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DRAFT

Project Plan Document for the Methane Recovery From Coalbeds Project FY 1980

November 1979

Department of Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

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DEFINITIONS

The following definitions apply in this document:

Minable Coalbed	A coal deposit, often well defined, that has been, is now, or could be mined at the present time using existing technology.
Unmined Coalbed	A coal deposit that presently cannot be mined using existing technology. Also, an otherwise minable coalbed may be designated unmined because of unfavorable economic considerations such as seam depth below the surface, seam thickness or distance from a use/market.

ACRONYMS AND ABBREVIATIONS

CGS	Colorado Geological Survey
DOE	U. S. Department of Energy
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ET	Energy Technology (DOE)
FE	Fossil Energy (DOE)
FRAC	Fracture, or Fracturing
IMP	(MRCP) Information Management Plan
LNG	Liquified Natural Gas
Mcfd	Million cubic feet per day
METC	Morgantown Energy Technology Center (DOE)
MRCP	Methane Recovery From Coalbeds Project
ORO	Oak Ridge Operations (DOE)
PPD	Project Plan Document
R&D	Research and Development
RDP	(MRCP) Resource Delineation Plan
RFP	Request for Proposal
TBD/TBS	To Be Determined/Supplied
Tcf	Trillion cubic feet
TTP	(MRCP) Technology Transfer Plan
UGR	Unconventional Gas Recovery
UGMS	Utah Geological and Mineral Survey
USBM	U. S. Bureau of Mines
USGS	U. S. Geological Survey
WBS	Work Breakdown Structure
WP	(WBS) Work Package
WU	(WBS) Work Unit

PREFACE

The purpose of this document is to provide current planning for implementation of the Methane Recovery from Coalbeds Project (MRCP). Project activity definition, funding and scheduling are updated and established in detail for the fiscal year 1980 and, to a lesser extent, for four out years.

Activities Planned for FY 1980

FY 1980 planning anticipates

- Increased resource engineering and delineation efforts
- Evaluation of reservoir areas based on newly acquired data
- Initiation of additional R&D and technology test projects

These activities will satisfy major near term thrusts of the MRCP to build knowledge of the resource as broadly and rapidly as practical and to sponsor early experience with improved/new means for the extraction, preparation, and utilization of gas from coalbeds. Detailed implementation plans for FY 1980 are contained in Section 4 of this document.

Budget

The MRCP basic budget for FY 1980 and four out years is shown below in millions of constant 1979 dollars. An enhanced budget of 10.1 million dollars is included in FY 1980 implementation planning (Section 4.).

FY80	FY81	FY82	FY83	FY84	5 YEAR TOTAL
5.9	13.9	18.1	19.2	16.9	74.0

Five Year Major Milestones and Activity Interrelationships

MRCP major milestones and an integrated activity network for the five year period FY 1980 through FY 1984 are depicted in Figure 1-2. This figure reflects the MRCP work breakdown structure (WBS) identified in Figure 3-1 and the five-year budget projection presented in Table 6-2.

SECTION 1
SUMMARY

- Problems/Issues
- Expected Accomplishments in FY 1980
- Long Term Accomplishments and Benefits
- Activity Flow and Integration
- Document Organization

1. SUMMARY

Methane Recovery from Coalbeds Project activity and organization of this document are summarized below:

1.1 PROBLEMS/ISSUES

Major problems and issues addressed by the MRCP are:

- Insufficient knowledge of the coalbed methane resource/reserves (gas-in-place/gas recoverable with present technology and price).
- Lack of reliable rationale for selection of specific reservoir areas and well sites.
- Lack of a demonstrated technical, economical, and environmental data base indicating extraction/utilization viability.
- Concern for mine damage resulting from methane recovery activities.
- Uncertainty of coalbed methane ownership rights.

1.2 EXPECTED ACCOMPLISHMENTS IN FY 1980

The following accomplishments are anticipated during FY 1980:

- Data acquisition from up to 32 wells is planned for the year. This should result in significant additional knowledge of the methane coalbed resource with respect to both its location and extent.
- Estimates of the coalbed methane resource/reserves will be refined to the degree possible using this new information.
- Detailed design and procedure planning will be completed for several R&D and technology test projects. Field test experience will be gained for ongoing and future projects.
- Technical and economic information will become better known. This will assist private operators in deriving more reliable estimates of cost and risk factors.
- Identification and planning will be completed for additional R&D efforts required to support the MRCP activities.
- The Project Information Data Base will be augmented and technology transfer accelerated.

1.3 LONG TERM ACCOMPLISHMENTS AND BENEFITS

Long term accomplishments and benefits expected to result from the MRCP include the following:

- Provision of an additional source of a proven and consumer acceptable gas energy, to date essentially untapped.
- Greatly increased knowledge of the location and magnitude of this resource, particularly with respect to that portion of the resource associated with unmined coalbeds.
- Cost and use information to support decisions by the private sector to proceed with development of the resource.
- Establishment of the production potential of the resource and its possible contribution to national gas supplies. The activities described are expected to provide domestic gas reserves in greater quantity and at a much earlier date than that possible without Federal government involvement.

1.4 ACTIVITY FLOW AND INTEGRATION

An overview of the Methane Recovery from Coalbeds Project (MRCP) is depicted graphically in Figure 1-1. Three major elements of the project are shown (shadowed boxes): Resource Engineering, R&D, and Technology Tests. Not Shown is a Project Integration function that encompasses all MRCP elements, including support of DOE Headquarters program level requirements and coordination with other participating/cooperating government and private organizations. Activities currently ongoing within, and interfacing with, the major elements are indicated by subtitles; activity and information flow are shown by arrows.

A detailed five year major milestone schedule is shown in Figure 1-2 for the period FY 1980 through FY 1984. This diagram depicts an integrated activity network for the MRCP.

Government involvement is directed primarily in promising areas where private interests are presently unable or unwilling to undertake a high risk project; e.g., DOE sponsorship of a high cost R&D effort having only long-term economic return.

Provision is made for timely transfer of resulting new information and technologies to potential users.

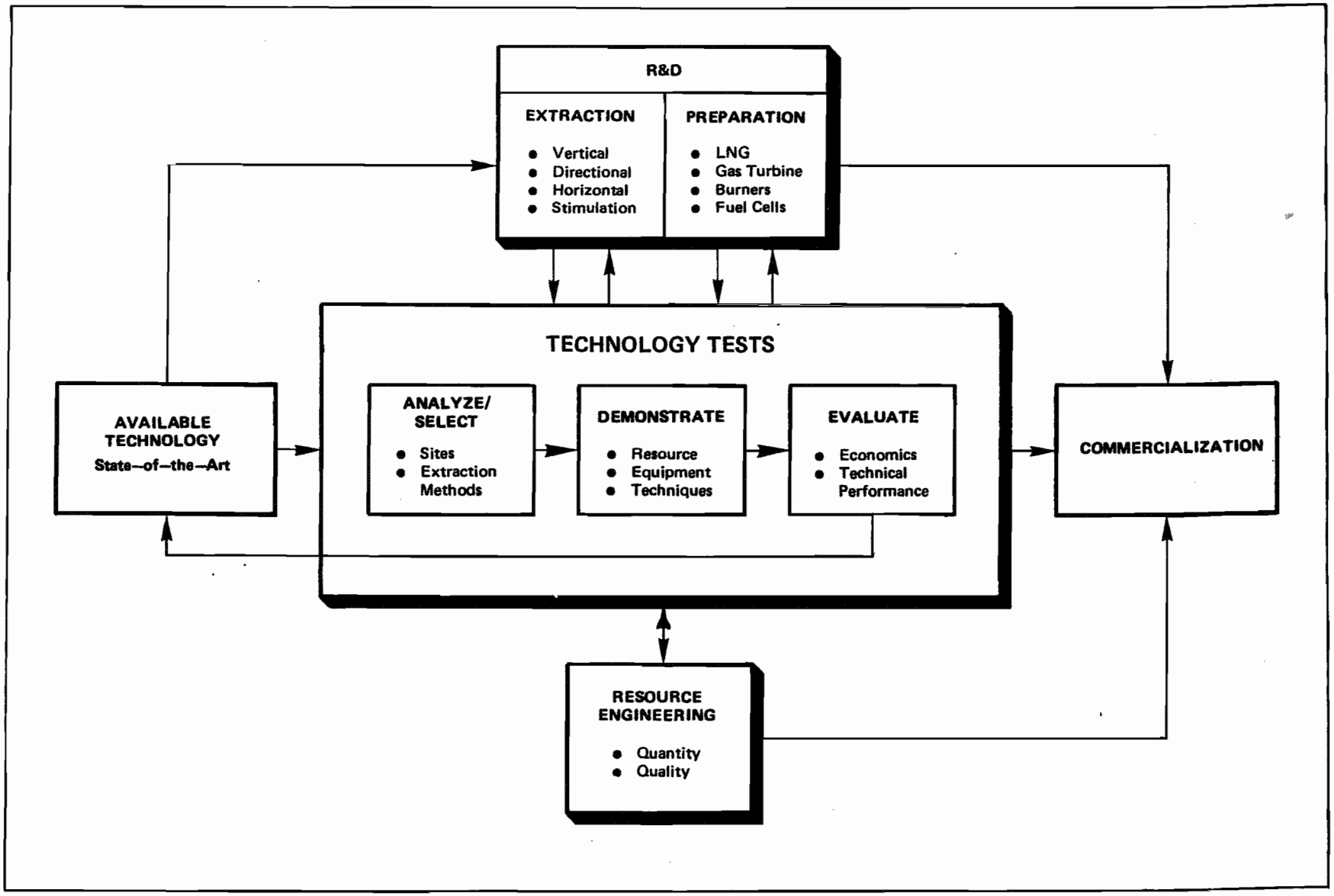
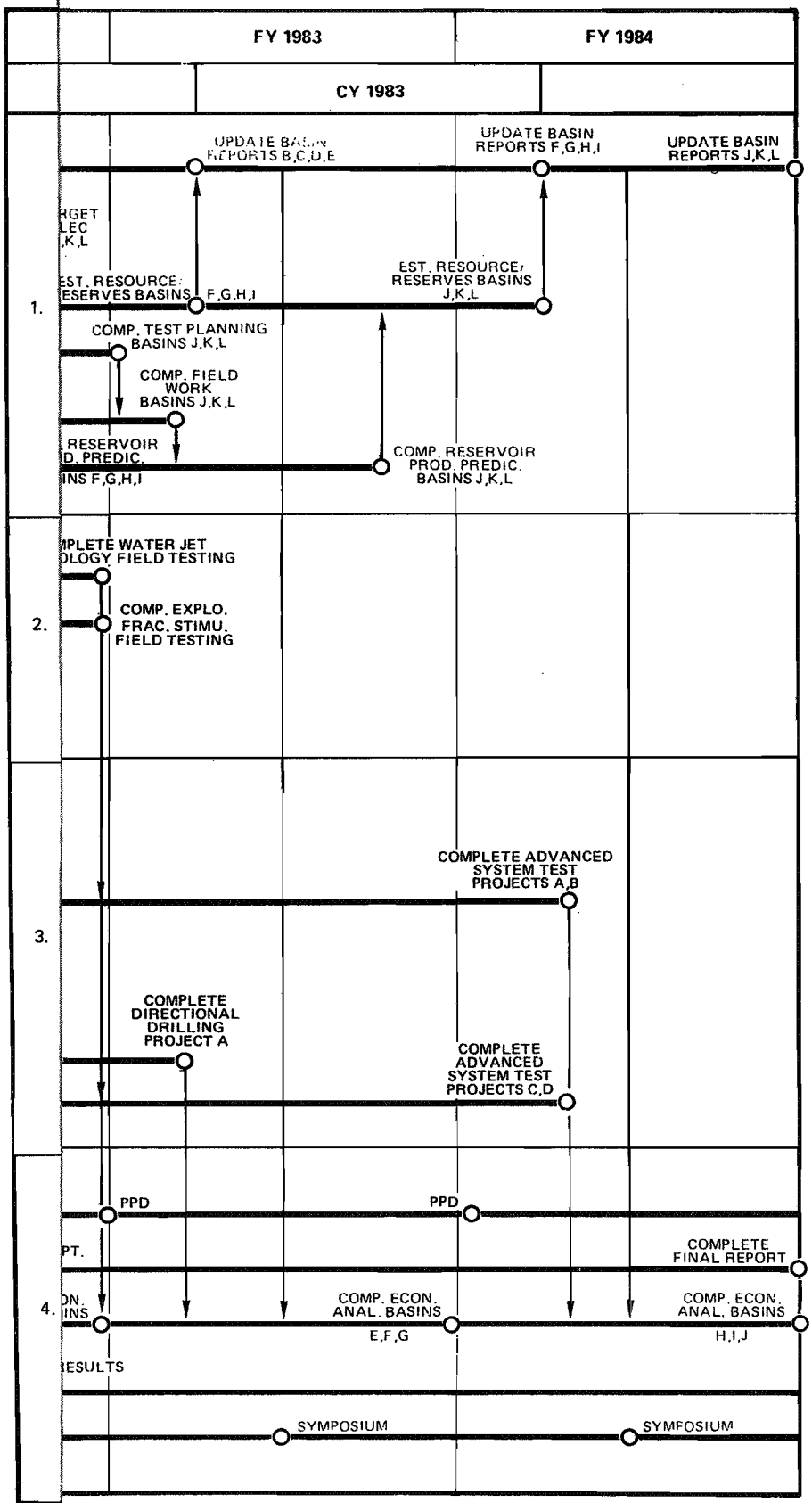


FIGURE 1-1. PROJECT DESCRIPTION/ACTIVITY FLOW OVERVIEW
METHANE RECOVERY FROM COALBEDS PROJECT



NO RELATIONSHIPS

1.5 DOCUMENT ORGANIZATION

The primary purposes of this plan are to establish project objectives and to provide planning for the technical work and supporting activities that must be performed to achieve the objectives.

Organization of the document is summarized below:

Section 1.0 Summary - States current problems and issues, accomplishments expected in FY 1980, and long term accomplishments; and describes project activity flow and document organization.

Section 2.0 Introduction - Identifies the MRCP goals, objectives and strategy, states the federal role, describes the coalbed methane resource, and provides background information of coalbed methane technology.

Section 3.0 Project Description and Structure - Presents (1) a description of the MRCP, its major elements and planned activities; (2) the project work breakdown structure (WBS); and (3) a matrix correlation of the MRCP activities with overall Unconventional Gas Resource (UGR) activities.

Section 4.0 Detailed Implementation Plan for FY 1980 - Presents technical activity and budget planning for the current fiscal year. WBS elements are developed to the specific task level with individual contractors and budget allocations identified.

Section 5.0 Management - Describes the roles and responsibilities of project participants and identifies features and requirements with respect to information management and project control.

Section 6.0 Five Year Budget Projection - Presents the MRCP 5-year budget projection through FY 1984.

SECTION 2

INTRODUCTION

- Project Goals and Objectives
- Project Strategy
- Federal Role
- Resource Delineation
- Technology Background

2. INTRODUCTION

This Project Plan Document (PPD) establishes a plan for implementation and field management of the Methane Recovery from Coalbeds Project (MRCP) by the Morgantown Energy Technology Center (METC), U. S. Department of Energy (DOE) for the Energy Technology Fossil Fuel Program Director.

