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Site where work will be performed ▷	State: / County:
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RIPTION OF

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e nature and scope unstruction, new facilities ve to be acquired d.

Technology development and supporting research in coal and shale processing and combustion are proposed. This sub-program is an integral part of the national program to obtain energy from domestic resources of coal and shale in an environmentally-acceptable manner. The work in the present sub-program will be done on a laboratory scale, thus requiring only moderate cost while still providing the necessary tests, data on materials, component development and chemical process development for the national program, which will involve large pilot and demonstration plants. Both improvement of present conversion and combustion systems and development of new, more efficient systems are proposed.

A number of independent small-scale facilities for testing materials, equipment and special chemical processes will be required.

TION *(Use a separate sheet(s). See Item 6. on Instruction Sheet.)*

7. MAJOR RESOURCE REQUIREMENTS

FISCAL YEAR ▷	1975	1976	1977	1978	1979
(1) Scientific					
(2) Technical					
(3) Support					
(4) Other					
RIALS *and units of e, such as tons of f oil, kilograms of Show amount of rs at right.)*	Neglible	Neglible	Neglible	Neglible	Neglible
(1) Government-owned	"	"	"	"	"
(2) Contractor	"	"	"	"	"
(3) Private vendors	"	"	"	"	"
(4) Other	"	"	"	"	"
OURCES NEEDED *and unit of e. Show quantity ining at right.)*	(1)				

4

[ ] MAXIMUM
[-] GUIDELINE
[ ] MINIMUM

IDENTIFICATION NUMBER
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JUSTIFICATION—State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or attainment of the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits expected to be derived from meeting the objectives or solving the problems for which the project is proposed. Outline the risks/uncertainties (R/U), plans to minimize R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

ustification

This subprogram involves technology development and supporting research for the larger rogram on coal and shale processing and combustion. Most of the quantitative data showing he economic benefits of the program and the U. S. foreign policy strategic need for this rogram are given in the fact sheets for the coal gasification, coal liquefaction, coal ombustion and environmental sub-programs in this overall program. These data will not be epeated here. The justification for the present sub-program is that the other sub-program n this coal and shale program could not be pursued economically or rationally without para echnology development and supporting research in these areas. The chemical processes, kin nd thermodynamic data, equipment components and materials required in all the various typ f coal and shale processing systems have numerous common features and are not truly separa rom one system to another. Thus, these are all treated together in this sub-program.

Although the basic feasibility of producing gas and oil from coal and shale has already demonstrated, ultimate economic practicality of these energy sources may depend either on t evelopment of new procedures for at least part of these processes or on the gradual impro f existing processes, materials and equipment. Specific areas where technology developmer nd support research are needed include:

A. Equipment Development

The objective of the equipment development program is to develop, independent of pilot demonstration plants, new reliable coal injections systems for high pressure, char and withdrawl systems, solids monitoring instruments, valves and other key components requi for coal processing.

(1) Lock hoppers, sealing devices, valves and slurry pumps used to feed coal into pres. reaction vessels have been found subject to frequent failure. Reliable feed device are needed as well as reliable devices to discharge char and ash from the reactor.

(2) Improved equipment for filtration and separation/purification processes is needed.

(3) Instrumentation is needed for continuous monitoring and managing of solids and gas in high temperature, high pressure systems.

(4) Improved stack gas cleaning devices are needed, as described in the subprogram on environmental aspects of coal and shale processing and combustion.

B. Materials

The objective is to develop methods for service life prediction, test methods for mater and improved materials for coal processing equipment.

(1) Improved materials are needed which can withstand the highly erosive, corrosive, h temperature, high pressure environments used in conversion devices. Critical propertie include:

(a) Resistance to erosive wear
(b) Resistance to stress corrosion cracking
(c) Resistance to sulfidation and other general corrosion processes
(d) Stability when in contact with molten slag and coal ash/materials
(e) Resistance to various types of slow mechanical failure
(f) Insulating properties in firebox refractories
(g) Heat transfer characteristics in heat exchange tubes

(2) Short-time methods are needed which will predict long-time mechanical durability reliability of materials in highly erosive, corrosive environments. Better measur and methods of measuring critical properties listed above in Section B.1, a-g, ar needed to allow improved screening of materials used in conversion devices.

C. Data compilations handbooks and analyses

Level of Effort
- [ ] MAXIMUM
- [x] OPTIMUM
- [ ] MINIMUM

IDENTIFICATION NUMBER
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C. Data compilations, handbooks and analyses

The objective is to advance the development of coal processing by developing a tech design and economic information data base.

(1) Data collections and measurements are needed on

(a) Properties of coal
(b) Kinetic and thermodynamic data on process chemistry of coal conversion
(c) Kinetic and thermodynamic data on sulfur compounds and other pollutants resulting from coal conversion

3

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(a) Engineering data books on coal conversion processes should be published

(b) Computer modeling should be done to evaluation conversion processes and where greater accuracy is needed in data.

(3) Standard reference materials are need to aid in chemical analyses for trace p and toxic effluents from coal or shale conversion.

(4) Central information center is neeeded to provide ready access, probably compu to all data related to coal conversion.

(5) Analyses of economic and manpower implication of coal conversion programs are

D. Catalysts and chemical kinetics for conversion processes.

Improved catalysts are needed for methanation, coal gasification and liquefac the chemical kinetics necessary for improved coal processing systems must be
(1) Methanation catalysts and processes need considerable work, including
(a) Mechanism of sulfur poisoning or trace metal poisoning of presently based catalysts and way of altering the catalyst or the process str such poisoning
(b) Methods of increasing heat flow from catalyst
(c) Methods of allowing methanation catalysts to operate at a higher te good methane yield, including methods of preventing carbon deposit temperatures.
(d) Alternate methods of methanation by catalysts flowing in a process conversion of producer gas to methane in one step, and non-catalyti methods relying on vibrational excitation.

(2) Catalysts for coal liquefaction processes need work to establish optimum con develop improved catalysts, including
(a) Cobalt molybdate catalysts for Synthoil process
(b) Catalysts to improve hydrocracking processes and the up-grading of liquids.
(c) Improved catalysts for Fisher-Tropsch process
(d) Other coal liquefaction catalysts

(3) Catalysts for the shift reations in high BTU processes should be optimized.

(4) Basic studies of chemical kinetics are needed including studies on:
(a) Physical/chemical modifications of coal to control its reactivity (coal)
(b) Combustion of coal with pre-treatment or additives being applied to tant emissions.
(c) Kinetics and mechanisms of hydrogenation, carbonization and methana in conversion of coal
(d) Reaction of char with carbon dioxide flue gas to yield fuel
(e) Extractive-distillation process for ash/coal oil separation
(f) Determination of properties and constituents of coal-derived liquid of polymerization and depolymerization.
(g) Development of liquid/solid separation methods by filtration, preci centrifugation and use of hydroclones.
(h) Kinetics of reactions by solids in contact with gases, including fl dilute phase or entrained beds, and fixed beds.
(i) Kinetics of coal agglomeration
(j) Side and co-product reactions from trace amounts of nitrogen and h

ESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort
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☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
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(d) Alternate methods of methanation by catalysts flowing in a process stream, direct conversion of producer gas to methane in one step, and non-catalytic methanation methods relying on vibrational excitation.

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   (i) Kinetics of coal agglomeration
   (j) Side and co-product reactions from trace amounts of nitrogen and hydrogen in product stream following methanation, in order to avoid ammonia formation

E. Process Development.

The objective is to advance the development of coal processing by research on the uni operations of coal processing (i.e., fluidized bed technology) and by developing new processes for producing hydrocarbons from coal.

Processes which should be investigated include

(1) Fast fluidized bed reactions for rapid carbonization or hydrogenation
(2) Fluidized bed or entrained flow combustion reactions with sulfur scavengers
(3) Improved plant "front end" technology, including new methods for handling, conveyanc

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Combustion of coal with pre-treatment or additives being applied to reduce pollu-
tant emissions.
Kinetics and mechanisms of hydrogenation, carbonization and methanation reactions
in conversion of coal
Reaction of char with carbon dioxide flue gas to yield fuel
Extractive-distillation process for ash/coal oil separation
Determination of properties and constituents of coal-derived liquids and rates
of polymerization and depolymerization.
Development of liquid/solid separation methods by filtration, precipitation,
centrifugation and use of hydroclones.
Kinetics of reactions by solids in contact with gases, including fluidized beds,
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drying, surface oxidation, etc., processes.

(5) Study of coal/oil slurries(formation, stability, flow characteristics, etc.)

