be difficult to define and/or accept in light of the newness of the technology being applied. A real impediment to commercialization will exist if industry is required to assume the liability risks for the coal liquefaction process and/or products. In similar prior situations, the U.S. Congress has decided to remove such impediments to the commercial development of advanced technology by enacting legislation whereby the Government, through an appropriate insurance program, assumes the liability risks. Similar Congressional action may be necessary in connection with commercialization of synthetic fuels technologies.