The PPD, prepared and updated by METC annually or as required, is a project oriented plan that reflects strategic planning for overall Unconventional Gas Recovery (UGR) activities and contributes to the achievement of national goals and objectives respecting the coalbed methane resource. The PPD is intended to be sufficiently comprehensive to permit detailed planning, conduct, and monitor of project level activities. Provision is made to support coalbed methane program level requirements of DOE headquarters.

2.1 PROJECT GOALS AND OBJECTIVES

The MRCP overall goals are to estimate the extent of the coalbed methane resource with greatly increased accuracy and reliability and to provide technically and economically viable means for methane extraction, preparation, and use. The ultimate purpose is to promote extensive private use of coalbed methane to assist in meeting our national energy needs. Project objectives include:

- Location and delineation of coalbed methane resources
- Development of systems and techniques for gas extraction and preparation for use that are efficient, cost effective, and specifically designed for coalbed methane application
- Development of techniques applicable to methane producibility prediction/projection
- Selection through detailed studies, analyses, and experimentation of the most promising systems/technologies for timely development and testing
- Definition, selection, and field test of methane extraction/preparation/utilization technology systems to ascertain operational and economic viability
- Identification of legal, environmental and other institutional barriers to commercialization, and recommendations for required actions to overcome these barriers
- Development of systems and techniques for use in mine planning, particularly with respect to development of capabilities to
    - Predict the amount of methane extraction achievable ahead of mining
    - Control the methane remaining after drainage (by traditional mine ventilation methods or other means)
    - Estimate costs reliably and determine the economics of methane drainage options
- Transfer of applicable technology to industry.

2.2 PROJECT STRATEGY

The following strategy is outlined to assure timely achievement of established objectives and successful completion of the project:

- Build on prior efforts initially
- Locate and delineate methane resources which enable selection of suitable target gas recovery sites
- Define and implement near-term projects using available data and appropriately modified current technology
- Continue delineation and analyses of the resource to acquire new information and understanding of the resource
- Provide R&D activities to develop new/improved methods and systems for methane extraction, preparation, and end use
- Define and implement long-term projects as new information becomes available
- Define and field test new technology systems
- Provide means for flow of new information and technology to the private sector.

The results anticipated from this approach are expected to provide an increased store of information and significant advances in the state-of-the-art. Both are required to attract large-scale commercial interest.

Although not part of the project per se, increased coal productivity is anticipated by removal of gas to reduce mine ventilation requirements and minimize mine shutdown time.

2.3 FEDERAL ROLE

The federal role in Unconventional Gas Recovery (UGR) activities is to define rapidly the resource base and to speed the process of developing commercial technology to recover unconventional gas such as coalbed methane. Although private companies are likely to develop gas recovery technologies where warranted by market price, significant delay may occur before that happens.

Several factors indicate need for federal government involvement:

- From an industry viewpoint of investment dollars, the coalbed methane resource and other unconventional gas sources compare poorly with the location of conventional gas.
- Substantial improvements in performance--measurement, production, economics, and risks (predictability)--are required to improve the present situation.
- Some improvements in performance require complex, extensive, and expensive R&D. Only in very unusual circumstances can individual operators recoup the R&D costs from production of their individual holdings, and there is little patentable technology to produce higher investment returns.
- Industry R&D, to date and in the foreseeable future, is limited to high payoff, near-term efforts and the most geologically favorable resource settings.
- Field testing of new technology systems and methods is needed to demonstrate their viability to private interests.
- Only the federal government is capable of complementing these efforts to the extent required to make unconventional resources commercially available.

Consequently, the federal role is largely one of complementing industry efforts to provide the R&D and field tests necessary to lead to full commercialization--the point at which investments in such unconventional gas sources as coalbed methane are commensurate with their potential return.

Two factors are unique to coalbed methane:

- Legal disputes have arisen concerning ownership rights of gas recovered from coalbeds. Since these problems are not limited to a single state and will vary from state to state, federal government involvement may mitigate the resulting constraints on coalbed methane recovery.
- The federal role includes coal mine safety improvement, which indirectly benefits coalbed methane recovery by increasing both productivity and the total amount of recoverable gas.

2.4 RESOURCE DESCRIPTION

Methane is the primary constituent of natural gas and occurs naturally within or near virtually all coal formations. It is believed to have evolved as a byproduct gas during the transformation of vegetation to coal during geologic time and is retained within coal seams by virtue of their low permeability and low diffusivity. All coal deposits contain some methane, but its concentration varies widely within a seam and from seam to seam.

This source of energy is virtually untapped. To minimize safety hazards during coal mining operations, gas that seeps into the mine is diluted with ventilating air and swept out to the atmosphere where it is lost. About 200 bituminous coal mines in the United States each emitted 100 Mcfd or more methane during 1975.

The total area in the 48 conterminous states underlain by bituminous and subbituminous coal bearing strata of interest is approximately 380,000 square miles (Figure 2-1). A large methane resource is known to occur with these coals but its extent and the total amount of gas involved has not been well established. Most currently available methane information has been acquired from areas in the eastern states, primarily because the coal seams are well defined and mining operations have been extensive. Very little is known about large portions of the resource located in western states.

Estimates of the gas-in-place and the portion of this resource considered technically recoverable vary considerably because of a lack of information. The magnitude of the total coal associated methane resource has been estimated to be between 700 and 800 trillion cubic feet (700+ quads). No universally accepted estimate exists for the recoverable portion; estimates range from 16 to 500 Tcf. Several study results indicate that, given current conservatively projected economic and technological factors, the recovery of some 300 Tcf appears feasible.

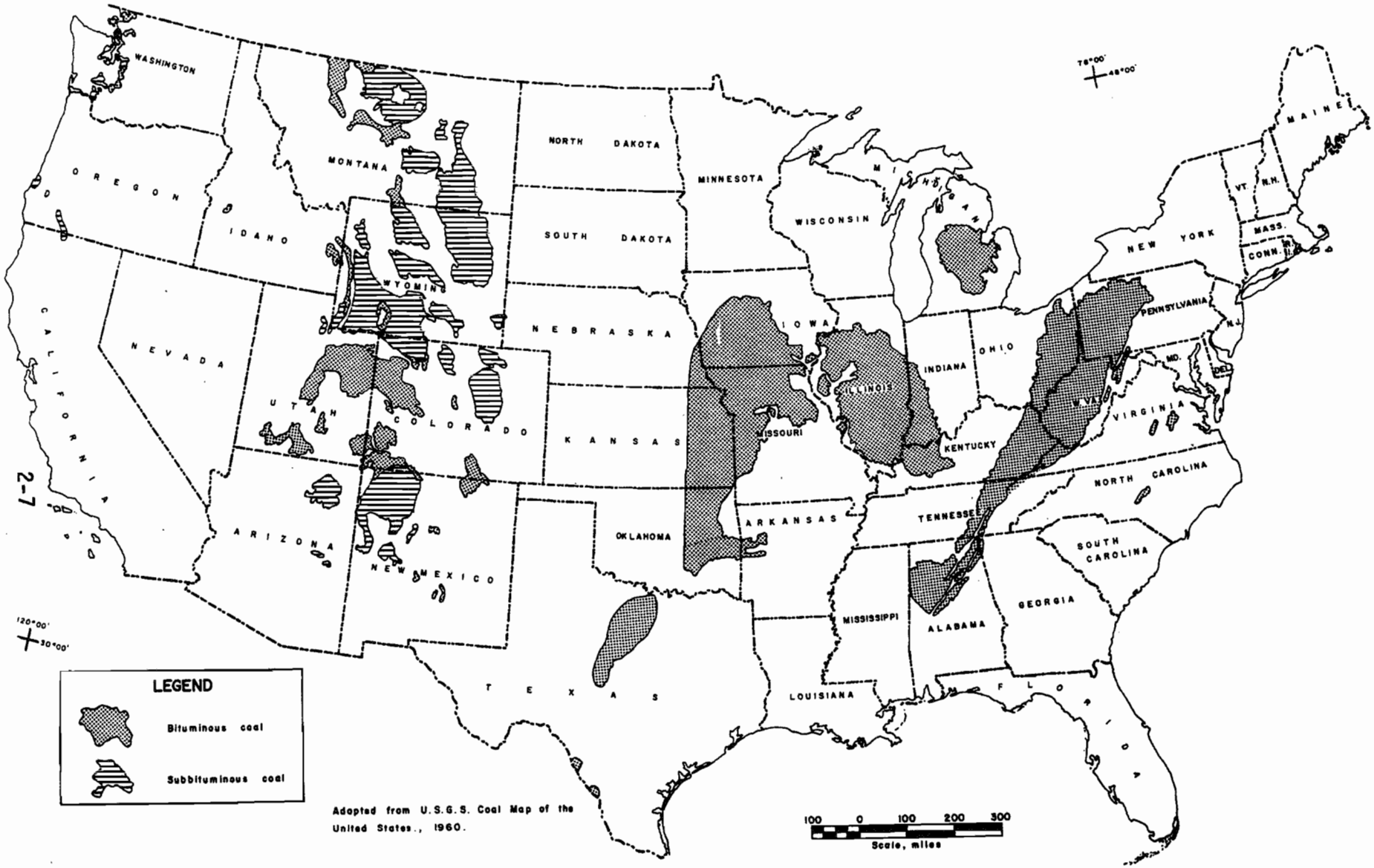


FIGURE 2-1. 380,000 SQUARE MILE AREA UNDERLAIN BY COAL BEARING STRATA

2.5 TECHNOLOGY BACKGROUND

Techniques have been developed for control/removal of the methane occurring in coalbeds as a necessary safety measure for mining operations. These include mine ventilation, gob gas drainage, and drainage in advance of mining to reduce gas migration into active mining areas. The latter, pre-drainage, also may be feasible for gas extraction from unmined coalbeds where depth or thickness of the coal seam has made mining uneconomical at present levels of technology and price.

New systems and operating procedures, or modifications to present methods and industrial processes, are needed to permit extraction and more efficient use of coalbed methane. The extraction of methane having marginally acceptable purity also appears feasible. Development of methods and determination of economic factors are planned for the use of gob gas and other contaminated, low volume,and low pressure sources.

In the past, industry has shown virtually no interest in commercial coalbed methane ventures. Essentially all methane extraction activity has been secondary to coal mining operations, usually as a mine safety improvement procedure, confirming use of the recovered gas to local applications.

2.5.1 State-of-the-Art

Several techniques for methane removal have been developed by the coal industry and the United States Bureau of Mines (USBM). These are classified and described as follows:

- Ventilation. The mine workings are flushed with large volumes of air to reduce the methane concentration to a safe level (less than 1% by volume). The diluted methane-air mixture is swept to the atmosphere and lost. This requires extensive equipment installations and large energy usage. No economic use of the highly diluted methane has been identified.

- Gob Drainage. Methane-rich gases are recovered from areas collapsed following coal extraction by drilling from the surface and draining the areas. This reduces gas migration into the active workings, and less ventilation is required. Drainage gas mixtures range between 25 to 90 percent methane content. Although gob drainage mixtures would be suitable for some low to medium Btu applications, no serious attempts at commercialization have been made.

- Pre-Drainage. Methane is removed from virgin coalbeds and adjacent rock strata by drilling and associated stimulation techniques prior to mining. This technique also may work well for recovery of methane from unmined coalbeds such as those of thickness or depth that currently make mining uneconomical.

2.5.2 Prior Efforts

The MRCP was initiated by DOE in 1977 with implementation responsibility and field management delegated to the METC. The project was organized into four major activities, summarized in the following paragraphs. Project startup and continuing activities are summarized through FY 1979.

Resource Engineering

Initial activities focused on defining a drilling program to provide timely data on unmined and, to a lesser degree, minable coalbed methane resources. Potential drilling areas were evaluated, a Resource Delineation Plan was developed, and target areas were selected and investigated.

Research and Development

An effort is being directed to develop improved, more cost effective methods and systems for methane extraction, preparation and use. Activity during the project start-up period has been largely confined to state-of-the-art systems and the identification of problem areas that indicate a need for R&D. Plans provide for concept designs which will enable the desired R&D to be performed at lower cost or an earlier date than otherwise possible.

Technology Tests

Field activities are on going and planned to operate and test integrated systems that provide for the extraction, preparation and end use of methane from coal seams. Testing will be coordinated with mine planning where applicable. Collectively, the technology tests encompass many phases of mining: predrainage ahead of mining, active operations, and drilling from the surface and within the mine.

Project Integration

An Information Management Plan was developed and an interim system was placed in operation to handle the information resulting from the project. Two "Methane From Coalbed" symposiums were held as a MRCP technology transfer function. Semi-Annual and Annual Reports encompassing MRCP activities through 1979 were prepared.

2.5.3 Current Needs

Need for new technologies and lack of reliable economic information, among other factors, have restrained private sector involvement in the coalbed methane resource. Current needs presently being addressed by the MRCP are:

Resource Delineation

Although coalbed methane exists in large quantities, areas of maximum concentration relative to coal seam properties cannot be predicted with sufficient reliability. In many areas the methane content is not well defined, and in large areas of the western states neither the coal strata nor the methane therein are adequately characterized.

Methane Extraction

Methane extraction technology is inadequate to attract general commercialization. Directional drilling, fracture stimulation and other factors appear to hold the key to increased and more economical production, but extensive R&D and field testing is needed to prove proposed new techniques.

Preparation Technology

Coalbed gas as extracted is often of lower quality and pressure than that presently obtained from conventional sources. This fact, and the remoteness of common end uses from many coalbed methane sources, requires the development and testing of new preparation techniques.

Mine Planning

The amount of gas predrained from a coalbed ahead of mining determines to a large degree the amount of ventilation required to maintain a non-hazardous atmosphere during active mining operations. Since the cost and operation of mine ventilation systems are high, mine operators must be able to estimate in advance with reasonable assurance their ventilation requirements, and therefore cost, for specific coal seam areas. In the same mode, an integrated methane pre-drainage/mining plan will aid in providing increased productivity to the mining effort.

Mine Operator Acceptance

Particularly in the eastern states, where it appears that for economic/safety reasons methane extraction will be accomplished only in coordination with coal mining, mine operators must acquire a reasonable confidence in investment return before undertaking commercial development. Coal mine developers must be provided with data and proven systems clearly demonstrating that methane extraction in the interest of increasing productivity is to their advantage. Oil and gas developers must be convinced to include coal seams as a target reservoir in addition to conventional reservoirs.

Clearly, there are many uncertainties concerning coalbed methane, and their importance is apparent. Unless many of them are mitigated, commercialization of the coalbed methane resource will not be realized. This PPD addresses resolution of these uncertainties and constraints.

SECTION 3

PROJECT DESCRIPTION AND STRUCTURE

- Project Description
- Work Breakdown Structure
- Correlation with Other UGR Activities

3. PROJECT DESCRIPTION AND STRUCTURE

3.1 PROJECT DESCRIPTION

The MRCP consists of the following major activities (elements) considered essential for success:

- Resource Engineering: Identification, definition and evaluation of the coalbed methane resource so that productive and economically attractive target sites may be reliably predicted and selected in advance.
- Research and Development: Development of improved, more cost-effective systems and methods for extraction, preparation, and utilization of methane from coalbeds and for mine planning.
- Technology Tests: Field testing technical and economic viability of a number of different system-coalbed combinations to accommodate the variety of specific site conditions encountered in mine planning and large-scale commercialization.
- Project Integration: Management and technical overview and control, project activity planning/liaison, supporting studies/analyses (environmental, regulatory, safety, and economic), report development, information management, and technology transfer.