(6) Combustion of Chars and synthetic fuels
(7) Acetylene from coal by the arc-coal process
(8) Methods of handling coal fines in gasifiers
(9) Methods for removal of char and tar from reactors
(10) Unit operations involved in liquefaction
(11) High pressure fluidized bed reactors
(12) Multiphase flow characteristics in coal liquefaction
(13) Useful byproducts from coal conversion processes
(14) Emission control processes, as described in sub-program on environmental aspects and shale processing and combustion

F. Hydrogen production for use in coal conversion processes

The objective is the development of low-cost on-site processes for producing hydro rich gases from non-petroleum sources for near and mid-term coal and oil shale pro
1. Candidate processes should be investigated on a laboratory scale first with a plant only for the most promising techniques.
(a) Steam-oxygen process for H_2 production from coal and residue chars (ready for plant studies)
(b) Methods using thermochemical cycles at low temperatures so that heat from met or other process heat might be used to drive the H_2 reaction (laboratory scal at this time)
(c) Electrothermal generation from coal
(d) Steam-iron process

The recommended spending rate for FY75 benefits and risks/uncertainties in each of the objectives areas A-F above are:

A. Equipment ($8 M in FY75)
1. Benefits--Frequent breakdown of equipment or inefficient operation coal and shal version plants because of poor equipment could easily raise costs 10%. If coal became a primary source of U. S. gas and oil, a 10% reduction in price would result in billions of dollars of cost savings.
2. Risks/uncertainties--Development of equipment is subject to some uncertainties high temperature reactors under pressure are often involved. Nevertheless, the possibility of significant achievement appears good, as high pressure technolo U. S. is an active field.

B. Materials ($7 M in FY 75)
1. Benefits -- Fracture, erosion and corrosion of materials used in coal conversi might require unnecessarily frequent rebuilding of conversion reactors and the accessories and possibly cause frequent unexpected shut downs, all of which co easily raise costs 10%. If coal and shale conversion became a primary source gas and oil, a 10% reduction in price would result in billions of dollars of c savings.
2. Risks/Uncertainties -- Monitoring deterioration and measurement of properties materials is a straight forward procedure. The major uncertainty here lies in whether new and improved test methods and materials can be developed. Based o previous experience, the possibility of significant achievement here appears g

C. Data compilations, handbooks and analyses ($2M in FY 75)
1. Benefits -- In designing pilot and demonstration plants, engineering data are on the construction materials used, coal itself and chemical processes. Econo analyses also are needed. Serious engineering problems and inefficient designs result from lack of suitably analyzed data, which might lead to long delays in

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operations involved in liquefaction
pressure fluidized bed reactors
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2

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able operation. Loss of time [illegible]

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(10) Unit operations involved in liquefaction
(11) High pressure fluidized bed reactors
(12) Multiphase flow characteristics in coal liquefaction
(13) Useful byproducts from coal conversion processes
(14) Emission control processes, as described in sub-program on environmental aspects o
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or other process heat might be used to drive the H_2 reaction (laboratory scale
at this time)
(c) Electrothermal generation from coal
(d) Steam-iron process

The recommended spending rate for FY75 benefits and risks/uncertainties in each of the objectives areas A-F above are:

A. Equipment ($8 M in FY75)
1. Benefits--Frequent breakdown of equipment or inefficient operation coal and shale version plants because of poor equipment could easily raise costs 10%. If coal a became a primary source of U. S. gas and oil, a 10% reduction in price would result in billions of dollars of cost savings.
2. Risks/uncertainties--Development of equipment is subject to some uncertainties high temperature reactors under pressure are often involved. Nevertheless, the possibility of significant achievement appears good, as high pressure technolog U. S. is an active field.

B. Materials ($7 M in FY 75)
1. Benefits -- Fracture, erosion and corrosion of materials used in coal conversio might require unnecessarily frequent rebuilding of conversion reactors and thei accessories and possibly cause frequent unexpected shut downs, all of which cou easily raise costs 10%. If coal and shale conversion became a primary source o gas and oil, a 10% reduction in price would result in billions of dollars of co savings.
2. Risks/Uncertainties -- Monitoring deterioration and measurement of properties o materials is a straight forward procedure. The major uncertainty here lies in whether new and improved test methods and materials can be developed. Based on previous experience, the possibility of significant achievement here appears go

C. Data compilations, handbooks and analyses ($3M in FY 75)
1. Benefits -- In designing pilot and demonstration plants, engineering data are n on the construction materials used, coal itself and chemical processes. Econom analyses also are needed. Serious engineering problems and inefficient designs result from lack of suitably analyzed data, which might lead to long delays in suitable operation. Loss of time even in an orderly program is irreplaceable, w inefficient design or the need for costly design could easily raise costs for p and demonstration plants by 20 to 50 per cent, equal to many millions of dollar
2. Risks/Uncertainties -- The collection and analysis of data although time-consum is more certain of accomplishment than most R&D work.

D. Catalysts and chemical kinetics for conversion processes ($13M in FY75)
1. Benefits -- Some of the most important reactions in coal and liquefaction depe Catalysts with catalytic stages representing perhaps 30% the total cost in thes processes. Even minor improvements in catalysis or in chemical processes would in massive savings in coal and shale processing.
2. Risks/uncertainties -- As with all research programs, the fractional improvemen will be accomplished in this area cannot be definitely stated. Still definite

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pressure fluidized bed reactors
iphase flow characteristics in coal liquefaction
ul byproducts from coal conversion processes
sion control processes, as described in sub-program on environmental aspects of coal shale processing and combustion

gen production for use in coal conversion processes

bjective is the development of low-cost on-site processes for producing hydrogen-gases from non-petroleum sources for near and mid-term coal and oil shale processing. ndidate processes should be investigated on a laboratory scale first with a pilot only for the most promising techniques.
Steam-oxygen process for H_2 production from coal and residue chars (ready for pilot plant studies)
Methods using thermochemical cycles at low temperatures so that heat from methanation or other process heat might be used to drive the H_2 reaction (laboratory scale only at this time)
Electrothermal generation from coal
Steam-iron process
mended spending rate for FY75 benefits and risks/uncertainties in each of the s areas A-F above are:

ent ($3 M in FY75)
nefits--Frequent breakdown of equipment or inefficient operation coal and shale conversion plants because of poor equipment could easily raise costs 10%. If coal and shale came a primary source of U. S. gas and oil, a 10% reduction in price would result in billions of dollars of cost savings.
isks/uncertainties--Development of equipment is subject to some uncertainties since igh temperature reactors under pressure are often involved. Nevertheless, the ossibility of significant achievement appears good, as high pressure technology in the . S. is an active field.

ials ($7 M in FY 75)
nefits -- Fracture, erosion and corrosion of materials used in coal conversion devices ight require unnecessarily frequent rebuilding of conversion reactors and their ccessories and possibly cause frequent unexpected shut downs, all of which could sily raise costs 10%. If coal and shale conversion became a primary source of U. S. as and oil, a 10% reduction in price would result in billions of dollars of cost vings.
isks/Uncertainties -- Monitoring deterioration and measurement of properties of terials is a straight forward procedure. The major uncertainty here lies in ether new and improved test methods and materials can be developed. Based on evious experience, the possibility of significant achievement here appears good.
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ysts and chemical kinetics for conversion processes ($13M in FY75)
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ks/uncertainties -- As with all research programs, the fractional improvement that l be accomplished in this area cannot be definitely stated. Still definite

6. JUSTIFICATION - Give the specific energy problem or objective, and specify how the proposal will contribute to the solution of the pr or attainment of the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefi expected to be derived from meeting the objectives or solving the problems for which the project is proposed. Outline the risks/uncertai (R/U), plans to minimize R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

scientific breakthrough.

E. Process Development ($20M in FY75)

1. Benefits -- Even in existing pilot plants, a number of individual process been optimized. Individual optimization of various processes as listed a easily reduce costs by 10%. If coal and shale conversion become a primar U. S. gas and oil, a 10% reduction in price could result in billions of d cost savings.
2. Risks/uncertainties -- Development programs have inherent uncertainties, listed in this section should yield significant results.

F. Hydrogen Production for use in Coal Conversion Processes ($4M in FY75)

1. Benefits -- The economical production of hydrogen from residue chars or c essential for the economical development of the Synthoil coal liquefacti the Hydrane and Hygas coal gasification processes In general, sources of necessary for any process which converts coal to gas or oil, since the ch difference between coal and these other fuels is the deficiency of hydrog
2. Risks/uncertainties -- A number of hydrogen production processes can be s technically feasible. The main uncertainty lies in the selection of an e for particular coal conversion systems.

RCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort:
- ☐ MAXIMUM
- ☒ OPTIMUM
- ☐ MINIMUM

IDENTIFICATION NUMBER
0505550310555602

State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or objective. Include reasons for selection for recommended approach over other alternatives. Also include the benefits ved from meeting the objectives or solving the problems for which the project is proposed. Outline the risks/uncertainties minize R/U, and basis for proceeding in face of R/U. Quantitative data *should be used* to the fullest extent.

breakthrough.

Development ($20M in FY75)

efits -- Even in existing pilot plants, a number of individual processes have not optimized. Individual optimization of various processes as listed above could ly reduce costs by 10%. If coal and shale conversion become a primary source of . gas and oil, a 10% reduction in price could result in billions of dollars of savings.

s/uncertainties -- Development programs have inherent uncertainties, but all items ted in this section should yield significant results.

n Production for use in Coal Conversion Processes ($4M in FY75)

efits -- The economical production of hydrogen from residue chars or coal is sential for the economical development of the Synthoil coal liquefaction process and Hydrane and Hygas coal gasification processes In general, sources of hydrogen are essary for any process which converts coal to gas or oil, since the chief chemical ference between coal and these other fuels is the deficiency of hydrogen in coal.

s/uncertainties -- A number of hydrogen production processes can be shown to be nically feasible. The main uncertainty lies in the selection of an economic process particular coal conversion systems.

F

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Coal and Shal
Supporting Res

EDULE *(Include major facilities and major equipment. Indicate dates by Fiscal Year and Quarter).*

a. DEVELOPMENT MILESTONES *(number each consecutively)*

(Limit Title of Milestone to 60 characters and spaces)

b. DATES			
Start		Complete	
FY	Q	FY	Q

(Continue to next column)

Coal and Shale Processing Combustion
Supporting Research

☐ MAXIMUM
☑ ORDERLY
☐ MINIMUM

Decision

IDENTIFICATION NUMBER
05 05 55 03 10 55 54 02

b. DATES

Start		Complete	
Q		FY	Q

b. [redacted] MILESTONES (continued)

(Limit Title of Milestone to 60 characters and spaces)

FY	Q	FY	Q

Decision Milestones for Individual Projects

1.	Start of coal processing supporting research projects.	75	1	77
2.	Initial decision point on coal processing support projects.	78	1	80
3.	Decision point on second generation coal processing support.	80	1	80

NOTE: Maximum, orderly and minimum programs differ primarily in level of effort. This results in varying the number of projects and the options explored but does not change the schedule of decision points for individual projects.

(Continue on separate sheet)

2

9. SUMMARY OF FUNDING REQUIREMENTS—Federal Government Only *(in millions of dollars)*

Supporting I

Requirement	(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays
a. OPERATING *(See p. for detail)* Total Operating Requirements *(from Detail Sheet)*						
b. CONSTRUCTION *(See p. for detail)* Total Construction Requirements *(from Detail Sheet)*						
c. EQUIPMENT *(See p. for detail)* Total Equipment Requirements *(from Detail Sheet)*						
d. GRAND TOTAL–OBLIGATIONS	12		55		70	
e. GRAND TOTAL–OUTLAYS		12		55		70

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funds; [illegible] should be separately provided in the above format.

search

☐ MAXIMUM
☑ ORDERLY
☐ MINIMUM

IDENTIFICATION [illegible]
05 05 55 09 10 55 56 00

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Estimated FY 1974 Cr. [illegible]	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
80		80		80		365		200		565	
	80		80		80		365		200		565

g. A brief description of the Cooperative programs and the rationale for the division of funding

Page [illegible]

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued) Coal and Supporti

B. DETAIL OF FUNDING REQUIREMENTS- Federal Government Only *(in millions of dollars)*

a. OPERATING

ITEM	(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	C
TOTAL *(Carry forward to summary sheet)* ▷	12	12	55	55	70	70	
1. Name of Performing Organization: AEC							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION			12	12	14	14	1
1. Name of Performing Organization: Bureau of Mines--DOI							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION			9	9	10	10	
1. Name of Performing Organization: National Bureau of Standards --DOC							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION			3	3	4	4	4
1. Name of Performing Organization: ERDA Contractors, NSF Contractors, NASA, Bituminous Coal Research Corp. and others							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION			31	31	42	42	50

(Continue on

...l and Shale Processing and Combustion
...pporting Research

Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05 05 55 03 10 55 56 02

	(4)		(5)		(6)		(7)		(8)		(9)	
'6	FY 1977		FY 1978		FY 1979		SUBTOTAL FY 1975-79		BALANCE TO COMPLETE		TOTAL ESTIMATE FY 1975	
utlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obl	Outlays	Obl	Out
70	80	80	80	80	80	80	365	365	200	200	565	5 5
14	15	15	15	15	15	15	72	72			72	72
.0	11	11	11	11	11	11	53	53			53	53
	4	4	4	4	4	4	19	19			19	19
2	50	50	50	50	50	50	223	223			223	223

(continue on Separate Sheet)

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2

DETAIL OF FUNDING REQUIREMENTS—Federal Government Only *(in millions of dollars)*

b. CONSTRUCTION

N/A

ITEM	Item No.	(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	C
TOTAL *(Carry forward to summary sheet)*	>							
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) for each item consecutively). Every project costing one million dollars or more should be separately identified with a brief justification as required.								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)*	( )							
State / County / TEC *(in millions)*								
Statements:								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)*	( )							
State / County / TEC *(in millions)*								
Statements:								
TITLE OF PROJECT *(Not to exceed characters and spaces.)*	( )							
State / County / TEC *(in millions)*								
Statements:								

(Continue on Sep

☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

ESTIMATE DATE
05 05 55 03 10 55 56 02

976	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1974 [illegible]	
Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

DETAIL OF FUNDING REQUIREMENTS—Federal Government Only *(In millions of dollars)*

c. EQUIPMENT

ITEM *(Each item not to exceed 60 characters and spaces)*		(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	FY 1 Obls.
Each major performing organization, additional project funds, with a separate description of each item of equipment costing one-half million dollars or more.	TOTAL *(Carry forward to summary sheet)* ▷							

Included in 9a.

(Continue on Separ

Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05 05 55 03 10 55 56 02

	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1974 (COLS. 7 & 8)	
	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays

...ue on Separate Sheet)

Page of

2

FACT SHEET

☐ MANPOWER
☐ GROUNDWATER
☐ ENVIRONMENTAL

1. IDENTIFICATION NO. 05 05 55 03 10 5[illegible]

2. a. PROPOSAL	Coal [illegible]
b. [illegible]	[illegible] Coal and Shale Processing-Combus
3. a. PROPOSED AGENCY	[illegible] Program
b. BRANCH	

4. CONTRACTOR AND SITE

(No more than 32 characters and spaces for name of contractor, use standard abbreviation if necessary; up to 16 characters and spaces for county.

NAME OF CONTRACTOR: Various contractors in many locations both int

Site where work will be performed ▶ | State: | County: and extramural.

NAME OF CONTRACTOR:

Site where work will be performed ▶ | State: | County:

NAME OF CONTRACTOR:

Site where work will be performed ▶ | State: | County:

NAME OF CONTRACTOR:

Site where work will be performed ▶ | State: | County:

NAME OF CONTRACTOR:

Site where work will be performed ▶ | State: | County:

5. BRIEF DESCRIPTION OF PROPOSAL

(No more than 24 lines of text and no more than 73 characters and spaces per line)

Briefly outline nature and scope of work to be undertaken, including any new facilities which may have to be acquired or constructed.

Technology development and supporting research in coal and sha processing and combustion are proposed. This sub-program is a integral part of the national program to obtain energy from do resources of coal and shale in an environmentally-acceptable m The work in the present sub-program will be done on a laborato scale, thus requiring only moderate cost while still providing necessary tests, data on materials, component development and chemical process development for the national program, which w involve large pilot and demonstration plants. Both improvemen present conversion and combustion systems and development of n more efficient systems are proposed.