These project activities and their integration are described in this section. Some project modifications may become necessary during out-years since long-term project direction and activity planning depend heavily on the results of prior work and the degree of involvement by the private sector.

3.1.1 Resource Engineering

Delineation of the methane content of coalbeds in the United States has been accomplished on a very limited basis, mostly in conjunction with active mining. Previous work includes only a very small percentage of the coal resources and does not provide the knowledge needed to locate recovery and utilization projects in coalbeds with the greatest potential for methane production.

Historically, about 80 to 90 percent of U.S. coal has been produced from the Pittsburgh area. Thus, much of the delineation of coalbeds has been limited to that area and has addressed only minable coal. Some data obtained by industrial organizations are retained as proprietary. Moreover, the available acquired data are not centrally located, making acquisition difficult.

In accomplishing this project, data will be acquired and assimilated on a continuing basis. Activities necessary to obtain these data are in progress.

The Resource Engineering effort includes:

- Development of overall methane resource identification and definition planning
- Development of cooperative core/sample/well test/drilling plans
- Acquisition of characterization information--existing data sources and cores/samples from additional coalbed locations
- Analysis and evaluation of all available data
- Identification of reservoir areas and specific sites
- Production prediction efforts
- Information storage in a repository available to potential users.

Methane resource characterization information also is acquired by other organizations. Support from these agencies and institutions is required to acquire available data located at multiple locations:

- USGS - Computerized data base (under development)
- USBM - Information source and laboratory analyses
- State Geological Surveys - Information sources, including geologic maps
- Universities/Institutions - Information sources and technical studies/analyses.

A large increase is required in the depth and scope of methane resource characteristics to support assessment of the overall benefits that can be derived from the use of coalbed methane. The current price incentive has been insufficient to encourage widespread commercial interest.

A Methane Resource Delineation Plan has been developed to provide detailed information and planning for delineation of the coalbed methane resources (Reference 1).

For specific FY 1980 Resource Engineering activities, see Section 4.1.

3.1.2 Research and Development

High risk R&D tasks (such as investigation of improved drilling tools and extraction techniques) are being identified and performed in conjunction with ongoing Resource Engineering and Technology Test project activities. Such tasks will be funded primarily by government due to high risk and cost factors which prevent timely investigation by industry. The primary purpose of R&D will be to obtain answers to fundamental questions involving methane recovery from coalbeds and technological advancements necessary for economic production and utilization. The work will involve proper instrumentation of wells (logging tools and surface devices) to determine stimulation effectiveness, fracture containment, effects of water saturation, in situ stresses, etc. R&D tests such as mineback experiments will be performed to evaluate roof integrity for subsequent mining operations. R&D planning includes technology development for:

- Improved equipment and techniques for directional drilling
- Advanced fracturing techniques to provide more effective stimulation with resultant increase in gas flow
- Improved dewatering techniques to maintain more effective gas flow
- Improved gas drainage techniques to provide more economical recovery of methane and (when active mining is involved) to support mine planning and assist productivity
- Fracture containment to minimize mine roof damage.

Drilling technology is presently available for extracting methane from coalbeds. Specific techniques include:

- Drilling of conventional wells-and possible stimulation of production through explosive, hydraulic, or foam fracturing
- Directional drilling of horizontal boreholes that intercept the natural fracture system of coalbeds-and possible application of stimulation techniques
- Drilling of horizontal boreholes from the bottom of shafts or from mine headings.

Although the above techniques are available, none are developed to the degree that efficiency and cost are optimum. Multiple wells are required to drain the gas effectively before mining. The spacing and pattern of wells for most effective methane drainage are essential to both safety and productivity when mining the coal is involved. Optimum geometries are unknown. Current hydraulic or foam fracturing techniques will suffice for near-term test projects to extract methane now wasted; however, they may not be optimum for longer-range commercial ventures. To provide for commercialization, proven prediction techniques and demonstrated results must apply to a sufficiently broad spectrum of the coalbed methane resource.

Possible utilization of the gas from coalbeds includes heat, power generation, and LNG. Early systems will use equipment developed from other applications, modified as necessary for adaptation to coalbed methane applications.

To provide improved and efficient equipment for specific applications, design modifications and technology development are required. This includes development/modification of systems for:

- Gob gas feedstock to gas turbines
- Gob gas burning for heating or drying applications
- Low quality gas preparation
- Conversion to LNG.

For specific FY 1980 R&D activities, see Section 4.2.

3.1.3 Technology Tests

Technology tests are designed to determine the technical and economic feasibility of specific combinations of extraction and utilization methods installed as complete systems operating under realistic field conditions. Up to nine projects are expected to be underway or programmed for initiation by FY 1980, five in minable and four in unmined coalbeds. Each is described and discussed in Section 4.3.

Collectively, the technology tests will examine several different extraction methods in different coal formations, taken in combination with a wide spectrum of different utilization subsystems. Each technology test will be planned and executed as a complete system test to ensure optimum test results and realistic contribution to the project information data base and to its technology transfer. The parameters to be studied in technology tests underway or projected for initiation through FY 1979 are illustrated in Table 3-1. Others will be initiated in subsequent years to investigate other important extraction or utilization features or the same methods in different geologic or environmental settings.

Results obtained from resource engineering and research and development activities are used to assist in the selection of technology systems to be tested. Resource engineering and research and development taken alone; however, cannot provide the overall data base necessary for rapid exploitation of the coalbed methane resource. Only through the conduct of well planned and executed technology tests can projects demonstrate true economic and technical viability and environmental acceptability.

Technology tests will develop and demonstrate the advantages of appropriate mine planning, taking into account the benefits achievable in mine productivity and safety. These tests will provide the experience and information needed to ensure fracture containment in coalbeds to be mined later--information essential to optimum stimulation practice. Validated information will be provided as a base on which mine owners can decide whether predrainage is necessary, the best method of predrainage to use, and what reduction in planned ventilation requirement should result.

Technology tests will provide experience and information for efficient placement, spacing and geometry: of wells, for predrainage from the surface; for horizontal drainage from within mines; or from directionally drilled drainage holes. Information from technology tests also will be fed back for use in the mathematical production model to assist in refining the model's ability to forecast production expected from new wells or in-seam drainage holes.

TECHNOLOGY TESTS	EXTRACTION TECHNIQUE								PREPARATION/UTILIZATION			
	PREDRAINAGE	GOB GAS	SINGLE WELL	MULTIPLE WELL	DIRECTIONAL BOREHOLE	HORIZONTAL BOREHOLE	HYDRAULIC FRACTURING	FOAM FRACTURING	GAS FRACTURING	PIPELINE INJECTION	POWER GENERATION	HEATING APPLICATION	LNG CONVERSION
MINABLE COALBED PROJECTS	X			X						X		X	
	X			X			X			X			
	X					X		X					X
	X	X	X								X		
	X			X						X			
UNMINED COALBED PROJECTS				X			X			X			
							X			X			
			X		X		X	X		X			
			X					X		X			

TABLE 3-1. TECHNOLOGY TEST PROJECTS

Finally, too, the technology tests will reveal voids in the work programmed under the Resource Engineering and Research and Development elements, which will require added or modified tasks in these areas. This close interrelationship of technology tests with other project elements is illustrated in Figure 1-1.

For specific FY 1980 technology test project activities, see Section 4.3.

3.1.4 Project Integration

Integration of project activities plays an important part in the implementation and management of this project. Besides normal project planning and coordinating functions, a large amount of informational exchange, or "crossfeeding", necessarily takes place between the several individual R&D and technology system tests and their supporting activities. Also, information resulting from one activity is frequently used as "feedback" input to another. Much of this information is technical and continually pressing the state-of-the-art. The large amount and variation in types of data dictate the use of a systematic information management system to maintain orderly flow, storage, and ready availability. An automated system may be required in future years.

In the technology test projects, it is planned to include a methane utilization subsystem with each extraction subsystem. Integrated planning is mandatory for these combined test projects to assure selection of optimum overall systems design and coordination of operational procedures. Tradeoffs involving site locations and design features are inevitable. Factors in these trades include: distance to a gas gathering line or other end use, site accessibility, methane quantity/quality, cost-sharing opportunities, project priorities and confidence in the expected results. These are very different factors, requiring diverse technical and adminsitrative knowledge, and a common integrating function is used to provide "single-point" coordination. For some test projects, detailed supporting studies and analyses will be required to provide the requisite knowledge to enable good decisionmaking and selection of viable systems and site locations.

New information resulting from activities such as R&D projects and analytical studies will be provided to an appropriate ongoing technology test or support activity, if available, for test and proof under field conditions. On the other hand, field operations can be expected to identify

problems that may be resolved in a timely manner by immediate assignment to a related ongoing R&D activity.

Coordination of the many project parts is paramount to successful achievement of project objectives. It is anticipated that as the project progresses, this coordinating effort will continue, but with decreasing government support and increasing industrial participation. To realize this trend, economic and environmental viability of the new technologies must be demonstrated to attract private ventures. In fact, evidence that termination of the project is at hand will be signaled by general acceptance and use of the new technologies in commercial ventures.

It is recognized that other gas recovery efforts involving methane (not coalbed associated) are underway or planned and MRCP activities will be coordinated with the appropriate agencies, particularly where mutual support or other interactivity will be beneficial to overall DOE UGR goals and national energy interests.

For specific FY 1980 project integration activities, see Section 4.4.

3.2 WORK BREAKDOWN STRUCTURE

To provide identification of all work required to accomplish the project, the four major activities (elements) of the project described in Section 3.1 are subdivided into progressively lower levels. This breakdown results in specific work, or tasks, each small enough to enable complete understanding of all of its requirements (technical, administrative, schedule, manpower, funding, etc.). Use of this technique, a detailed work breakdown structure (WBS), proceeds to the level of detail necessary to plan and perform all work--and, thereby, the entire project. If a problem area cannot be resolved, an alternate means must be provided to accomplish the work/task involved.

The WBS is shown in Figure 3-1 to the Work Unit level (Level 3) to provide an overview of the MRCP work requirements. In Section 4, the project work is further subdivided to the Task level (Level 4) for FY 1980. The WBS will be updated and detail added when required to reflect revisions as new requirements are identified.

A planned flow of project activities reflecting the WBS requirements is shown in the five year major milestone schedule and activity interrelationships diagram presented in Section 1 (Figure 1-2).

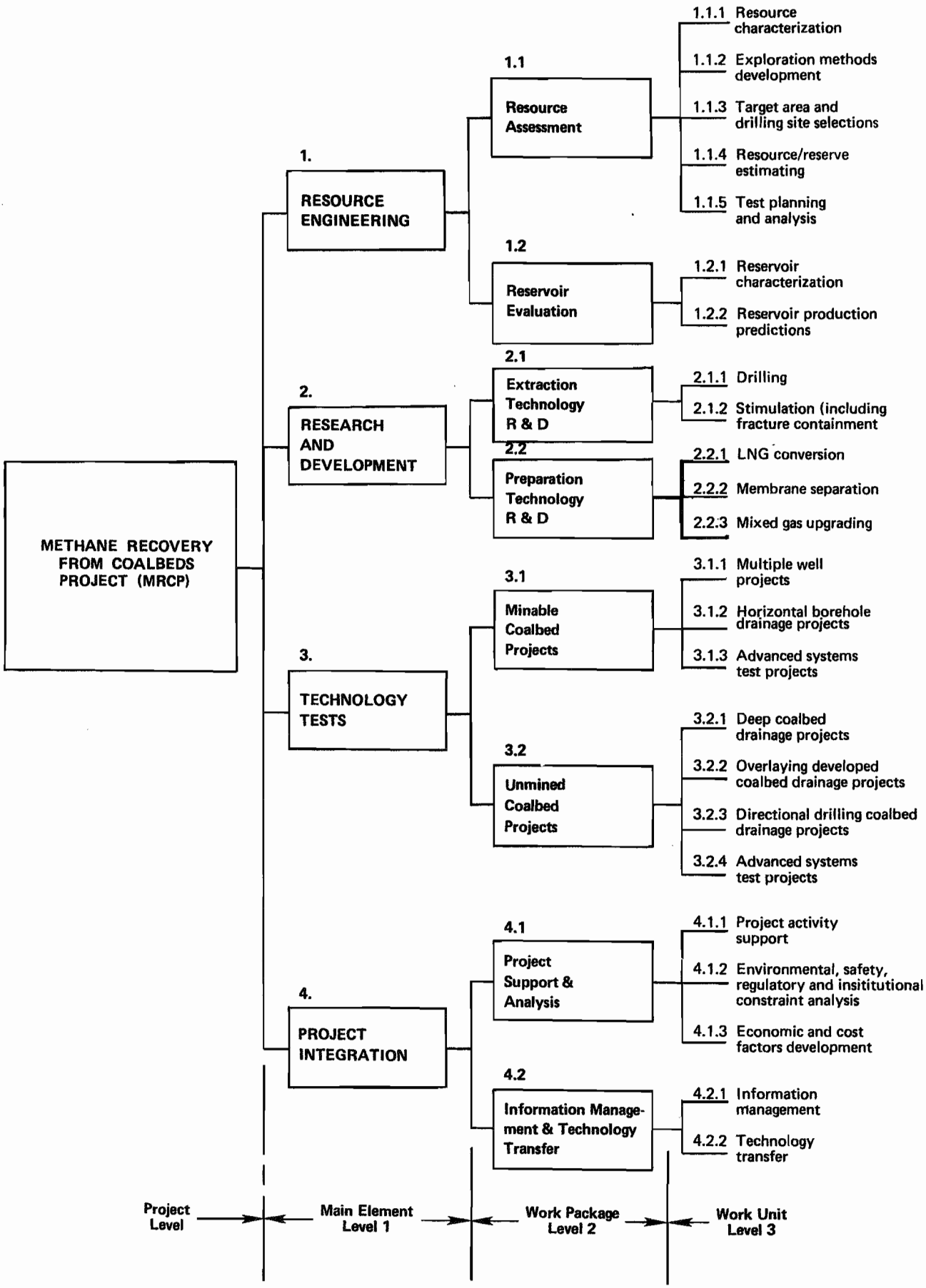


FIGURE 3-1. WORK BREAKDOWN STRUCTURE SUMMARY METHANE RECORVERY FROM COALBEDS PROJECT

3.3 CORRELATION OF MRCP AND UGR ACTIVITIES

The activities planned for the MRCP (Section 3.1 and 3.2) are correlated with the activities designated for all of the Unconventional Gas Resources (UGR) by the matrix in Table 3-2. MRCP work breakdown structure numerical designators are noted in this matrix for positive identification of the MRCP activities. Basic correlation occurs at the MRCP work unit level.

MRCP ACTIVITIES / UGR ACTIVITIES	ELEMENT 1 RESOURCE				ELEMENT 4 PROJECT INTEGRATION					
	1.1.1 Resource characterization	1.1.2 Exploration methods development	1.1.3 Target area and drilling site selections	3.2.4 Advanced systems test projects	4.1.1 Project activity support	4.1.2 Environmental, safety, regulatory and institutional constraint analyses	4.1.3 Economic and cost factors development		4.2.1 Information management	4.2.2 Technology transfer
EVALUATION					•				•	•
RESOURCE AND SITE CHARACTERIZATION	•	•	•		•				•	•
RESEARCH, INSTRUMENTATION AND MODELING	•	•	•		•				•	•
PRODUCTION TECHNOLOGY DEVELOPMENT				•	•	•	•		•	•
ENVIRONMENTAL SAFEGUARDS					•	•	•		•	•
PREPARATION & UTILIZATION				•	•	•	•		•	•

SECTION 4

DETAILED IMPLEMENTATION PLAN FOR FY 1980

- Elements
  - Objectives
  - Organization
- Work Packages
  - Major Problems/Issues
- Work Units
  - Objectives
  - State-of-the-Art
  - Needs
  - Technical Approach
  - Tasks, Contractors and Budget
- FY 1980 Contracted Work Budget Summary

4. DETAILED IMPLEMENTATION PLAN FOR FY 1980

Detailed technical and budget planning is presented in this section to guide implementation of the MRCP during fiscal year 1980. For convenience, the section arrangement is similar to the work breakdown structure (WBS) as tabulated below:

PPD Section	MRCP Major Activity	WBS Element
4.1	Resource Engineering	WBS 1.
4.2	Research and Development	WBS 2.
4.3	Technology Tests	WBS 3.
4.4	Project Integration	WBS 4.

All planned contract work is organized in one of the four MRCP major activities, or WBS elements. Within each element, work is divided into groups of related subordinate activities; namely, the Work Packages, Work Units and Tasks that comprise the WBS (Figure 3-1).

In the following sections, overall objectives are established for each of the Elements, and Work Packages and Work Units are defined to address known problem areas and issues.

Specific objectives, background information, and a technical approach are presented for each Work Unit, and FY 1980 planning to accomplish the required work is shown in chart format, indicating Tasks, contractors and budget allocations. The budget dollars are compiled and totaled in Table 4-1, providing a summary of the FY 1980 contracted work at the end of Section 4.

The Task activities planned for FY 1980 in this section are integrated with long-term MRCP requirements to assure coordinated implementation strategy for achievement of overall project goals and objectives. This is reflected in the five year major milestones and budget projections presented in other sections (Figures 1-2 and 6-2).

4.1 MRCP ELEMENT 1 - RESOURCE ENGINEERING

Element 1. Objectives

Objectives of Resource Engineering activities are to:

- Provide a reliable estimate of the total coalbed methane resource; i.e., gas-in-place.
- Develop a rationale and methodology for the selection of potential reservoirs and specific test sites.
- Estimate reserves; i.e., economically recoverable gas.
- Provide test planning and analysis.

Element 1. Organization

4.1.1 Work Package 1.1 - Resource Assessment

Major Problems/Issues to be Resolved

- Present knowledge and understanding of the coalbed methane resource is uncertain and does not encompass all parts of the resource. Resource/reserve estimates are only very rough approximations.
- Techniques available for use in selecting potential reservoirs and specific production sites are inadequate.

Work Units

- Resource characterization (WBS 1.1.1)
- Exploration Methods Development (WBS 1.1.2)
- Target Area and Drilling Site Selections (WBS 1.1.3)
- Resource/Reserve Estimating (WBS 1.1.4)
- Test Planning and Analysis (WBS 1.1.5)

4.1.1.1 Work Unit 1.1.1 - Resource Characterization (Figure 4-1)

a. Objective

To determine more precisely the content and distribution of methane in the coalbeds.

b. State-of-the-Art

In many areas of the U.S. the distribution of coal-bearing strata is well known, particularly where coal has been mined using available technologies. Considerably less is known about the methane associated with these strata, and present methane information is, to a large extent, limited to coals of the eastern U.S. Little is known about methane content and distribution in coals of the western U.S.

c. Needs

Additional methane content and distribution information is needed to better estimate the national resource and to support the development of production prediction capabilities applicable to major coal bearing basins.

d. Technical Approach

A MRCP Resource Delineation Plan, prepared in 1979

- Provides the basic rationale for the resource/reserve investigation
- Outlines the initial areas of interest as about 80,000 square miles of 380,000 square miles underlain by coal-bearing rock located predominantly in 11 major basin areas in the continental U.S.
- Examines the exploration methodologies available
- Establishes the basic well test planning.

In FY 80, the coalbed methane resource characterization effort will be continued. Emphasis will be directed toward areas where insufficient data are currently available to permit prediction of methane distribution within a geologic basin. The data collected will be limited by availability of well drilling opportunities and project funding; however, the intent is to provide resource characterization to the extent of one data point every 1000 square miles in primary target areas totalling about 80,000 square miles (Figure 2-1).

e. Tasks, Contractors, and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 1.1.1 are tabulated in Figure 4-1.

CONTRACTORS / TASKS	Evaluate and Correlate Coal and Gas Data	Update Gas-In-Place Estimates	Analyze/Evaluate Production Predictions	Provide Geologic Information for Potential Reservoir Areas/Specific Sites	Evaluate Potential Reservoir Target Areas and Well Site Selections	Evaluate Southern Coalfields, Primarily Unmined		FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X		X			90	200
Intercomp	X	X	X		X			10	20
Colorado Geological Survey				X				60	90
U. S. Geological Survey				X					
Utah Geological and Mineral Survey				X				60	60
Virginia Polytechnic Institute						X		120	120
BASIC BUDGET TOTAL								340	
ENHANCED BUDGET TOTAL									490

FIGURE 4-1. TASKS, CONTRACTORS AND FY80 BUDGET ($1000)
Work Unit 1.1.1, Resource Characterization

4.1.1.2 Work Unit 1.1.2 Exploration Methods Development (Figure 4-2)

a. Objective

To determine which exploration methods or combination of methods will provide maximum information on the distribution and producibility of methane within coalbeds.

b. State-of-the-Art

The primary exploration method presently used to determine coalbed methane distribution involves use of information acquired during exploratory drilling to determine the distribution of coalbeds prior to the development of mine plans, or use of the same types of information gathered while drilling to deeper horizons for oil or gas.

c. Needs

Techniques are required to provide a maximum of subsurface information at reasonable cost. Use of these techniques will economically develop knowledge of the depth and distribution of potential coalbed methane reservoirs. To best judge the methane production potential of these reservoirs it also is desirable to be able to predict the distribution and orientation of fractures within the coalbeds.

d. Technical Approach

In FY 80 the exploration methods development will be centered around the detailed geological investigation of sites with relatively large methane production potentials. Satellite imagery studies will provide information on regional stress and structure patterns and thence on the distribution and orientation of major fractures. Surface mapping on a smaller scale with emphasis on fractures in both coalbeds and adjacent rock units will facilitate the extrapolation of satellite detected fracture patterns to those mappable on land surface. Geophysical seismic surveys will aid in the definition of subsurface structure. Borehole geophysical techniques will aid in confirming the presence of coal and defining local subsurface structure. Finally, well tests, accomplished for other purposes, can confirm the presence of the coalbed methane resource as well as its producibility. Data from these individual well tests and the relationships of the data, the location of the well, and the local and regional geology will be utilized to form the systematic correlation framework for interpolation between test/production areas.

e. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 1.1.2 are tabulated in Figure 4-2.

CONTRACTORS / TASKS	Evaluate Borehole Geophysical Techniques	Utilize/Evaluate Geophysical Seismic Surveys for Coalbed Definition	Utilize/Evaluate Remotely Sensed (Satellite Imagery) Data	Evaluate Potential of Gravity, Magnetic, and/or Resistivity Surveys				FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X	X				30	125
BASIC BUDGET TOTAL								30	
ENHANCED BUDGET TOTAL									125

FIGURE 4-2. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 1.1.2, Exploration Methods
Development

4.1.1.3 Work Unit 1.1.3 - Target Area and Drilling Site Selections (Figure 4-3)

a. Objective

To determine, on the basis of available information, geologic areas of coalbed methane production potential and to select drilling sites that provide the maximum amount of methane resource potential information within the geologic target areas.

b. State-of-the-Art

The initial target areas of interest outlined in the Resource Delineation Plan vary widely in the amount of methane resource and geological data available. Some methane containing coal seams in the eastern United States are quite well defined, many western coal areas are very poorly defined both in terms of the methane resource potential and the general geology of the area.

c. Needs

Geologic definition of the selected areas of interest is required. This information must be supplemented by the proper utilization of methane concentration data already available. Optimization of test well locations can be obtained through knowledge of coal rank, thickness, depth, etc. so that the necessary resource/reserve information within the geologic framework can be obtained.

d. Technical Approach

In FY 80, Basin Reports will be prepared as outlined in the Resource Delineation Plan on selected geological basins of interest. These reports will present the basic geologic framework of the basins together with locations and gas concentrations of known methane from coalbed occurrences. Recommendations will be presented on production potential.

e. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 1.1.3 are tabulated in Figure 4-3.

CONTRACTORS / TASKS	Define Criteria to Identify Primary Target Areas	Redefine Primary Target Areas on Basis of New Data	Evaluate Geology of Redefined Target Areas	Select Specific Drilling Sites on the Basis of Maximum Methane Production Potential				FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X	X				40	100
Intercomp	X	X		X				3	7
BASIC BUDGET TOTAL								43	
ENHANCED BUDGET TOTAL									107

FIGURE 4-3. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 1.1.3, Target Area and Drilling Site Selections

4.1.1.4 Work Unit 1.1.4 - Resource/Reserve Estimating (Figure 4-4)

a. Objective

To provide a more precise estimate of the methane present in coalbeds and that portion of the gas which is producible.

b. State-of-the-Art

Based on extrapolation of an extremely small amount of data, estimates ranging from 700 to 800 trillion cubic feet (Tcf) of methane have been suggested as present in coalbeds of the conterminous U.S. These estimates are derived from mine gas emission data and some studies of methane observed in unmined coals. Not much is known about the actual quantity or distribution of methane within coal seams on a regional basis.

c. Needs

Knowledge of the locations, extent and quantity of the methane resource is required to understand its potential useability. Knowledge of the ability to produce the resource is also required to determine what portions of the resource may be considered a national reserve.

d. Technical Approach

Coal resources and the attendant geologic framework presented in basin reports represent the data base framework for estimating the coalbed methane resource. Type I (methane content) well tests, as described in the Resource Delineation Plan, and historical data will then be used to estimate the potential resource within a basin. Type III (production) tests coupled with reservoir models of total well production over time will then be utilized to estimate the potential reserve.

These individual basin reports will be updated annually as more data is acquired to produce increasingly more reliable estimates of the national coalbed methane resource/reserves.

e. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 1.1.4 are tabulated in Figure 4-4.

CONTRACTORS / TASKS	Evaluate All Available Coal Resource/Reserve Data for the Areas of Interest	Correlate Coal Resource/Reserve Data with Coalbed Methane Data	Estimate Methane Present in Coalbeds (Gas in Place Resource)	Estimate the Methane Potentially Producible from Coalbeds (Reserve)				FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X	X				50	200
Intercomp	X	X	X	X				8	15
BASIC BUDGET TOTAL								58	
ENHANCED BUDGET TOTAL									215

FIGURE 4-4. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 1.1.4, Resource/Reserve Estimating

4.1.1.5 Work Unit 1.1.5 - Test Planning and Analysis (Figure 4-5)

a. Objective

To develop a set of tests which will permit acquisition of maximum usable information during each drilling opportunity, DOE funded or cost shared.

b. State-of-the-Art

Where operations are conducted as joint ventures with others in control, it often is not possible to conduct an entire set of tests because of scheduling or operational problems. Coring, desorption, logging, flow testing, drill stem testing, and production testing are desirable to provide maximum information, but all of these procedures are usually not performed in every case since they require significantly more time than that available.

c. Needs

A pre-planned set of tests and a prioritization of the tests is needed to acquire maximum information in minimum time.

d. Technical Approach

As outlined in the Resource Delineation Plan, well test efforts are being carefully planned to provide the maximum amount of data at minimum expense to the project. To this end, available information on the coal (and any available methane content data), including rank, thickness, depth, distribution, etc., within a basin is accumulated and evaluated. Areas to be tested within that basin are then carefully selected. Type I (gas content) tests are cost shared with interested operators and the data generated by these are evaluated before an extensive flow test (Type III) project is considered.

Analysis of the data obtained is centered about the reservoir parameters considered to be the independent variables of most importance to production prediction. They are:

- Gas content
- Pressure
- Permeability
- Relative permeability
- Fracture length
- Fracture conductivity

The production model verification effort and the determination of the correctness of values assumed for modeling are covered under Work Unit 1.2.2 (See Section 4.1.2.2).

The analysis performed under this work unit is concerned with:

- Test validity (is the correct data being obtained)
- Test accuracy (assumed versus actual limits of accuracy)
- Test prioritization (well availability versus need for data within a region, basin, etc.)
- Parameter variation (by region, basin, etc.)

e. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 dollars for Work Unit 1.1.5 are tabulated in Figure 4-5.

CONTRACTORS / TASKS	Determine Optimum Data Requirements	Establish Test Operations Necessary to Obtain Optimum Data	Determine Which Tests Can Be Conducted Within Time and Other Operator Constraints	Develop Test Program Planning (Model Updating and Verification)	Review Test Plans and Prepare Subcontracts			FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X	X	X			70	213
Intercomp	X	X		X				3	7
BASIC BUDGET TOTAL								73	X
ENHANCED BUDGET TOTAL								X	220

FIGURE 4-5. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 1.1.5, Test Planning and Analysis

4.1.2 Work Package 1.2 - Reservoir Evaluation

Major Problems/Issues to be Resolved

- Knowledge of the reservoir characteristics most strongly influencing coalbed methane producibility are poorly understood.
- The interrelationships of these parameters to one another have not been adequately addressed.
- Mathematical simulations capable of predicting reservoir behavior have not been adequately validated for a reasonble spectrum of coalbed methane reservoirs. This lack of validation limits application of the model to certain geographical areas.

Work Units

- Reservoir Characterization (WBS 1.2.1)
- Reservoir Production Predictions (WBS 1.2.2)

4.1.2.1 Work Unit 1.2.1 - Reservoir Characterization (Figure 4-6)

a. Objective

To determine the character and productivity of coalbed methane reservoirs.

b. State-of-the-Art

The characteristics of coalbed methane reservoirs which govern the quantities of methane contained and the producibility of that methane are insufficiently understood. Tests have been developed which are able to determine basic information important to providing such understanding. They include:

- Gas Content
- Reservoir Pressure
- Water/gas flows (pre-fracture)
- Water/gas flows (post-fracture)

c. Needs

Because of widely varying characteristics within regional coal basins and wide variances between basins many well tests are required to properly characterize the coalbed methane resource.

d. Technical Approach

The Resource Delineation Plan outlines an approach for a "fast track" commercialization test activity. One of the primary purposes of this activity is to obtain reservoir characteristics data by conducting well tests within approximately 80,000 square miles of coal bearing rock (Figure 2-1). These tests include:

- Type I tests which determine the methane content of the coal cores obtained and the pressures within the coalbeds penetrated
- Type II tests which determine the bulk permeability of coalbeds penetrated by wells drilled for other purposes and later abandoned
- Type III tests which determine the same information as Type I tests and also determine natural flow quantities both before and after fracturing.

e. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 1.2.1 are tabulated in Figure 4-6.