A number of independent small-scale facilities for testing mat

6. JUSTIFICATION *(Use a separate sheet(s). See Item 6. on Instruction Sheet.)* equipment and special chemical proce

7. MAJOR RESOURCE REQUIREMENTS be required.

RESOURCE	FISCAL YEAR ▶	1975	1976	1977	1978	
a. MANPOWER *(in man years)*	(1) Scientific					
	(2) Technical					
	(3) Support					
	(4) Other					
b. RAW MATERIALS *(List materials and units of measure below, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)*		Neglible	Neglible	Neglible	Neglible	Neg
c. LAND AREA REQUIRED *(in acres)*	(1) Government	"	"	"	"	
	(2) Government	"	"	"	"	
	(3) Private	"	"	"	"	
	(4) Other	"	"	"	"	
d. OTHER RESOURCES NEEDED						

[illegible]T SHEET

☐ MAXIMUM
☐ ORDERLY
☐ [illegible]

1. IDENTIFICATION NUMBER: 05 05 55 03 10 5[illegible]

[illegible]: Coal and Shale [illegible]
[illegible]: Supporting Research in [illegible] Coal and Shale Processing-Combustion
[illegible]AGENCY: [illegible], AEC, [illegible], NASA — Program objectives

[illegible]ND SITE ([illegible] characters and [illegible] contractor; [illegible] ation for state [illegible] and spaces for [illegible])

NAME OF CONTRACTOR: Various contractors in many locations both intramural and extramural.		
Site where work will be performed ▷	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▷	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▷	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▷	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▷	State:	County:

[illegible]ON OF ([illegible] nes of text [illegible] characters [illegible] re and scope [illegible] taken, [illegible] be attained)

Technology development and supporting research in coal and shale processing and combustion are proposed. This sub-program is an integral part of the national program to obtain energy from domestic resources of coal and shale in an environmentally-acceptable manner. The work in the present sub-program will be done on a laboratory scale, thus requiring only moderate cost while still providing the necessary tests, data on materials, component development and chemical process development for the national program, which will involve large pilot and demonstration plants. Both improvement of present conversion and combustion systems and development of new, more efficient systems are proposed.

A number of independent small-scale facilities for testing materials, equipment and special chemical processes will be required.

([illegible] a separate sheet(s). See Item 6. on Instruction Sheet.)

2

7. MAJOR RESOURCE REQUIREMENTS

[illegible]AL YEAR ▷	1975	1976	1977	1978	1979
[illegible]entific					
[illegible]hnical					
[illegible]pport					
[illegible]er					
[illegible]s of [illegible] tons of [illegible] grams of [illegible] ount of [illegible])	Neglible	Neglible	Neglible	Neglible	Neglible
[illegible]-owned	"	"	"	"	"
[illegible]eased	"	"	"	"	"
[illegible]ry-owned	"	"	"	"	"
	"	"	"	"	"
[illegible]EEDED					

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NAME OF CONTRACTOR			
Site where work will be performed	1	State:	County:
NAME OF CONTRACTOR			
Site where work will be performed	2	State:	County:
NAME OF CONTRACTOR			
Site where work will be performed	3	State:	County:

BRIEF DESCRIPTION OF PROPOSAL

(No more than 24 lines of text and no more than 70 characters and spaces per line)

Briefly outline nature and scope of work to be undertaken, including any major items which may have to be returned or continued.

Technology development and supporting research in coal and shale processing and combustion are proposed. This sub-program is an integral part of the national program to obtain energy from domestic resources of coal and shale in an environmentally-acceptable manner. The work in the present sub-program will be done on a laboratory scale, thus requiring only moderate cost while still providing the necessary tests, data on materials, component development and chemical process development for the national program, which will involve large pilot and demonstration plants. Both improvement of present conversion and combustion systems and development of new, more efficient systems are proposed.

A number of independent small-scale facilities for testing materials, equipment and special chemical processes wi

JUSTIFICATION *(Use a separate sheet(s). See Item 6. on Instruction Sheet.)*

7. MAJOR RESOURCE REQUIREMENTS IF REQUIRED.

RESOURCE ▽	FISCAL YEAR ▷	1975	1976	1977	1978	1979
MANPOWER *(In man years)*	(1) Scientific					
	(2) Technical					
	(3) Support					
	(4) Other					
RAW MATERIALS *(List materials and units of measure below, such as tons of coal, barrels of oil, kilograms of uranium, etc. Show amount of each in columns at right.)*		Neglible	Neglible	Neglible	Neglible	Neglible
LAND AREA REQUIRED *(In acres)*	(1) Developed	"	"	"	"	"
	(2) Undeveloped	"	"	"	"	"
	(3) Productive agricultural	"	"	"	"	"
	(4) Other	"	"	"	"	"
OTHER RESOURCES NEEDED *(Specify item and unit of measure below. Show quantity of each in columns at right.)*						
1)	(1)					

N/A

[ ] MAXIMUM
[ ] ORDERLY
[X] MINIMUM

IDENTIFICATION NUMBER: 050555031055602

JUSTIFICATION: [illegible] the specific [illegible] problem or objective, and specify how the proposal will contribute to the solution of the problem [illegible]. Also include the benefits [illegible] proposed. Outline the risks/uncertainties [illegible] plans to minimize R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

ustification

This subprogram involves technology development and supporting research for the large rogram on coal and shale processing and combustion. Most of the quantitative data show he economic benefits of the program and the U. S. foreign policy strategic need for thi rogram are given in the fact sheets for the coal gasification, coal liquefaction, coal ombustion and environmental sub-programs in this overall program. These data will not epeated here. The justification for the present sub-program is that the other sub-prog in this coal and shale program could not be pursued economically or rationally without p echnology development and supporting research in these areas. The chemical processes, nd thermodynamic data, equipment components and materials required in all the various t f coal and shale processing systems have numerous common features and are not truly sep from one system to another. Thus, these are all treated together in this sub-program.

Although the basic feasibility of producing gas and oil from coal and shale has alrea demonstrated, ultimate economic practicality of these energy sources may depend either o development of new procedures for at least part of these processes or on the gradual imp of existing processes, materials and equipment. Specific areas where technology develop and support research are needed include:

A. Equipment Development

The objective of the equipment development program is to develop, independent of pilo demonstration plants, new reliable coal injections systems for high pressure, char a withdrawl systems, solids monitoring instruments, valves and other key components re for coal processing.

(1) Lock hoppers, sealing devices, valves and slurry pumps used to feed coal into pr reaction vessels have been found subject to frequent failure. Reliable feed dev are needed as well as reliable devices to discharge char and ash from the reacto

(2) Improved equipment for filtration and separation/purification processes is neede

(3) Instrumentation is needed for continuous monitoring and managing of solids and g in high temperature, high pressure systems.

(4) Improved stack gas cleaning devices are needed, as described in the subprogram c environmental aspects of coal and shale processing and combustion.

B. Materials

The objective is to develop methods for service life prediction, test methods for ma and improved materials for coal processing equipment.

(1) Improved materials are needed which can withstand the highly erosive, corrosive temperature, high pressure environments used in conversion devices. Critical proper include:

(a) Resistance to erosive wear
(b) Resistance to stress corrosion cracking
(c) Resistance to sulfidation and other general corrosion processes
(d) Stability when in contact with molten slag and coal ash/materials
(e) Resistance to various types of slow mechanical failure
(f) Insulating properties in firebox refractories
(g) Heat transfer characteristics in heat exchange tubes

(2) Short-time methods are needed which will predict long-time mechanical durabilit reliability of materials in highly erosive, corrosive environments. Better mea and methods of measuring critical properties listed above in Section B.1, a-g, needed to allow improved screening of materials used in conversion devices.

☐ MAXIMUM
☐ ONLY IF NEEDED
☒ MINIMUM

0505503105555602

TION: State the specific energy problem or objective, and specify how the proposed will contribute to the solution of the problem
it of the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits
ed from meeting the objectives or solving the problems for which the project is proposed. Outline the risks/uncertainties
to minimize R/U, and basis for proceeding in face of R/U. Quantitative data should be used to the fullest extent.

tion

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n coal and shale processing and combustion. Most of the quantitative data showing
mic benefits of the program and the U. S. foreign policy strategic need for this
re given in the fact sheets for the coal gasification, coal liquefaction, coal
n and environmental sub-programs in this overall program. These data will not be
here. The justification for the present sub-program is that the other sub-programs
oal and shale program could not be pursued economically or rationally without parallel
y development and supporting research in these areas. The chemical processes, kinetic
odynamic data, equipment components and materials required in all the various types
nd shale processing systems have numerous common features and are not truly separable
system to another. Thus, these are all treated together in this sub-program.

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re needed as well as reliable devices to discharge char and ash from the reactor.

Improved equipment for filtration and separation/purification processes is needed.

Instrumentation is needed for continuous monitoring and managing of solids and gases
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ials

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mproved materials for coal processing equipment.