CONTRACTORS / TASKS	Continue Determination of Reservoir Parameters on Coal Core Samples	Perform Water/Gas Injection Tests of Flow Tests to Determine Permeability	Study Regional Stress Patterns to Determine Cleat Orientation	Perform Production Tests to Determine Long Term Gas Production Characteristics	Determine Effects of Artificial Fracturing on Coalbed Reservoir			FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW*	X	X	X	X	X			255	1050
Intercomp				X	X			8	16
BASIC BUDGET TOTAL								263	
ENHANCED BUDGET TOTAL									1066

*Some well drilling, coring and other sampling and test work will be accomplished by subcontractors.

FIGURE 4-6. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 1.2.1, Reservoir Characterization

4.1.2.2 Work Unit 1.2.2 - Reservoir Production Predictions (Figure 4-7)

a. Objectives

To provide for meaningful extrapolation of data derived from individual tests to coalbed reservoirs having similar reservoir characteristics.

To enable prediction of methane production rates that can be realistically expected from a particular coalbed reservoir.

b. State-of-the-Art

A mathematical model exists that simulates two-phase flow in gas reservoirs. This model is currently being applied to coalbeds to simulate methane production. The model has been shown to be most sensitive to changes in the following parameters:

- Coal seam thickness
- Coal permeability
- Relative permeability characteristics of coal
- Gas pressure
- Gas content of coals
- Fracture length
- Fracture conductivity.

c. Needs

Once it has been satisfactorily demonstrated that a model is capable of predicting that which has been observed under short term ($\sim$1 year) test conditions in a sufficient number of test cases, significant confidence can be placed in production predictions, generated by the model for a given set of reservoir parameters. Verification of long term (10-20 year) production predictions are outside the scope of the project. Individual well productivity and the attendant well interference/well spacing data is needed to define mining parameters of interest. These methane drainage parameters, total methane drained, time of drainage, well spacing, etc., are needed for use in an integrated planning mode to increase mining productivity and reduce the cost of ventilation.

d. Technical Approach

Following the methodology set forth in the Resource Delineation Plan, in FY 1980 it is planned to provide a number of production tests in several different coalbed reservoirs. From the preliminary data obtained in well testing, the mathematical model will provide preliminary predictions of pre- and post-fracture gas flows as well as longer-term productivities. The results of the predictions will be compared with the production data obtained, and appropriate history matching adjustments will be made to model predictions.

e. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 1.2.2 are tabulated in Figure 4-7.

CONTRACTORS / TASKS	Conduct Production Tests to Provide Data for Model Validation	Modify Models as Required to Predict Coalbed Reservoirs						FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X						50	160
Intercomp	X	X						8	15
BASIC BUDGET TOTAL								58	
ENHANCED BUDGET TOTAL									175

FIGURE 4-7. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 1.2.2, Reservoir Production Predictions

4.2 MRCP ELEMENT 2 - RESEARCH AND DEVELOPMENT

Element 2. Objectives

Overall objectives of the MRCP R&D activities are to investigate technology and equipment improvements to increase economical gas production and utilization from coalbeds. Specific R&D objectives are to:

- Improve drilling methods and tools for more efficient extraction of coalbed methane from minable and unmined sources.
- Integrate methane extraction/coal mining operations for optimal methane recovery and mine planning and productivity.
- Develop gas preparation and utilization technologies which maximize the commercial attractiveness of coalbed methane.

Element 2. Organization

4.2.1 Work Package 2.1 - Extraction Technology R&D

Major Problems/Issues to be Resolved

- Current coalbed methane extraction methods (drilling plus completion) are generally uneconomical.
- Well fracture treatments pose potential roof damage problems in minable coal seams.
- Technically viable extraction methods for unmined coal seams (deep or steeply-dipping) have not been demonstrated.

Work Units

- Drilling (WBS 2.1.1)
- Stimulation (WBS 2.1.2)

4.2.1.1 Work Unit 2.1.1 - Drilling (Figure 4-8)

a. Objective

To develop and modify horizontal drilling techniques and equipment specifically applicable to the extraction of methane from coalbed reservoirs.

b. State-of-the-Art

Experimentation has been conducted of a technique for placing horizontal boreholes in coal seams by directional drilling from the surface with a conventional oilfield-type rotary rig. Also, available technology for drilling methane drainage holes into active mining faces has been employed within-mine using conventional machinery normally employed in drilling blast holes. On a larger scale, little has been known until recently on effective well spacing and patterns to aid in maximizing production of natural gas from coal seams.

c. Needs

Drilling R&D needs for coalbed methane recovery arise from mining-related practical considerations and economics. Improved directional and horizontal drilling techniques and hardware are required for gas production in conjunction with mining operations and from deep unmined coal sources. Drilling patterns and spacing for methane production in advance of mining operations need to be researched to obtain maximum well deliverability over reasonable production intervals (e.g., 4 to 6 years). As a result, much of the present technology does not meet specific requirements inherent in producing the coalbed methane resource.

R&D efforts are needed in the following areas:

- Evaluation of directional drilling with improved downhole drilling motors
- Development of waterjet drilling techniques for horizontal drilling
- Demonstration of vertical borehole, directional drilling, and horizontal drilling recovery benefits and economics (same site, common geological setting, etc. for comparisons).

d. Technical Approach

The approach to drilling R&D consists of investigating specific drilling methods and tools for effective use in coalbed methane extraction (both minable and unmined) which meet identified needs. Drilling R&D efforts are required in the following areas:

- Determination of effective drilling radii and angles based on local fracture systems and stress fields to maximize well deliverability.
- Development and testing of the Maurer downhole drilling motor which is expected to deliver more power and increase reliability in directional drilling applications.

- Improvement of guidance equipment and development of downhole steering systems for directional drilling efficiency.
- Development of improved drill bits to accommodate advanced downhole drilling motors.
- Performance of developmental field testing of downhole drilling motors, directional guidance systems and downhole steering tools for directional drilling applications.
- Investigation of the use of waterjet drilling systems to reduce overall drilling costs in coal seams for horizontal drilling.
- Development and demonstration of directional and horizontal drilling applications.
- Demonstration testing of vertical, directional, and horizontal techniques under common geological conditions.

e. Tasks, Contractors and Budget

Current specific tasks, contractors and budget dollars for Work Unit 2.1.1 are tabulated in Figure 4-8.

CONTRACTORS / TASKS	Develop and Deliver Hardware for Turbodrill Testing	Assist in Phase II Testing of Turbodrill at Gearhart-Owen Inc.	Develop Downhole Turbodrill Tachometer Unit	Support Turbodrill Testing and Evaluate Results	Develop Technology for Water Jet Horizontal Drilling	Develop and Demonstrate Horizontal Drilling Techniques*	Develop and Demonstrate Directional Drilling Techniques**	FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
Maurer Engineering, Inc.	X							17	50
Maurer Engineering, Inc.		X						25	75
Maurer Engineering, Inc.			X					8	25
TRW				X				15	50
Sandia Laboratories					X			150	307
J & L Emerald Mines						X		*	*
Occidental Research Corporation (ORC)							X	**	**
							BASIC BUDGET TOTAL	215	
							ENHANCED BUDGET TOTAL		507

*This Task and budget allocation are included in Technology Test, Work Unit 3.1.3 (See Figure 4-15, Emerald Mines).

**This Task and budget allocation are included in Technology Test, Work Unit 3.1.2 (See Figure 4-14, ORC).

FIGURE 4-8. TASKS, ORGANIZATIONS AND FY80 BUDGET ($1,000)
Work Unit 2.1.1, Drilling

4.2.1.2 Work Unit 2.1.2 - Stimulation (Figure 4-9)

a. Objectives

The overall stimulation R&D objectives are to develop, modify and design stimulation techniques which apply to specific coal seam reservoir applications. Specific objectives include:

- Performance of multi-seam stimulations and completions from a single vertical borehole
- Design of stimulation treatments which maximize methane production and, in minable seams, without causing roof damage.

b. State-of-the-Art

Several fracturing techniques are available; however, their applicability to coalbeds (particularly with respect to fracture containment and mine safety for minable coal seams) remains to be demonstrated.

Normal hydraulic fracturing is already developed and has been in use for many years. Hydraulic fracturing is a mechanical process whereby in situ stress conditions are utilized to propagate fractures in a natural gas reservoir. The purpose is to open up artificial flow channels from the rock to the wellbore and thereby enhance gas recovery. This is accomplished by pumping a fluid under high pressure into the formation and then propping open the fracture once it is induced. The fluid utilized is designed for the specific reservoir rock and fluid properties so as not to damage the formation or inhibit production.

Foam fracturing has been under development by oil and gas service companies for some time. Foam fracturing is a process whereby nitrogen, water, and an emulsifying agent are combined and used as the fracturing fluid. Although some success has been realized, this process must still be considered as in the experimental stage of development.

The gas (cryogenic) fracturing process consists of injecting a mixture of liquefied CO_2, liquefied petroleum gases, and methyl alcohol and a gelling agent to fracture the formation. It also must be considered as in the experimental stage for coalbed methane.

A novel approach to fracturing recently developed is the dendritic process. The procedure for applying dendritic fracturing involves reversing flow in cycles. The technique utilizes at least two cycles of fluid injection sufficient to fracture the formation and includes at least one period of reverse flow from the formation long enough to allow a significant change to be registered in fluid pressure. The reason for reversing the flow between injections is to relax the in situ stress field so that the second injection induces fractures at right angles to the first set.

Explosive fracturing is a chemical process that uses two basic approaches. One is borehole shooting with a single charge, and the other involves detonating an explosive mixture after pumping a chemical slurry downhole. The borehole shooting method uses nitroglycerin or a shaped-charge explosive and has been in use in some areas for many years. With either method, a number of zones can be fractured simultaneously if enough explosive is introduced and isolated with a cement plug above the top interval. A particular disadvantage to this stimulation method is that all or some of the downhole area is usually reduced to rubble and filled with debris, sometimes to the extent of actually impeding fluid production after the shot. A successful cleanup operation may restore flow. In general, the results of borehole shooting with nitroglycerin are unpredictable in terms of incremental gas production over long-term well life.

c. Needs

Stimulation R&D relates to the characteristically low permeability of methane bearing coal formations. Production by conventional open hole completion generally results in noneconomic production levels. Specific R&D needs consist of reliable stimulation techniques (e.g., chemical explosives in highly fractured coal seams and foam treatments in less fractured coal seams) relative to specific geological settings which result in economic methane production from coal seams without sacrificing minability of the coal or mine safety. Reliable methods of treatment control for fracture containment are of particular concern in minable coal seams.

d. Technical Approach

The technical approach to stimulation R&D is based on evaluation of in situ parameters of coal formations and identifying appropriate stimulative treatments for methane production based on in situ measurements. Specific parameters include permeability, fracture density prior to treatment, gas content of the coal, in situ stresses, and water content. Evaluation criteria for specific stimulation treatments include well cleanup characteristics, improvement ratio of gas production, long-term production characteristics, fracture containment control and measurement, effect of the treatment, or the structural integrity of the coal seam for mining. In FY 1980, there will be 3 to 4 drilling test projects and 4 to 5 stimulations in technology test projects.

e. Tasks, Contractors and Budget

Current specific tasks, contractors and budget dollars for Work Unit 2.1.2 are tabulated in Figure 4-9.

CONTRACTORS / TASKS	Develop Use of Explosive Gas Fracturing to Increase Permeability of Coal	Study Concept of CO_2 Use to Enhance Gas Production from Coal	Review/Evaluate Effect of Pre-drainage Stimulation Techniques on Coal Recovery at Later Time	Study/Analyze Reservoir Fracturing and Mining Through Fractured Areas and Develop Gas Prediction Model	Obtain Experimental Data of Coal Fracture Mechanics	Study Coal Permeability Enhancement	Conduct Multi-seam Dendritic Fracture Treatments in Conjunction with Technology Test Project	FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
Physics International	X							300	600
University of Pittsburgh		X						30	50
Colorado School of Mines			X					85	85
Pennsylvania State University				X				120	120
TBD			X					410	410
West Virginia University					X			-	50
Scientific Applications, Inc.						X		-	150
Westinghouse							X	*	*
Intercomp				X				*	*
							BASIC BUDGET TOTAL	945	
							ENHANCED BUDGET TOTAL		1465

*Budget dollar allocations are included in other Tasks:

- Westinghouse, Work Unit 3.1.1 (See Figure 4-13)
- Intercomp, Element 1 (See Figures 4-1 through 4-7)

FIGURE 4-9. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 2.1.2, Stimulation

4.2.2 Work Package 2.2 - Preparation Technology R&D

Major Problems/Issues To Be Resolved

The quality, extraction flow rate, and relatively low and often variable pressure of coalbed methane requires the development of techniques and equipment that will make economic transport and use of this energy source possible. Preparation technology development is necessary to:

- Provide techniques/equipment capable of economically preparing coalbed methane so that it meets commercial pipeline specifications. The quality of gas produced from coalbeds typically falls short of that required for commercial pipeline utilization. In many cases it is a mixture of gases, including contaminants and diluents, that lower heating value and affect other properties. In active mining operations gob gas is frequently available in relatively large quantities, but of a quality that may vary from 25 to 90% methane. Frequently low and/or variable pressure must be accommodated when preparing for pipeline injection. All of the above described conditions present problems that must be satisfactorily resolved.
- Provide techniques/equipment capable of economically preparing coalbed methane so it may be stored and transported to markets when commercial pipelines are too remote/inaccessible to make their use feasible. In such instances conversion to LNG and subsequent transport in this form appears to offer the most promise to resolve this problem.

Current technology may be used to convert high quality predrained methane to LNG; however, equipment designed and developed for the relatively low flow rates encountered in coalbed methane is not commercially available. The utilization of gob gas encountered in mining operations is desirable and may also be accomplished by upgrading in the process of converting to LNG. The upgrading of the gob gas requires some modification of existing air separation technology for LNG manufacture. The above described requirements for equipment development must be accomplished as an alternative to pipeline injection when commercial pipelines are not available.

Work Units

- LNG Conversion (WBS 2.2.1)
- Membrane Separation (WBS 2.2.2)
- Mixed Gas Upgrading (WBS 2.2.3)

4.2.2.1 Work Unit 2.2.1 - LNG Conversion (Figure 4-10)

a. Objective

To convert coalbed methane to LNG when the economics of distribution and use require an alternative to commercial pipeline injection. The project scope includes system design, hardware fabrication, testing and evaluation.

b. State-of-the-Art

The process for converting pipeline quality methane gas to LNG exists and is accomplished commercially in applications involving quantities larger than are involved in coalbed methane extraction (millions of cubic feet per day vs. thousands of cubic feet per day). The equipment used in existing applications is many times larger than is suitable for coalbed method applications. In addition, when gob gas is available as a result of mining operations, suitable air separation technology is not currently available.

c. Needs

A requirement exists to provide an alternative means of getting coalbed methane to potential markets when commercial pipelines are not available. A requirement also exists to use gob gas rather than venting or flaring as is now practiced when mining coal. The above two requirements establish the need to develop LNG conversion capability for coalbed methane applications.

d. Technical Approach

The technical approach for converting pipeline quality coalbed methane to LNG will be to first identify existing processes and equipment being used in much larger applications. Each alternative will then be evaluated for the theoretical effect of equipment scale-down and the economics associated with each. The selected alternative will be recommended for development that will include design, fabrication, test and evaluation. The technical approach for converting gob gas to LNG will incorporate the equipment developed for converting pipeline quality gas and identify alternatives for modifying air separation technology needed for this application. The alternatives for air separation will be evaluated and a recommendation made to design, fabricate, test and evaluate the most promising option.