Improved materials are needed which can withstand the highly erosive, corrosive, high
rature, high pressure environments used in conversion devices. Critical properties
de:

Resistance to erosive wear
Resistance to stress corrosion cracking
Resistance to sulfidation and other general corrosion processes
Stability when in contact with molten slag and coal ash/materials
Resistance to various types of slow mechanical failure
Insulating properties in firebox refractories
Heat transfer characteristics in heat exchange tubes

hort-time methods are needed which will predict long-time mechanical durability and
eliability of materials in highly erosive, corrosive environments. Better measurements
nd methods of measuring critical properties listed above in Section B.1, a-g, are
eeded to allow improved screening of materials used in conversion devices.

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in this coal and shale program could not be pursued economically or rationally without p technology development and supporting research in these areas. The chemical processes, and thermodynamic data, equipment components and materials required in all the various t of coal and shale processing systems have numerous common features and are not truly sep from one system to another. Thus, these are all treated together in this sub-program.

Although the basic feasibility of producing gas and oil from coal and shale has alrea demonstrated, ultimate economic practicality of these energy sources may depend either o development of new procedures for at least part of these processes or on the gradual imp of existing processes, materials and equipment. Specific areas where technology develop and support research are needed include:

A. Equipment Development

The objective of the equipment development program is to develop independent of pilo demonstration plants, new reliable coal injections systems for high pressure, char a withdrawl systems, solids monitoring instruments, valves and other key components re for coal processing.

(1) Lock hoppers, sealing devices, valves and slurry pumps used to feed coal into pr reaction vessels have been found subject to frequent failure. Reliable feed dev are needed as well as reliable devices to discharge char and ash from the reacto

(2) Improved equipment for filtration and separation/purification processes is neede

(3) Instrumentation is needed for continuous monitoring and managing of solids and g in high temperature, high pressure systems.

(4) Improved stack gas cleaning devices are needed, as described in the subprogram o environmental aspects of coal and shale processing and combustion.

B. Materials

The objective is to develop methods for service life prediction, test methods for ma and improved materials for coal processing equipment.

(1) Improved materials are needed which can withstand the highly erosive, corrosive temperature, high pressure environments used in conversion devices. Critical proper include:

(a) Resistance to erosive wear
(b) Resistance to stress corrosion cracking
(c) Resistance to sulfidation and other general corrosion processes
(d) Stability when in contact with molten slag and coal ash/materials
(e) Resistance to various types of slow mechanical failure
(f) Insulating properties in firebox refractories
(g) Heat transfer characteristics in heat exchange tubes

(2) Short-time methods are needed which will predict long-time mechanical durabilit reliability of materials in highly erosive, corrosive environments. Better meas and methods of measuring critical properties listed above in Section B.1, a-g, a needed to allow improved screening of materials used in conversion devices.

C. Data compilations, handbooks and analyses

The objective is to advance the development of coal processing by developing a techn design and economic information data base.

(1) Data collections and measurements are needed on

(a) Properties of coal
(b) Kinetic and thermodynamic data on process chemistry of coal conversion
(c) Kinetic and thermodynamic data on sulfur compounds and other pollutants resulting from coal conversion

(2) Handbooks and evaluations of data for conversion process

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and shale program could not be pursued economically or rationally without parallel development and supporting research in these areas. The chemical processes, kinetic namic data, equipment components and materials required in all the various types shale processing systems have numerous common features and are not truly separable stem to another. Thus, these are all treated together in this sub-program.

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(a) Engineering data books on coal conversion processes should be published

(b) Computer modeling should be done to evaluation conversion processes and to where greater accuracy is needed in data.

(3) Standard reference materials are need to aid in chemical analyses for trace poll and toxic effluents from coal or shale conversion.

(4) Central information center is neeeded to provide ready access, probably computer to all data related to coal conversion.

(5) Analyses of economic and manpower implication of coal conversion programs are ne

D. Catalysts and chemical kinetics for conversion processes.

Improved catalysts are needed for methanation, coal gasification and liquefaction the chemical kinetics necessary for improved coal processing systems must be deve

(1) Methanation catalysts and processes need considerable work, including
   (a) Mechanism of sulfur poisoning or trace metal poisoning of presently use based catalysts and way of altering the catalyst or the process stream such poisoning
   (b) Methods of increasing heat flow from catalyst
   (c) Methods of allowing methanation catalysts to operate at a higher temper good methane yield, including methods of preventing carbon deposition temperatures.
   (d) Alternate methods of methanation by catalysts flowing in a process str conversion of producer gas to methane in one step, and non-catalytic me methods relying on vibrational excitation.

(2) Catalysts for coal liquefaction processes need work to establish optimum conditi develop improved catalysts, including
   (a) Cobalt molybdate catalysts for Synthoil process
   (b) Catalysts to improve hydrocracking processes and the up-grading of coal liquids.
   (c) Improved catalysts for Fisher-Tropsch process
   (d) Other coal liquefaction catalysts

(3) Catalysts for the shift reations in high BTU processes should be optimized.

(4) Basic studies of chemical kinetics are needed including studies on:
   (a) Physical/chemical modifications of coal to control its reactivity (pret coal)
   (b) Combustion of coal with pre-treatment or additives being applied to red tant emissions.
   (c) Kinetics and mechanisms of hydrogenation, carbonization and methanation in conversion of coal
   (d) Reaction of char with carbon dioxide flue gas to yield fuel
   (e) Extractive-distillation process for ash/coal oil separation
   (f) Determination of properties and constituents of coal-derived liquids an of polymerization and depolymerization.
   (g) Development of liquid/solid separation methods by filtration, precipita centrifugation and use of hydroclones.
   (h) Kinetics of reactions by solids in contact with gases, including fluidi dilute phase or entrained beds, and fixed beds.
   (i) Kinetics of coal agglomeration
   (j) Side and co-product reactions from trace amounts of nitrogen and hydrog

SEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort
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- ☒ MINIMUM

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(f) Determination of properties and constituents of coal-derived liquids and rates of polymerization and depolymerization.
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E. Process Development.

The objective is to advance the development of coal processing by research on th operations of coal processing (i.e., fluidized bed technology) and by developing processes for producing hydrocarbons from coal.

Processes which should be investigated include

(1) Fast fluidized bed reactions for rapid carbonization or hydrogenation
(2) Fluidized bed or entrained flow combustion reactions with sulfur scavengers
(3) Improved plant "front end" technology, including new methods for handling, conv

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rying, surface oxidation, etc., processes.

5) Study of coal/oil slurries (formation, stability, flow characteristics, etc.)

6) Combustion of Chars and synthetic fuels
7) Acetylene from coal by the arc-coal process
8) Methods of handling coal fines in gasifiers
9) Methods for removal of char and tar from reactors
10) Unit operations involved in liquefaction
11) High pressure fluidized bed reactors
12) Multiphase flow characteristics in coal liquefaction
13) Useful byproducts from coal conversion processes
14) Emission control processes, as described in sub-program on environmental aspects of and shale processing and combustion

. <u>Hydrogen production for use in coal conversion processes</u>

The objective is the development of low-cost on-site processes for producing hydrogen-rich gases from non-petroleum sources for near and mid-term coal and oil shale process

1. Candidate processes should be investigated on a laboratory scale first with a pil plant only for the most promising techniques.
   - (a) Steam-oxygen process for H_2 production from coal and residue chars (ready for pil plant studies)
   - (b) Methods using thermochemical cycles at low temperatures so that heat from methana or other process heat might be used to drive the H_2 reaction (laboratory scale or at this time)
   - (c) Electrothermal generation from coal
   - (d) Steam-iron process

ie recommended spending rate for FY75 benefits and risks/uncertainties in each of the jectives areas A-F above are:

Equipment ($ 2 M in FY75)

1. Benefits--Frequent breakdown of equipment or inefficient operation coal and shale co version plants because of poor equipment could easily raise costs 10%. If coal and became a primary source of U. S. gas and oil, a 10% reduction in price would result in billions of dollars of cost savings.
2. Risks/uncertainties--Development of equipment is subject to some uncertainties sin high temperature reactors under pressure are often involved. Nevertheless, the possibility of significant achievement appears good, as high pressure technology i U. S. is an active field.

Materials ($2 M in FY 75)

1. Benefits -- Fracture, erosion and corrosion of materials used in coal conversion d might require unnecessarily frequent rebuilding of conversion reactors and their accessories and possibly cause frequent unexpected shut downs, all of which could easily raise costs 10%. If coal and shale conversion became a primary source of U gas and oil, a 10% reduction in price would result in billions of dollars of cost savings.
2. Risks/Uncertainties -- Monitoring deterioration and measurement of properties of materials is a straight forward procedure. The major uncertainty here lies in whether new and improved test methods and materials can be developed. Based on previous experience, the possibility of significant achievement here appears good.

. Data compilations, handbooks and analyses ($1M in FY 75)

1. Benefits -- In designing pilot and demonstration plants, engineering data are need on the construction materials used, coal itself and chemical processes. Economic analyses also are needed. Serious engineering problems and inefficient designs ca result from lack of suitably analyzed data, which might lead to long delays in ach suitable operation. Loss of time even in an orderly program is irreplaceable, wher

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(13) Useful byproducts from coal conversion processes
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   (c) Electrothermal generation from coal
   (d) Steam-iron process

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The recommended spending rate for FY75 benefits and risks/uncertainties in each of the objectives areas A-F above are:

Equipment ($2M in FY75)
1. Benefits--Frequent breakdown of equipment or inefficient operation coal and shale conversion plants because of poor equipment could easily raise costs 10%. If coal and sh became a primary source of U. S. gas and oil, a 10% reduction in price would result in billions of dollars of cost savings.
2. Risks/uncertainties--Development of equipment is subject to some uncertainties since high temperature reactors under pressure are often involved. Nevertheless, the possibility of significant achievement appears good, as high pressure technology in U. S. is an active field.

Materials ($2 M in FY 75)
1. Benefits -- Fracture, erosion and corrosion of materials used in coal conversion dev might require unnecessarily frequent rebuilding of conversion reactors and their accessories and possibly cause frequent unexpected shut downs, all of which could easily raise costs 10%. If coal and shale conversion became a primary source of U. gas and oil, a 10% reduction in price would result in billions of dollars of cost savings.
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Data compilations, handbooks and analyses ($1M in FY 75)
1. Benefits -- In designing pilot and demonstration plants, engineering data are needed on the construction materials used, coal itself and chemical processes. Economic analyses also are needed. Serious engineering problems and inefficient designs can result from lack of suitably analyzed data, which might lead to long delays in achie suitable operation. Loss of time even in an orderly program is irreplaceable, whereas inefficient design or the need for costly design could easily raise costs for pilot and demonstration plants by 20 to 50 per cent, equal to many millions of dollars.
2. Risks/Uncertainties -- The collection and analysis of data although time-consuming is more certain of accomplishment than most R&D work.

Catalysts and chemical kinetics for conversion processes ($ 3M in FY75)
1. Benefits -- Some of the most important reactions in coal and liquefaction depend on Catalysts with catalytic stages representing perhaps 30% the total cost in these processes. Even minor improvements in catalysis or in chemical processes would rest in massive savings in coal and shale processing.
2. Risks/uncertainties -- As with all research programs, the fractional improvement tha will be accomplished in this area cannot be definitely stated. Still definite

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scientific breakthrough.

E. Process Development ($2M in FY75)

1. Benefits -- Even in existing pilot plants, a number of individual processes been optimized. Individual optimization of various processes as listed abo easily reduce costs by 10%. If coal and shale conversion become a primary U. S. gas and oil, a 10% reduction in price could result in billions of dol cost savings.
2. Risks/uncertainties -- Development programs have inherent uncertainties, bu listed in this section should yield significant results.

F. Hydrogen Production for use in Coal Conversion Processes ($1M in FY75)

1. Benefits -- The economical production of hydrogen from residue chars or coa essential for the economical development of the Synthoil coal liquefaction the Hydrane and Hygas coal gasification processes In general, sources of hy necessary for any process which converts coal to gas or oil, since the chie difference between coal and these other fuels is the deficiency of hydrogen
2. Risks/uncertainties -- A number of hydrogen production processes can be sho technically feasible. The main uncertainty lies in the selection of an econ for particular coal conversion systems.

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[illegible]ific breakthrough.

[illegible]ocess Development ($3M in FY75)

Benefits -- Even in existing pilot plants, a number of individual processes have not been optimized. Individual optimization of various processes as listed above could easily reduce costs by 10%. If coal and shale conversion become a primary source of U. S. gas and oil, a 10% reduction in price could result in billions of dollars of cost savings.

Risks/uncertainties -- Development programs have inherent uncertainties, but all items listed in this section should yield significant results.

[illegible]drogen Production for use in Coal Conversion Processes ($1M in FY75)

Benefits -- The economical production of hydrogen from residue chars or coal is essential for the economical development of the Synthoil coal liquefaction process and the Hydrane and Hygas coal gasification processes. In general, sources of hydrogen are necessary for any process which converts coal to gas or oil, since the chief chemical difference between coal and these other fuels is the deficiency of hydrogen in coal.

Risks/uncertainties — A number of hydrogen production processes can be shown to be technically feasible. The main uncertainty lies in the selection of an economic process for particular coal conversion systems.

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

SCHEDULE *(Include major facilities and major equipment. Indicate dates by Fiscal Year and Quarter).*

a. DEVELOPMENT MILESTONES *(number each consecutively)*

(Limit Title of Milestone to 60 characters and spaces)	FY

(Continue to next column)

and Shale Processing Combustion
ting Research

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
05 05 55 03 10 55 56 02

Decision

a. [illegible] MILESTONES *(continued)*

(Limit Title of Milestone to 60 characters and spaces)

ATES Complete FY	ATES Complete Q	b. DATES Start FY	b. DATES Start Q	b. DATES Complete FY	b. DATES Complete Q
Decision Milestones for Individual Projects					
1. Start of coal processing supporting research projects.		75	1	77	1
2. Initial decision point on coal processing support projects.		78	1	80	1
3. Decision point on second generation coal processing support.		80	1	80	1

NOTE: Maximum, orderly and minimum programs differ primarily in level of effort. This results in varying the number of projects and the options explored but does not change the schedule of decision points for individual projects.

(Continue on separate sheet)

Page of

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. SUMMARY OF FUNDING REQUIREMENTS—Federal Government Only *(In millions of dollars)*

Coal and Sh
Combustion

Requirement	(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	(4) FY 1977 Obls.	(4) FY 1977 Outla
a. OPERATING *(See p. for detail)* Total Operating Requirements *(from Detail Sheet)*								
b. CONSTRUCTION *(See p. for detail)* Total Construction Requirements *(from Detail Sheet)*								
c. EQUIPMENT *(See p. for detail)* Total Equipment Requirements *(from Detail Sheet)*								
d. GRAND TOTAL—OBLIGATIONS	12		12		12		12	
e. GRAND TOTAL—OUTLAYS		12		12		12		12

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funding. A brief desc
expenditures should be separately provided in the above format.

Level of Effort:

☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

Coal and Shale Processing and Combustion Supporting Research

IDENTIFICATION NUMBER: 05 03 55 03 10 55 56 00

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total FY 1974	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
		12		12		12		60		300		360	
	12		12		12		12		60		300		360

vernment funding. A brief description of the Cooperative programs and the rationale for the division of funding

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

IL OF FUNDING REQUIREMENTS - Federal Government Only *(in millions of dollars)*

ERATING

Coal and Shale Pr
Supporting Resear

ITEM	(1) FY 1974 (Non-Add) Obls.	Outlays	(2) FY 1975 Obls.	Outlays	(3) FY 1976 Obls.	Outlays	(4) FY 1977 Obls.	Outlays
TOTAL *(Carry forward to summary sheet)* >	12	12	12	12	12	12	12	12
of Performing Organization:								
MANPOWER								
MATERIALS								
MAJOR PROCUREMENTS								
ALL OTHER								
TOTAL FOR THIS PERFORMING ORGANIZATION								
of Performing Organization:								
MANPOWER								
MATERIALS								
MAJOR PROCUREMENTS								
ALL OTHER								
TOTAL FOR THIS PERFORMING ORGANIZATION								
of Performing Organization:								
MANPOWER								
MATERIALS								
MAJOR PROCUREMENTS								
ALL OTHER								
TOTAL FOR THIS PERFORMING ORGANIZATION								
of Performing Organization:								
MANPOWER								
MATERIALS								
MAJOR PROCUREMENTS								
ALL OTHER								
TOTAL FOR THIS PERFORMING ORGANIZATION								

(Continue on Separate Shee

Coal and Shale Processing and Combustion Supporting Research

Level of Effort:
- ☐ MAXIMUM
- ☐ OPTIMUM
- ☒ MINIMUM

IDENTIFICATION NUMBER
05 05 55 03 10 55 5602

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1978-79		(8) BALANCE TO COMPLETE		(9) TOTAL ESTIMATED FY 1976 COST	
s.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obl.	Outlays
	12	12	12	12	12	12	12	60	60	300	300	360	360

(Continue on Separate Sheet)

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2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

3. DETAIL OF FUNDING REQUIREMENTS—Federal Government Only *(in millions of dollars)*

B. CONSTRUCTION

N/A

ITEM	(1) FY 1974 (Non-ADP) Obls.	(1) FY 1974 (Non-ADP) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	(4) FY 19 Obls.	(4) FY 19 C
TOTAL *(Carry forward to summary sheet)* ▶								
Title of Project, Location (State and County) and Total Estimated Cost (TEC) (Number each item consecutively). Every project costing one million dollars or more should be separately identified with a brief description. Item No. ( )								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* ( )								
State / County / TEC *(in millions)*								
Statement:								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* ( )								
State / County / TEC *(in millions)*								
Statement:								
TITLE OF PROJECT *(Not to exceed characters and spaces.)* ( )								
State / County / TEC *(in millions)*								
Statement:								

(Continue on Separate S

Level of Effort:

- ☐ MAXIMUM
- ☐ ORDERLY
- ☒ MINIMUM

IDENTIFICATION [illegible]

05 05 55 03 10 55 56 0.