One LNG R&D application is currently under consideration in conjunction with a technology test project (Work Unit 3.1.2, Horizontal Borehole Drainage Projects, Occidental Research Corporation).

e. Tasks, Contractors, and Budget

Current specific tasks, contractors, and budget dollars for Work Unit 2.2.1 are tabulated in Figure 4-10.

CONTRACTORS \ TASKS	Develop LNG Conversion Equipment*							FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
Occidental Research Corporation (ORC)	X							*	*

* This Task and budget dollar allocation are included in Technology Tests, Work Unit 3.1.2 (See Figure 4-14, ORC).

BASIC BUDGET TOTAL	-	X
ENHANCED BUDGET TOTAL	X	-

FIGURE 4-10. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 2.2.1, LNG Conversion

4.2.2.2 Work Unit 2.2.2 - Membrane Separation (Figure 4-11)

a. Objective

To develop membrane separation technology capable of upgrading low quality coalbed methane so it is suitable for pipeline injection. Coalbed methane contaminated with other gases such as CO_2 and nitrogen may be of lower quality than is acceptable for injecting into commercial pipelines.

b. State-of-the-Art

The best available information indicates some small scale R&D is being conducted privately for mixed gas separation. The technique reportedly shows promise but no data is available for evaluation.

c. Needs

Many sources of coalbed methane have been analyzed and found to be contaminated with other gases such as CO_2 and nitrogen. This makes them unsuitable for pipeline injection and establishes a need to develop a technology capable of economically separating the contaminating gases from the methane so it is upgraded to pipeline quality.

d. Technical Approach

The technical approach will initially involve performing a feasibility study to better define:

- The potential resource recoverable
- The organizations currently involved in membrane separation and extent of their effort that is applicable to this requirement
- The projected economics of membrane separation
- Alternative methods of mixed gas separation

Based on positive study results, laboratory scale development and testing of the most promising processes will be provided. Final development will take the best laboratory scale option and scale it up for field test and evaluation in a technology test project.

e. Tasks, Contractors, and Budget

Current specific tasks, contractors, and budget dollars for Work Unit 2.2.2 are tabulated in Figure 4-11.

CONTRACTORS / TASKS	Conduct Membrane Separation Feasibility Study							FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TBD	X							*	*
BASIC BUDGET TOTAL								-	
ENHANCED BUDGET TOTAL									-

*Funding not available in FY 1980

FIGURE 4-11. TASKS, CONTRACTORS AND BUDGET ($1,000)
Work Unit 2.2.2, Membrane Separation

4.2.2.3 Work Unit 2.2.3 - Mixed Gas Upgrading Device/Process (Figure 4-12)

a. Objective

To develop a mixed gas upgrading device(s)/process capable of removing contaminating gases from coalbed methane sufficient to make utilization of the methane economically feasible for many applications.

b. State-of-the-Art

The best available information indicates that Hydrotech Engineering of Tulsa, Oklahoma is conducting research and developing such a device/process. Activiated charcoal is thought to be involved in the process; however, the device/process is proprietary and a patent has been applied for. Intercomp reportedly has sole marketing rights to the device/process.

c. Needs

Many sources of coalbed methane have been analyzed and found to be contaminated with other gases such as CO_2 and Nitrogen. This makes them unsuitable for many desirable applications and establishes a need to develop a technology capable of economically removing the contaminating gases to the degree necessary for a selected application.

d. Technical Approach

The technical approach will initially involve performing a feasibility study to:

- Obtain more information on the device being developed by Hydrotech Engineering and what its specified performance characteristics will be.
- Based on the performance specifications, determine utilization applications for which this device/process would remove sufficient contaminating gases from the coalbed methane.
- Project the economics of utilization applications that require the use of this device/process.
- Compare this device/process with other alternatives for mixed gas upgrading.

Based on positive study results, determine what mutually satisfactory arrangement could be worked with Hydrotech Engineering/Intercomp for independent testing of their device/process to ascertain its actual performance and operating costs. If this is satisfactory, scale-up to coalbed methane utilization applications will be accomplished.

Pressure swing adsorption techniques may also be studied.

e. Tasks, Contractors, and Budget

Current specific tasks, contractors, and budget dollars for Work Unit 2.2.3 are tabulated in Figure 4-12.

CONTRACTORS \ TASKS	Conduct Mixed Gas Upgrading Device/ Process Feasibility Study							FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TBD	X							*	*

* Funding not available in FY 1980.

BASIC BUDGET TOTAL		
ENHANCED BUDGET TOTAL		

FIGURE 4-12. TASKS, CONTRACTORS AND BUDGET ($1,000)
Work Unit 2.2.3, Mixed Gas Upgrading

4.3 MRCP ELEMENT 3 - TECHNOLOGY TESTS

Element 3. Objectives

Objectives of the Technology Testing activities are to:

- Field test coalbed methane integrated extraction, product preparation, and utilization systems.
- Investigate and resolve variables that will be encountered under field conditions.
- Evaluate the systems/subsystems tested for technical and economic feasibility and readiness for commercial ventures.

Element 3. Organization

4.3.1 Work Package 3.1 - Minable Coalbed Projects

Major Problems/Issues to be Resolved

- Resolution of variables that may be encountered in systems/subsystems selected for commercial extraction, processing, and utilization of coalbed methane.
- Coordination/integration of extraction and preparation/utilization equipment under actual field tests.
- Determination of more accurate and reliable economic factors.
- Determination of environmental impacts and information concerning cost of compliance.

Work Units

- Multiple Well Projects (WBS 3.1.1)
- Horizontal Borehole Drainage Projects (WBS 3.1.2)
- Advanced Systems Test Projects (WBS 3.1.3)

4.3.1.1 Work Unit 3.1.1 - Multiple Well Projects (Figure 4-13)

a. Objectives

To drain methane in advance of mining.

To evaluate new and improved extraction methods (well spacing, geometry, etc.)

To operate, test, and evaluate new and improved systems/subsystems and methods during methane extraction, product preparation, and utilization operations.

b. State-of-the-Art

- Oil and conventional gas well equipment and methods have been employed to a very limited degree for coalbed methane extraction, but almost no utilization subsystem designs have been tried.
- Extraction to date has demonstrated probable technical viability, but quantitative experience in gas yield over time, mine safety and mine productivity increase is not demonstrated.
- Proven economic experience based on full systems tests (extraction through utilization) is lacking.
- Measures to minimize costs have been conceived and in certain cases are in R&D (e.g., new drills, new fracture methods, etc.) but require further test and evaluation.

c. Needs

- More effective equipment and methods to achieve economical drainage and utilization from well fields.
- Field tests to develop and improve such methods.
- Experience through such tests to determine and demonstrate technical and economic viability.

d. Technical Approach

Technology test projects normally are performed in several phases with project continuation dependent upon favorable review and approval at selected milestones: (1) Feasibility (including economic considerations) is first reviewed for proposed test projects. (2) Methane extraction/utilization equipment is designed to provide an integrated total system which is also coordinated with (3) Site selection. (4) Drilling/construction/installation, (5) Test and (6) Field operation phases follow. Information resulting from each test project is (7) evaluated, documented and made available to the private sector.

At present, one project technology test project in this category is in progress. Wells have been completed, dewatering performed, and free flow flared. However, more suitable candidates will be investigated because of the marginal cost/benefit ratio of the present project. Two or three other test projects are expected to start in FY 1980.

e. Tasks, Contractors and Budget

Specific tasks, contractors, and FY 1980 budget dollars for Work Unit 3.1.1 are tabulated in Figure 4-13.

CONTRACTORS / TASKS	Develop Techniques for Methane Extraction and Utilization for Space Heating/Drying Applications	Develop Utilization System for Gas From Multiple Wells	TBD					FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
Westinghouse* (Waltz Mill)	X							300	450
US Steel Corporation		X						320	320
Clinchfield Coal Company		X						**	**
New Project			X						305
BASIC BUDGET TOTAL								620	
ENHANCED BUDGET TOTAL									1075

* Also see Figure 4-9.

** Funding requirements met prior to FY 1980.

FIGURE 4-13. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 3.1.1, Multiple Well Projects

4.3.1.2 Work Unit 3.1.2 - Horizontal Borehole Drainage Projects (Figure 4-14)

a. Objectives

To drain methane prior to or during mining operations.

To evaluate new and improved equipment and methods for horizontal borehole drainage.

To operate, test, and evaluate new and improved systems/subsystems, and methods during actual horizontal borehole operations.

b. State-of-the-Art

- Equipment and methods are in use for emplacement of directionally drilled holes from within the mines or from the surface and placement of explosive charges and underground lines or drains.
- In the interest of mine safety, limited use of equipment and methods has been made for drilling in advance of mining to reduce methane at the mine face.
- No real experience data base exists, however, on full system (extraction through utilization) installation and operation.
- A start has been made in drill improvement and drill guidance, but greater efficiency and reliability is required.

c. Needs

- More efficient equipment and methods to achieve economical drainage and well fields.
- Field tests to develop and improve such method (i.e., trying different hole spacing, lengths, placement in seams, etc.) and to prove equipment reliability.
- Experience through such tests to determine technical and economical viability.

d. Technical Approach

A technology test project for recovery of methane using long horizontal boreholes from within the mine has been identified, and negotiations with the potential participating contractor are in progress. The project is due to be completed by the end of calendar year 1979. Additional candidates may be evaluated as they are identified.

e. Tasks, Contractors, and Budget

Specific tasks, contractors, and FY 1980 budget dollars for Work Unit 3.1.2 are tabulated in Figure 4-14.

CONTRACTORS / TASKS	Develop Techniques for Methane Recovery From Horizontal Boreholes Within Mine and for LNG Utilization							FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
Occidental Research Corporation (ORC)*	X							800	1000
BASIC BUDGET TOTAL								800	
ENHANCED BUDGET TOTAL									1000

* Also see Figures 4-8 and 4-10.

FIGURE 4-14. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 3.1.2, Horizontal Borehole
Drainage Projects

4.3.1.3 Work Unit 3.1.3 - Advanced Systems Test Projects (Figure 4-15)

a. Objectives

- To drain methane prior to mining by new methods or to use the methane in advanced utilization subsystems.
- To operate, test, and evaluate the new methods or advanced subsystems during methane extraction, product preparation, and utilization.

b. State-of-the-Art

- A technology test project is underway to extract methane by multiple wells and use the gas as fuel for a transportable turbine generator plant. The plant is capable of using either predrainage or gob quality gas. It will be tested with both qualities of gas.
- Directional drilling from the surface has been successful in entering and penetrating several hundred feet along a near-horizontal, gassy coal seam. Two other in-seam, long holes are programmed to proceed rapidly. No accurate estimate of gas to be extracted is yet available, and no utilization system has been designed.

c. Needs

- To continue the technology test project for transportable power generation using predrainage or gob quality gas to determine the technical and economic viability of this advanced utilization system.
- To design an appropriate utilization system for the large gas output expected from the directional well project. Install and test upon confirmation that gas extracted indicates viability of the system.

d. Technical Approach

- The two advanced projects described above are proceeding on a phased basis, with the power generation project presently in a detailed design and validation phase, and the directional well's extraction subsystem in an implementation phase. For the latter, various utilization subsystems will be evaluated, and thereafter a proposed design finalized.
- As other systems are recognized as possibly warranting full system tests to establish economic and technical viability, they will be planned and implemented.

e. Tasks, Performing Organizations, and Budget

Specific tasks, performing organizations and FY 1980 budget dollars for Work Unit 3.1.3 are tabulated in Figure 4-15.

CONTRACTORS / TASKS	Develop Utilization System for Gas Produced by Directional Drilling Techniques							FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
J & L Emerald Mines Mines*	X							-	200
BASIC BUDGET TOTAL									XXXX
ENHANCED BUDGET TOTAL								XXXX	200

* Also see Figure 4-8.

FIGURE 4-15. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 3.1.3, Advanced Systems Test
Projects (Minable Coalbed Technology Tests)

4.3.2 Work Package 3.2 - Unmined Coalbed Projects

Major Problems/Issues to be Resolved

- Resolution of system/subsystems variables that will be encountered in commercial operations.
- Coordination/integration of extraction and preparation/utilization equipment under actual field tests.
- Determination of more accurate and reliable economic factors.
- Determination of possible project environmental impacts and means and costs of satisfactorily ameliorating such impacts.

Work Units

- Deep Coalbed Drainage Projects (WBS 3.2.1)
- Overlaying Urban Area Coalbed Drainage Projects (WBS 3.2.2)
- Directional Drilling Coalbed Drainage Projects (WBS 3.2.3)
- Advanced Systems Test Projects (WBS 3.2.4)

4.3.2.1 Work Unit 3.2.1 - Deep Coalbed Drainage Projects (Figure 4-16)

a. Objectives

- To develop and field test effective systems for extraction and utilization of methane from deeply lying coal seams.
- To investigate and resolve variables which will be encountered under field conditions.
- To operate, test, and evaluate new and improved systems, subsystems and methods for methane extraction, product preparation, and utilization.

b. State-of-the-Art

- Little to no experience has been gained to date in extracting and utilizing methane from deeply lying coal seams.
- No specific new methods or equipment have been developed and tried to exploit solely the deep coalbeds.
- Nevertheless, from extraction from conventional gas and oil wells, methods and equipments exist to form a baseline for initial technology testing of extraction subsystems. Product preparation and utilization subsystems can use in significant measure experience gained and equipment used or developed for conventional gas recovery.

c. Needs

- Development of methods and techniques which will provide greater efficiency or less cost for coalbed methane extraction and utilization.

- Experience through such tests to determine and demonstrate technical and economic viability.

d. Technical Approach

Technology test projects normally are performed in several phases with project continuation dependent upon favorable review and approval at selected milestones: (1) Feasibility (including economic considerations) is first reviewed for proposed test projects. (2) Methane extraction/utilization equipment is designed to provide an integrated total system which is also coordinated with (3) site selection. (4) Drilling/construction/installation, (5) test and (6) field operation phases follow. Information resulting from each test project is (7) evaluated, documented and made available to the private sector.

At the present time, three technology test projects investigating methane drainage from deep coalbeds are in progress. For the first, drilling plans and the preliminary environmental impact assessment have been completed. The project is long-ranged, and will continue through FY 1982. The second project has just begun, and will consist of a multiwell project. The system preliminary design has been completed and the detailed design and analysis and the implementation will be completed by the end of FY 1980. The third project is being negotiated and work on the environmental impact assessment, the detailed design, well drilling and completion will be started. The project is slated for completion in December 1981.

e. Tasks, Contractors, and Budget

Specific tasks, contractors, and FY 1980 budget dollars for Work Unit 3.2.1 are tabulated in Figure 4-16.