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		TOTAL [illegible] FY 1979	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls	O.

[illegible] Sheet)

Page [illegible] of

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

DETAIL OF FUNDING REQUIREMENTS—Federal Government Only *(In millions of dollars)*

EQUIPMENT

ITEM *(Each item not to exceed 60 characters and spaces)*	(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	F Obl
a. Each performing organization, with all current funds, with a separate item of each item of equipment costing one million dollars or more. TOTAL *(Carry forward to summary sheet)* ▷							

Included in 9a.

(Continue on S

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
05 05 55 03 10 55 56 00

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL ENCLUDING FY 1974 AND 75	
	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays

(Continue on Separate Sheet)

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SUBPANEL 5

COAL AND SHALE PROCESSING AND COMBUSTION

APPENDIX A

MEMBERS AND EXECUTIVE SECRETARY OF SUBPANEL

Appendix A

Subpanel #V: COAL & SHALE PROCESSING & COMBUSTION

William Crentz Bureau of Mines Rm. 4560 - Interior Building U. S. Department of the Interior Washington, D. C. 20240	DOI	Chairman
Neal P. Cochran Office of Coal Research U. S. Department of the Interior Washington, D. C. 20240	DOI	
Dr. John Cowles Division of Applied Technology U. S. Atomic Energy Commission Washington, D. C. 20545	AEC	
Robert Hangebrauck CSL National Environmental Research Center Research Triangle Park, North Carolina 27711	EPA	
Dr. Gerald A. Hollinden Power Resources Planning Office of Power Tennessee Valley Authority Chattanooga, Tennessee 37401	TVA	
Dr. John Manning National Bureau of Standards U. S. Department of Commerce Washington, D. C. 20234	DOC	
Lewis G. Mayfield National Science Foundation Washington, D. C. 20550	NSF	
Dr. Alex Mills Bureau of Mines Rm. 4559 - Interior Building U. S. Department of the Interior Washington, D.C. 20240	DOI	
Rufus W. Shivers Division of Applied Technology U. S. Atomic Energy Commission Washington, D. C. 20545	AEC	Executive Secretary

SUBPANEL 5

COAL AND SHALE PROCESSING AND COMBUSTION

APPENDIX B

CONSULTANTS

Appendix B

Subpanel #V: COAL & SHALE PROCESSING & COMBUSTION

Consultants

John B. Anderson, Product Manager
Research and Development Sales
Combustion Engineering Company
Windsor, Connecticut 06095

L. Berkowitz, Director
ESSO Research and Engineering Company
Government Research Laboratory
Linden, New Jersey 07036

W. E. Bond, Vice President
Atlantic Richfield Company
Los Angeles, California

Arthur L. Conn, Director
Government Contracts
Research and Development Department
American Oil Company
2500 N. W. Avenue
Whiting, Indiana 46394

R. G. Daniel
Atlantic Richfield Company
Los Angeles, California

Dr. Martin A. Elliot
Texas Eastern Transmission
Houston, Texas

Brian Harney
BuMines
Washington, D. C.

Dr. W. B. Harrision, Vice President
Southern Service, Inc.
Birmingham, Alabama

Jack Huebler
Institute Gas Technology
Chicago, Ill.

T. Kelly Janes
EPA
Research Triangle Park, North Carolina 27711

Harry Johnson
BuMines
Washington, D. C.

Martin Kyle
Argonne National Laboratory
Chicago, Illinois

Dr. B. G. McKinney
TVA
Chattanooga, Tennessee

Jere Nichols
Oak Ridge National Laboratory
Oak Ridge, Tennessee

John A. Phinney
Consolidation Coal Company
Library, Pennsylvania

Dr. Paul Pitts, V.P.
Atlantic Richfield Company
Philadelphia, Pennsylvania

Dr. Charles Prien
Colony Development Company
Denver, Colorado

H. M. Seigel, Manager
Synthetic Fuels Research Department
ESSO Research and Engineering Company
Florham Park, New Jersey 07932

Paul W. Spaite
6315 Grand Vista
Cincinnati, Ohio 45213

SUBPANEL 5

COAL AND SHALE PROCESSING AND COMBUSTION

APPENDIX D

PROJECT PROPOSALS CONSIDERED

PROPOSALS APPENDIX D

Sub-Panel 5 Sub-program: Coal and Shale Processing and Combustion

Sub-program Title	Identification Number	Proponent
1. Base Technology Coal Laboratory - Process Engineering	0501-1410-1055-0202-0293	AEC
2. Base Technology Coal Laboratory - Process Development	0501-1410-1155-0202-0191	AEC
3. Base Technology Coal Laboratory - Materials Technology	0501-0003-1055-0202-0186	AEC
4. Fluidized Bed Combustion	0501-1403-1185-0201-0817	AEC
5. Flash Hydrogenation of Coal	0501-1203-1055-0202-0188	AEC
6. Coal Structure and Reactivity	0502-0003-2055-0502-0189	DOI
7. Base Technology Coal Laboratory - Process Chemistry	0501-1410-2055-0202-0192	AEC
8. Base Technology Coal Laboratory - Process Instrumentation	0501-1103-1055-0202-0193	AEC
9. Process Development of a Fluidized-Bed System for Combined Shift and Methanation Reaction	0514-1405-1155-0302-0183	Bituminous Coal Research, Inc.
10. Early Optimization of HYGAS Process for Converting Coal to Gas	0515-1103-1185-0301-0183	Institute of Gas Technology

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
11. Equipment Standardization, Reliability and Maintainability Program	0522-1403-1055-0102-0143	DOI
12. Fisher-Tropsch Synthesis	0520-1202-1255-0101-0144	DOI
13. Methanol From Coal	0522-1203-1283-0101-0145	DOI
14. Clean Coke Process	0520-1203-1155-5501-0146	DOI
15. Direct Hydrogenation	0520-1203-1285-5501-0147	DOI
16. Demonstration of a Combined Coal Conversion Facility - the COED Process	0520-1203-1285-5501-0148	DOI
17. Commercialization of Coal Liquefaction	0501-1203-1281-0201-0185	AEC
18. Zinc Chloride Conversion Process Coal to Gasoline	0521-1103-1278-5501-0122	DOI
19. Demonstration BTU Gasification Plant - Construction and Operations	0521-1103-1283-0301-0123	DOI
20. Self-Agglomerating Process for Synthesis Gas Production	0521-1103-1180-0301-0124	DOI
21. Hydrogen Donor Extraction	0521-1203-1235-0101-0127	DOI

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
22 Simultaneous Stack Gas Emission Control and Wastewater Purification	0514-0009-1278-0301-0128	Chemsoil Co.
23 N/A (Optimization of Coal Cleaning Circuits	0514-1403-2055-0302-0130	Bituminous Coal Research, Inc.
24. High Temperature Laboratory to Test Components to Contain Liquid Coal Ash Ingredients	0514-1403-1055-0303-0131	Bituminous Coal Research, Inc.
25. Electrostatic Beneficiation of Fine Dry Coal	0514-1403-1155-0303-0132	Bituminous Coal Research, Inc.
26. 300 to 1000 Lbs/Hr Pulverized Coal-fired Research Boiler	0514-1403-1155-0303-0133	Bituminous Coal Research, Inc.
27. Effects of Coal Cleaning on Trace Element Removal	0514-1403-2055-0302-0134	Bituminous Coal Research, Inc.
28. Removal of SO_2 from Industrial Stack Gases with Simultaneous Purification of Waste Water	0504-0009-1279-5501-0135	NASA
29 Stack Gas Cleanup	0502-1409-1278-5502-0136	DOI
30 SO Removal Using Alkaline Ash Slurry	0522-1409-1178-5501-0137	DOI