CONTRACTORS / TASKS	Develop Techniques for Coalbed Methane Extration From Deep Horizons for Pipeline Insertion	Develop Techniques for Coalbed Methane Extraction From Deep Horizons for Pipeline Insertion	Develop and Demonstrate Systems for Multi-Well Methane Recovery From Anthracite for Pipeline Use					FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
Mountain Fuel	X							150	250
Intercomp/COSEKA		X						-	150
Pennsylvania Energy Resources, Inc. (PERI)			X					500	650
BASIC BUDGET TOTAL								650	
ENHANCED BUDGET TOTAL									1050

FIGURE 4-16. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 3.2.1, Deep Coalbed Drainage Projects

4.3.2.2 Work Unit 3.2.2 - Overlaying Developed Area Coalbed Projects (Figure 4-17)

a. Objective

To extract methane from coalbeds underlying well developed surface areas (e.g., underlaying an urban area).

b. State-of-the-Art

Since methane drainage has been related to coal mining activities, systems and subsystems for economical extraction, product processing, and utilization of methane from such areas has not been demonstrated.

c. Needs

- Design of systems for extraction processing and utilization which will not disturb the surface environment.
- Field testing of novel ways of utilizing the extracted methane which would enhance economic viability.

d. Technical Approach

- To date, one such project has been identified, and contract conditions are being reviewed. The potential contractor will use methane extracted to supplement the commercial gas supply.
- Continue review of conceptual designs from interested parties to identify additional candidates for technology test projects for extraction of methane from coalbeds overlain by developed urban areas.

e. Tests, Contractors, and Budget

Tests, contractors and FY 1980 budget dollars for Work Unit 3.2.2 are tabulated in Figure 4-17.

CONTRACTORS / TASKS	Develop Multiple Well Completion and Dewatering for Pipeline Use							FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
Waynesburg College	X							25	25
BASIC BUDGET TOTAL								25	X
ENHANCED BUDGET TOTAL								X	25

FIGURE 4-17. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 3.2.2, Overlaying Developed Area
Coalbed Drainage Projects

4.4 MRCP ELEMENT 4 - PROJECT INTEGRATION

Element 4. Objectives

Objectives of the Project Integration Activities are to:

- Provide project support and analysis.
- Provide project report development.
- Develop plans and implement systems for project information management and technology transfer.

Element 4. Organization

4.4.1 Work Package 4.1 - Project Support and Analysis

Major Work to be Accomplished

- Intra- and inter-project activities require coordination particularly with respect to the resource engineering activities and the R&D and technology test projects.
- Supporting studies and analyses are needed in broader scope/greater depth than will be provided by individual project tasks and other contract work performed for specific purposes.

Work Units

- Project Activity Support (WBS 4.1.1)
- Environmental, Safety, Regulatory and Institutional Constraints Analyses (WBS 4.1.2)
- Economic and Cost Factors Development (WBS 4.1.3)

4.4.1.1 Work Unit 4.1.1 - Project Activity Support (Figure 4-18)

a. Objectives

To provide necessary project technical and nontechnical support and coordination: internally for the several diverse activities (resource delineation, reserve estimation, R&D and technology tests); and externally, by laision with other UGR projects/programs and private industry activities.

b. Tasks, Contractor and Budget

Specific tasks, contractor and FY 1980 budget dollars for Work Unit 4.1.1 are tabulated in Figure 4-18.

CONTRACTORS / TASKS	Provide Technical and Project Integration Assistance	Provide Technical and Project Integration Assistance	Provide Technical and Project Integration Assistance					FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW *	X							750	1000
Harris & Associates Engineers		X						150	200
U.S. Bureau of Mines (USBM)			X					(120)	(120)
							BASIC BUDGET TOTAL	1020	
							ENHANCED BUDGET TOTAL		1320

*Includes project engineering support to Technology Tests

FIGURE 4-18. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 4.1.1, Project Activity Support

4.4.1.2 Work Unit 4.1.2 - Environmental, Safety, Regulatory and Institutional Constraints Analyses (Figure 4-19)

a. Objectives

To identify/investigate/analyze/evaluate MRCP problem areas resulting from environmental requirements, safety considerations, and regulatory and other institutional constraints.

To determine actions required for the resolution of factors constraining project success and early coalbed methane commercialization.

b. State-of-the-Art

In general, the various constraints are set forth in laws, regulations, court decisions or local practices. However, their application to specific projects, potential project areas, or catagories must be analyzed and evaluated, frequently on a case by case basis.

c. Needs

Analysis and study is required to support specialized areas of project activities. Known areas encompass environmental and regulatory issues. It is anticipated that other problems/issues will be identified.

d. Approach

Constraints and problem areas will be identified and reviewed and, if required, specific analysis or study assignments made to investigate specific areas in depth. Where appropriate, investigative R&D activity will be initiated. If field testing is desirable, an on going test project may be able to provide timely verification of proposed solutions resulting from analysis or R&D findings.

e. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 4.1.2 are tabulated in Figure 4-19.

CONTRACTORS / TASKS	Perform Environmental Analyses/ Studies and Assess Impact and Cost of Compliance	Perform Safety Hazards Analyses and Other Safety Related Functions as Directed	Identify Regulatory Constraints and Means for Resolution	Identify/Analyze/Evaluate Other Institutional Constraints as Directed				FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X	X				25	50
BASIC BUDGET TOTAL								25	X
ENHANCED BUDGET TOTAL								X	50

FIGURE 4-19. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 4.1.2, Environmental, Safety, Regulatory and Institutional Constraints Analyses

4.4.1.3 Work Unit 4.1.3 - Economic and Cost Factors Development (Figure 4-20)

a. Objective

To determine the economic considerations of the methane extraction/utilization systems which are proposed/tested and to determine that combination of systems which will provide maximum viability under expected field conditions.

b. State-of-the-Art

Present methane recovery methods are based for the most part on oil field drilling practices and established mining procedures. Utilization methods are based on proven commercial processes, but the equipment has been designed for large gas volume throughput. New equipment and methods must be developed/modified and off the shelf equipment must be scaled down as appropriate to accommodate the relatively small gas production from coalbeds.

c. Needs

Improved methods and equipment are required which will provide economical extraction and preparation for use of coalbed methane, without compromising safety where mining operations are involved. This requires determination of detailed cost factors for equipment, development and operation, and determination of the economic effect on mining operations of the use of that equipment.

Some specific recovery and utilization methods have been technically demonstrated. However, the economic viability of methods and conbination(s) of methods must be demonstrated under field conditions, and the requisite technology/economic analyses provided to industry in order to promote early and rapid commercialization.

d. Approach

In FY 1980, combinations of off the shelf methods for methane extraction and use will be selected which most closely meet expected requirements of field conditions. For each method combination, costs to develop, modify, and operate the system will be determined. In conjunction with this, the economic effects of these operations on mining operations also will be determined.

e. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 4.1.3 are tabulated in Figure 4-20.

CONTRACTORS / TASKS	Determine Cost to Develop/Modify Extraction Equipment	Determine Cost to Develop/Modify Product Preparation/Utilization Equipment	Determine Economic Effect on Mining Operations of Use of Recovery and Utilization Equipment					FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X					75	100
Selected Mine Contractors	X	X	X					*	*
Selected Equipment Manufacturers	X	X						*	*
BASIC BUDGET TOTAL								75	
ENHANCED BUDGET TOTAL									100

* Task cost included in TRW task.

FIGURE 4-20. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 4.1.3, Economic and Cost Factors Development

4.4.2 Work Package 4.2 - Information Management and Technology Transfer

Major Work to be Accomplished

- The MRCP requires development and implementation of a system for management of the information resulting from the project activities.
- Technical information resulting from the activities of multiple MRCP participants needs to be evaluated and consolidated into project-wide reports. MRCP information needs to be prepared for inclusion in overall UGR reporting.
- MRCP information must be made available to potential users, including the private sector, on a timely basis during the course of the project.

Work Units

- Information Management (WBS 4.2.1)
- Technology Transfer (WBS 4.2.2)

4.4.2.1 Work Unit 4.2.1 - Information Management (Figure 4-21)

a. Objectives

To develop a plan and implement a system for management of MRCP information requirements.

To correlate information resulting from the several parts of the MRCP (in-house information, individual contractor technical reports, information from other agencies, etc.)

To provide integrated, overall reporting of MRCP activities and results.

b. Approach

Initially, management of information resulting from MRCP activities will use a simple and economical, but planned, system sufficient to meet anticipated modest early project and user needs--a manually maintained open file at one location. To meet increased information volume and complexity, MRCP requirements will be reviewed/updated periodically (three to six month intervals) and appropriate revisions will be made to the system as needed. Possible modifications include:

- Additional locations (other DOE technology centers)
- Partial automation (indexing)
- Full automation (all functions)
- Calculating capability (modeling)
- Full computerization (including copy production)

Information generated at many sources by the several MRCP activities will be correlated, indexed, and stored where it readily may be retrieved for use by the originator or other project participants. Data will be reviewed and analyzed by a common integrating function and appropriate semi-annual/annual reports and other technical memoranda will be published to provide project-wide visibility and reporting.

c. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 4.2.1 are tabulated in Figure 4-21.

CONTRACTORS / TASKS	Provide Technical Assistance and Support for Development of an Information Management Plan (IMP)	Assist in Implementation of the IMP	Assist in Correlation/Editing/Consolidation of Project Reports and Other Information Resulting from the MRCP					FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X					70	100
BASIC BUDGET TOTAL								70	X
ENHANCED BUDGET TOTAL								X	100

FIGURE 4-21. TASKS, CONTRACTORS AND FY80 BUDGET ($1,000)
Work Unit 4.2.1, Information Management

4.4.2.2 Work Unit 4.2.2 - Technology Transfer (Figure 4-22)

a. Objectives

To develop a plan and implement a system for transferring MRCP information to potential users periodically on a timely basis.

To plan and implement "Methane from Coalbeds" symposiums, normally on an annual basis.

To assemble and publish memoranda, reports and other media to disseminate new technology and other information resulting from the MRCP to potential users.

b. Approach

A plan will be developed and implemented to transfer new technology and other information resulting from MRCP activities to potential users both within and external to the project. Design of this plan will be coordinated and compatible with design features of the information management system in use by the MRCP (Reference: Work Unit 4.2.1). The flow of information will favor those industries most likely to promote early and rapid commercialization. Material will be disseminated at several levels, including:

- Industry familiarity--industrial groups, symposia, work shops, etc. (brochures, slides, exhibits)
- Professional interchange--professional groups, associations, societies, etc. (technical papers, talks, publications)
- Instructional aids--schools, universities, etc. (training aids)
- Personal involvement--hands-on experience (student/ short-term employment).

Symposia, technical publications, brochures and other media will be used to facilitate timely dissemination of information and to provide broad exposure to potential users.

c. Tasks, Contractors and Budget

Specific tasks, contractors and FY 1980 budget dollars for Work Unit 4.2.2 are tabulated in Figure 4-22.

CONTRACTORS / TASKS	Provide Technical Assistance and Support for Development, Management & Implementation of Tech. Transfer Plan (TTP)	Assist in Planning & Implementation of Annual "Methane From Coalbeds" Symposiums	Assist in Publication of Memoranda, Reports,& Other Media to Disseminate MRCP Generated Technical Information	Assist in Development of a Methane From Coalbeds Engineering Handbook				FY80 BASIC BUDGET	FY80 ENHANCED BUDGET
TRW	X	X	X	X				30	50
BASIC BUDGET TOTAL								30	X
ENHANCED BUDGET TOTAL								X	50

FIGURE 4-22. TASKS, CONTRACTORS AND FY80 BUDGET
Work Unit 4.2.2, Technology Transfer

4.5 FY 1980 CONTRACTED WORK BUDGET SUMMARY

FY 1980 budget dollars appearing in Section 4 are consolidated and tabulated in Table 4-1. Basic and enhanced budget dollars are listed separately, with dollar totals shown for three WBS levels. The basic budget comprises the currently planned budget, which provides for limited project activities. The enhanced budget would provide for additional activities as indicated at the Task level throughout Section 4. The MRCP FY 1980 annual dollar totals for contracted work and work expected to be contracted are $5.22 and $9.22 million for the basic and enhanced budgets, respectively.

1. RESOURCE ENGINEERING	BASIC BUDGET	ENHANCED BUDGET
Resource Characterization	340	490
Exploration Methods Development	30	125
Target Area & Drilling Site Selection	43	107
Resource/Reserve Estimating	58	215
Test Planning and Analysis	73	220
RESOURCE ASSESSMENT	544	1157
Reservoir Characterization	263	1066
Reservoir Production Predictions	58	175
RESERVOIR EVALUATION	321	1241
ELEMENT 1. TOTALS	865	2398

2. RESEARCH AND DEVELOPMENT	BASIC BUDGET	ENHANCED BUDGET
Drilling	215	507
Stimulation	945	1465
EXTRACTION TECHNOLOGY R&D	1160	1972
LNG Conversion		
Membrane Separation		
Mixed Gas Upgrading		
PREPARATION TECHNOLOGY R&D	0	0
ELEMENT 2. TOTALS	1160	1972

3. TECHNOLOGY TESTS	BASIC BUDGET	ENHANCED BUDGET
Multiple Wells	620	1075
Horizontal Borehole Drainage	800	1000
Advanced Systems Tests		200
MINABLE COALBED PROJECTS	1420	2275
Deep Coalbed Drainage	650	1050
Overlaying Developed Area Drainage	25	25
UNMINED COALBED PROJECTS	675	1075
ELEMENT 2. TOTALS	2095	3350

4. PROJECT INTEGRATION	BASIC BUDGET	ENHANCED BUDGET
Project Activity Support	900	1200
Project Constraint Analyses	25	50
Economic & Cost Factors Development	75	100
PROJECT SUPPORT & ANALYSES	1000	1350
Information Management	70	100
Technology Transfer	30	50
INFORMATION MANAGEMENT & TECHNOLOGY TRANSFER	100	150
ELEMENT 4. TOTALS	1100	1500

WBS 1.	RESOURCE ENGINEERING	865	2398
WBS 2.	RESEARCH AND DEVELOPMENT	1160	1972
WBS 3.	TECHNOLOGY TESTS	2095	3350
WBS 4.	PROJECT INTEGRATION	1100	1500
	Project Totals	5220 Basic	9220 Enhanced

TABLE 4-1. FY 1980 MRCP CONTRACTED WORK BUDGET SUMMARY
DOLLAR ALLOCATION BY WORK BREAKDOWN STRUCTURE ($ THOUSANDS)

SECTION 5
MANAGEMENT

5. MANAGEMENT

5.1 MANAGEMENT OVERVIEW

Management of the project is structured to plan and implement the diverse efforts of resource engineering, research and development, technology systems tests, project integration and transfer of the resulting technology to industry. These different types of work involve organizations and individuals having various capabilities and interests. Therefore, effective planning and coordination is required to assure efficient project operations.

Management methods and techniques are selected to facilitate performance of the planned project activities. Many of these activities are defined as individual and separate tasks, but never-the-less require integrated planning because of their high degree of interdependence. For example, the design and operations planning for individual extraction and utilization subsystems must be well coordinated to develop an optimum total system.

Management flexibility is required. Changes, substitutions and deletions invariably are needed as unplanned requirements and subtasks are identified during the course of a project of investigative nature.

METC will implement the project, providing planning, field management, administrative services and other institutional support normally required for the activities planned. METC also will provide for the performance of specialized services such as well drilling, specific studies/analyses, geological surveys, modeling and project integration support by initiating in-house outside procurement/contractual arrangements in accordance with approved procedures.

5.2 ROLES AND RESPONSIBILITIES

5.2.1 DOE/FE

Programmatic aspects of this project are the responsibility of the Assistant Secretary for Energy Technology, DOE. Assigned to Fossil Energy (FE) for management and implementation, program level functions include the establishment of policies and broad objectives, the definition of key deliverables,

the determination of funding limits and the delegation of authority to initiate and conduct elements of the overall effort.

Management control is vested in the Office of the Director of the Fossil Energy Program which assures coordination of DOE/FE division activities with other Federal organizations and program level integration of all parts of the effort.

5.2.2 METC

Implementation and field management of all parts of the project are delegated to METC. The relationship of the MRCP to the METC is shown in Figure 5-1.

Responsibilities for performance of the METC functions are assigned to a Project Manager who provides administrative and technical direction to in-house and contracted project activities. Assistant Project Managers and Technical Project Officers (TPO's) may be designated as required to assist the Project Manager. The Project Manager, Assistant Project Manager and TPO's, if designated, are responsible for contract monitoring, including contractor technical performance, cost expenditures, material flow, work scheduling and reporting. The METC functions include detailed planning and day-to-day conduct of specific projects and supporting activities within the scope of the overall project.

Specific METC responsibilities include:

- Preparation of an annual Project Plan Document (PPD) for concurrence by DOE/FE. This document establishes project goals, objectives and strategy; establishes project implementation planning; and presents funding and schedules for planned activities
- Implementation and integration of all parts of the project in accordance with the current Project Plan Document
- Preparation of an annual procurement schedule for concurrence by DOE/FE. This document establishes the procurement schedule for contract action required to meet the planned activities of the following year

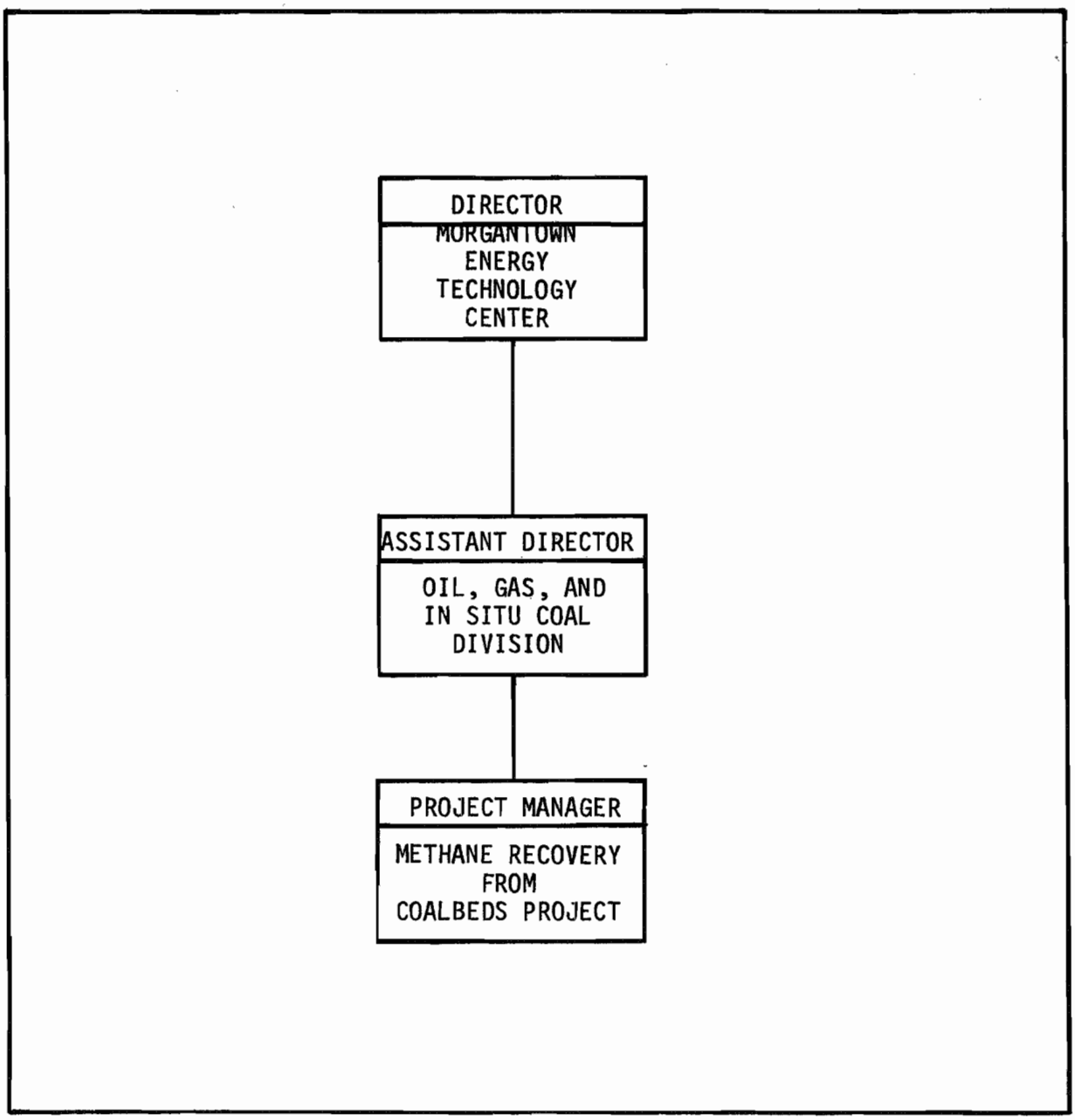


FIGURE 5-1. RELATIONSHIP OF THE MRCP TO THE MORGANTOWN ENERGY TECHNOLOGY CENTER

- Execution of contracts within the METC contractual obligational authority limitation as authorized for the project by DOE/FE. This includes all METC in-house and outside efforts, such as project management, outside contracts/grants, supporting research and technology systems tests. Contracts exceeding authorized limitations normally will be transacted by Oak Ridge Operations (ORO). Both competitive and non-competitive procurements handled by ORO require justification by METC based on project plans approved by DOE/FE

- Monitoring of contract work to insure technical accuracy; to verify cost expenditures, flow of material and reports; and to assure scheduled progress of the project

- Revision to the PPD to accommodate program/project changes, including administrative, technical and funding requirements.

5.2.3 ORO Support

Administrative support will be provided to METC by Oak Ridge Operations (ORO) for both in-house and out-of-house efforts. This support will include expertise in handling allotments, procurements and contracts, contract administration, legal assistance, financial control mechanisms, obligational authority and monthly operational reports.

5.2.4 Other Agencies and Organizations

The project is linked closely to, and will be coordinated with, efforts by other Federal agencies, industrial associations, and state, regional and local authorities.

Other Federal programs/projects are directed toward recovery of methane from unconventional gas resources (UGR). These include the:

- Eastern Gas Shales Project

- Western Tight Sands Project

- Geothermal/Geopressure Program

Upon concurrence by FE, implementation of this project will be coordinated with other programs/projects to avoid duplication of effort and to take advantage of prior or ongoing developmental work.

The primary thrust of interaction with other agencies and organizations is to maximize operations safety and to facilitate compliance with state, regional and local environmental and regulatory requirements.

The assistance of other agencies in terms of funds and technical assistance is required. The roles of state agencies responsible for energy development, mine safety and legal matters will not be overlooked, and their full cooperation will be sought to realize a federal/state partnership towards common goals.

5.3 INFORMATION MANAGEMENT

An Information Management Plan has been developed to guide processing, storage and retrieval of project-related information (Reference 2). Initially, an open file system is in operation at METC to handle the information exchange and dissemination required between major activities centered at different locations and performed by different organizations.

It is anticipated that technical and administrative processing requirements will increase significantly in the future and the existing capabilities and cost-benefit aspects will be reviewed periodically with a view to new requirements.

The information management system selected must be able to handle varied types of data generated by many different intro-project activities. The system must also enable distribution/acceptance of information to/from activities external to the project.

5.4 PROJECT CONTROL

Proper implementation of the project requires adequate management control. To establish and maintain control, the following features are incorporated in the implementation planning established in Section 4.

- Design reviews
- Operating procedure reviews
- Standard operating procedures
- Written approvals

- Go/no-go decision points
- Funding checkpoints and limitations
- Required reporting

Some of these features are particularly important to MRCP success; e.g., design reviews and standard sample handling procedures (Reference 4) to assure coordination of activities in multiple, widely dispersed locations.

Specific definition and descriptive instructions for the use of these and other control features, if necessary, will be issued as the project progresses and new/more detailed management control requirements develop.

SECTION 6

FIVE YEAR BUDGET PROJECTION

6. FIVE YEAR BUDGET PROJECTION

Project funding will be in accordance with DOE, Fossil Energy (FE) authorization. Funding will be processed through the METC with appropriate support from Oak Ridge Operations (ORO).

Budgeting of METC in-house and outside work such as drilling contracts, supporting research, technology system tests, project integration, and technology transfer functions will be processed by METC in accordance with the DOE authorization and the PPD.

Execution of contracts greater than the authorized dollar maximum will normally be transacted by ORO. Competitive and non-competitive procurements will be initiated upon submittal of proper justification prepared by METC for items defined in program/project planning and approved by FE.

Competitive contracts will be reviewed by an evaluation board whose functions include RFP preparation, proposal evaluation, contractor selection and contract negotiation. The board members include the METC Project Manager, Assistant Project Manager and Technical Project Officers and other METC, FE, and ORO personnel as required. Requirements for initiating board action will be established by the Project Manager.

Changes to on-going contracts will be initiated by the METC Project Manager with concurrence of the Contracting Officer. In all contract action, it is the responsibility of FE to insure that funding is available for the contemplated contractual activity.

Each fiscal year the Project Manager will prepare for FE review and concurrence a project budget which represents the contract action required to meet project objectives. This budget will reflect in-house and outside contract activities having an estimated value greater than $50,000.

A MRCP budget projection for the five fiscal years 1980 through 1984 is summarized in Table 6-1. In Table 6-2, budget allocations are indicated for each of these years. Two dollar figures are shown for FY 1980: a basic budget which comprises the currently planned budget providing for limited project activities and an enhanced budget which would provide for additional activities as indicated in Section 4.

WBS ELEMENT MRCP ACTIVITY	FISCAL YEAR					5 YEAR TOTAL
	1980 BASIC	1981	1982	1983	1984	
Element 1. RESOURCE ENGINEERING	0.8	3.0	3.1	1.6	1.1	9.6
Element 2 RESEARCH AND DEVELOPMENT	1.2	3.2	5.6	3.8	0.1	13.9
Element 3. TECHNOLOGY TESTS	2.1	5.2	5.7	8.8	10.2	32.0
Element 4. PROJECT INTEGRATION	1.7	2.5	3.7	5.0	5.5	18.4
PROJECT TOTALS	5.8	13.9	18.1	19.2	16.9	73.9

TABLE 6-1. FIVE YEAR BUDGET PROJECTION SUMMARY ($MILLION)
METHANE RECOVERY FROM COALBEDS PROJECT

Resource Engineering

PROJECT ACTIVITY	WBS Designation	FISCAL YEAR					
		80 Basic	80 Enhanced	81	82	83	84
Resource Characterization	WU 1.1.1	340	490	700	610	340	300
Exploration Methods Development	WU 1.1.2	30	125	130	130	60	50
Target Area and Drilling Site Selection	WU 1.1.3	43	107	100	100	50	50
Resource/Reserve Estimating	WU 1.1.4	58	215	250	240	130	100
Test Planning and Analysis	WU 1.1.5	73	220	220	220	120	100
RESOURCE ASSESSMENT Subtotals	WP 1.1	544	1157	1400	1300	700	600
Reservoir Characterization	WU 1.2.1	263	1066	1400	1500	750	400
Reservoir Production Prediction	WU 1.2.2	58	175	200	300	150	100
RESERVOIR EVALUATION Subtotals	WP 1.2	321	1241	1600	1800	900	500
RESOURCE ENGINEERING Totals	Element 1.	865	2398	3000	3100	1600	1100

TABLE 6-2. FIVE YEAR BUDGET PROJECTION ($ 1,000)
METHANE RECOVERY FROM COALBEDS PROJECT

Research and Development

PROJECT ACTIVITY	WBS Designation	FISCAL YEAR					
		80 Basic	80 Enhanced	81	82	83	84
Drilling	WU 2.1.1	215	507	600	1100	900	
Stimulation	WU 2.1.2	945	1465	1300	1100	900	50
EXTRACTION R&D Subtotals	WP 2.1	1160	1972	1900	2200	1800	50
LNG Conversion	WU 2.2.1			900	1000		
Membrane Separation	WU 2.2.2			200	1200	1000	
Mixed Gas Upgrading Device/Process	WU 2.2.3			200	1200	1000	50
PREPARATION R&D Subtotals	WP 2.2	0	0	1300	3400	2000	50
RESEARCH AND DEVELOPMENT Totals	Element 2.	1160	1972	3200	5600	3800	100

TABLE 6-2, Sheet 2 of 4

Technology Tests

PROJECT ACTIVITY	WBS Designation	FISCAL YEAR					
		80 Basic	80 Enhanced	81	82	83	84
Multiple Well Tests	WU 3.1.1	620	1075	900	900	1200	1800
Horizontal Borehole Drainage Tests	WU 3.1.2	800	1000	900	900	1200	1800
Advanced Systems Tests	WU 3.1.3	___	200	800	1000	1300	2100
MINABLE COALBED TESTS Subtotals	WP 3.1	1420	2275	2600	2800	3700	5700
Deep Coalbed Drainage Tests	WU 3.2.1	650	1050	700	700	1250	1100
Overlaying Developed Area Tests	WU 3.2.2	25	25	500	700	1250	1100
Directional Drilling	WU 3.2.3			700	700	1250	1100
Advanced Systems Tests	WU 3.2.4	___	___	700	800	1350	1200
UNMINED COALBED TESTS Subtotals	WP 3.2	675	1075	2600	2900	5100	4500
TECHNOLOGY TESTS Totals	Element 3.	2095	3350	5200	5700	8800	10200

TABLE 6-2, Sheet 3 of 4

Project Integration

PROJECT ACTIVITY	WBS Designation	FISCAL YEAR					
		80 Basic	80 Enhanced	81	82	83	84
Project Activity Support	WU 4.1.1	1530	2033	2150	3150	4300	4700
Project Constraints Analyses	WU 4.1.2	25	50	75	150	175	200
Economic and Cost Factor Development	WU 4.1.3	75	100	100	150	175	250
PROJECT SUPPORT AND ANALYSIS Subtotals	WP 4.1	1750	2303	2325	3450	4650	5150
Information Management	WU 4.2.1	70	100	100	150	250	250
Technology Transfer	WU 4.2.2	30	50	75	100	100	100
INFORMATION MANAGEMENT AND TECHNOLOGY TRANSFER Subtotals	WP 4.2	100	150	175	250	350	350
PROJECT INTEGRATION Totals	Element 4.	1730	2333	2500	3700	5000	5500

TABLE 6-2, Sheet 4 of 4

REFERENCES

1. METC, Methane Recovery from Coalbeds Project, Resource Delineation Plan, February 11, 1979

2. METC, Information Management Plan, in draft

3. METC, Technology Transfer Plan, in preparation

4. DOE, Semi-Annual Report for the Unconventional Gas Recovery Program, Volume 1, Covering period ending September-1978

5. DOE, Semi-Annual Report for the Unconventional Gas Recovery Program, Period Ending March 31, 1979

6. METC, Proceedings of the 1978 Methane Recovery from Coalbeds Project Symposium

7. METC, Proceedings of the 1979 Methane Recovery from Coalbeds Project Symposium, in press