Sub-program Title	Identification Number	Proponent
31. Coal Liquefaction	0515-1203-1286-0301-0141	Inst. of Gas Technology
32. Coal Gasification for Production of Chemicals and Oils	0515-1103-1281-0301-0142	Inst. of Gas Technology
33. Multiple Process Testing - Cresap	0521-1203-1185-5501-0102	DOI
34. Coal Conversion Process Development	0521-1203-1255-5501-0103	DOI
35. Solvent Refined Coal (SRC)	0521-1203-1285-5501-0104	DOI
36. Overall Program Summary: "Clean Liquid Fuels:	0521-1203-1281-0101-0105	DOI
37. Coal Conversion Engineering Data Book	0521-1403-2055-0302-0106	DOI
38. Exploratory Research	0521-1403-1055-0302-0108	DOI
39. Hygas Process	0521-1103-1180-0301-0109	DOI
40. Application of Heat Pipes in Coal Conversion Plants	0521-1203-1155-0301-0110	DOI
41. Supporting Basic Research	0521-1403-1055-0302-0111	DOI

Subpanel 5 — COAL & SHALE PROCESSING & COMBUSTION

Sub-program Title	Identification Number	Proponent
42. Waste Disposal and Byproduct Recovery	0521-1403-1080-0302-0112	DOI
43. Characterization, Handling, and Pretreatment of Coal	0521-1403-1055-0302-0113	DOI
44. Improved Materials for Energy Conversion Systems-Firebox Refractories and Heat Exchanger Tubes	0522-1405-1055-0102-0120	DOI
45. Fluidized Bed Combustion Boilers--Development of a Fluid Bed Combustion Boiler Demonstration Plant	0507-1405-5555-0102-0121	TVA
46 Cost Estimation: Computer Program	0502-1203-2085-0102-0280	DOI
47. Production of Liquid Hydrocarbons from Coal	0514-1203-1283-0301-0092	Atomics Int'l
48. Advanced Hydrocarbon Syntheses	0521-0003-1255-5502-0093	DOI

Subpanel 5	Coal & Shale Processing & Combustion	
Sub-program Title	Identification Number	Proponent
49. Catalytic Hydrocracking Process	0521-1103-1255-5502-0094	DOI
50. Fluidized-Bed Boiler (Atmospheric)	0521-1405-1255-0101-0095	DOI
51. Pressurized Fluidized-Bed (Adiabatic)	0521-1405-1281-5501-0096	DOI
52. Pressurized Fluidized-Bed	0521-1405-1255-0101-0097	DOI
53. Pressurized Fluidized-Bed (Supporting Studies)	0521-1405-1255-0102-0098	DOI
54. Combustion of Chars and Synthetic Fuels	1522-1405-1055-0102-0099	DOI
55. Synthoil Process	0522-1203-1280-0101-0100	DOI
56. Solvent Refined Coal Pilot Plant	0521-1203-1185-0101-0101	DOI
57. Development and/or Operation of Processes to Generate Hydrogen Required in Coal Conversion Plants	0521-1103-1155-0302-0169	DOI
58. Materials Development	0521-1103-1085-0302-0170	DOI
59. Thermal Efficiency and Availability of Boilers Burning Western Coals and Lignite	0522-1105-1155-0302-0173	DOI
60. Effects of Coal Cleaning in Trace Element Removal	0514-1402-2055-0302-0175	Bituminous Coal Research, Inc.

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
61. 300 to 1000 Lbs/Hr Pulverized Coal-fired Research Boiler	0514-1405-1155-0303-0179	Bituminous Coal Research, Inc.
62. Electrostatic Beneficiation of Fine Dry Coal	0514-1403-1155-0303-0180	Bituminous Coal Research, Inc.
63. High Temperature Laboratory to Test Components to Contain Liquid Coal Ash Ingredients	0514-1403-1055-0303-0181	Bituminous Coal Research, Inc.
64. Optimization of Coal Cleaning Circuits	0514-1403-1155-0303-0182	Bituminous Coal Research, Inc.
65. Novel Liquefaction Methods	0522-1203-1155-5501-0163	DOI
66 Development of the BI-GAS Coal Gasification Process for the Generation of Substitute Natural Gas	0521-1103-1180-0301-0164	DOI
67 The Investigation and Development of a Liquid Phase Methanation Process	0521-1103-1180-0302-0165	DOI
68. Equipment Development	0521-1103-1080-0302-0166	DOI
69. Development of the Carbon Dioxide Accepter Coal Gasification Process	0521-1103-1180-0302-0167	DOI
70. Synthane Process for Gasifying Coal to Substitute National Gas (SNG)	0522-1103-1180-0301-0168	DOI
71. Hydrane Process for Hydrogasification of Coal to SNG	0522-1103-1182-0101-0161	DOI
72. Process Development of a Fluidized-bed System for Combined Shift and Methanation Reactions	0514-1103-1155-0202-0178	Bituminous Coal Research, Inc.

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
73 Nuclear Heat Coal Gasification	0522-1103-1055-0101-0162	DOI
74 Sulfur Dioxide Removal "Joint EPA/TVA Ammonium-Bisulfate Program	0522-1103-1055-0101-0162	EPA
75 Second Generation: Advanced Technology	0521-1203-1185-0101-0154	DOI
76 Liquefaction Engineering Evaluations	0521-1203-1285-5502-0155	DOI
77. Fixed-Bed Hydrogenation	0521-1203-1285-5501-0156	DOI
78. Production of Chemicals from Coal	0521-1203-1285-0101-0157	DOI
79. Centrifugal Hydrogenation	0521-1203-1285-0101-0158	DOI
80 Extension of the Char-Oil-Energy-Development (COED) Program for the Conversion of Coal	0521-1203-1285-0102-0159	DOI
81 Steam-Iron Process for Hydrogen Production	0521-1103-1180-0301-0161	DOI
82 Financial Aspects of Coal Processing Commercialization	0521-1103-2055-0102-0171	DOI
83 Fuel Derived from Coal	0532-1408-1055-0131-0373	DOD
84. Utilizing Devices and Testing Equipment using a New Synthetic Fuel Derived from Coal	0532-1468-1080-5503-0374	DOD
85 Sulfur Dioxide Removal, "TVA's 1-MW Pilot Plant Operation and Supporting Research to Define the Most Economical SO_2 Removal Processes"	0507-1405-1155-0102-0151	TVA

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
86 Sulfur Dioxide Removal "TVA's 10-MW Prototype Wet Scrubbing Program"	0507-1405-1155-0101-0152	TVA
87. Base Technology Coal Laboratory - Component Development	0501-0003-1055-0202-0190	AEC
88. Evaluation	0521-1103-1180-0302-0139	DOI
89 Fluidized Bed Combustion (Supporting Study)	0521-1405-2055-0102-0126	DOI
90. Commercialization of Coal Processing	0521-1103-2055-0302-0177	DOI
91. Hydrocarbon Byproducts	0521-1103-1155-0301-0176	DOI
92. Durability and Reliability of Materials for Clean Energy from Coal	0503-1403-1055-0102-0681	DOC
93. Environmental Problems of Clean Energy from Coal	0503-1403-2055-0102-0680	DOC
94. Coal Processing	0505-1403-1279-0103-0750	EPA
95. Evaluation, Development and Demonstration for Shale Oil and Alternate Sources of Fuel	0505-2203-1285-0103-0751	EPA

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
96. Air Pollution Control Technology - Development of a Cleaned, Solid Fuel via Chemical Treatment of Coal	0505-1403-1280-5503-0752	EPA
97. Air Pollution Control Technology - Fuel Processing Control of Fine Particulates from Flue Extraction Processing Plants	0505-1403-1279-0102-0753	EPA
98. Air Pollution Control Technology - Energy Conservation and Environmental Improvement by the Recovery of Petroleum Refinery Hydro-carbon losses	0505-2103-2055-5502-0754	EPA
99. Environmental Control in Pulverized Coal Combusting	0502-1405-1055-0102-0756	DOI
100. Physical and Chemical Removal of Sulfur from Coals	0522-1403-1055-0102-0757	DOI
101. Separation Technology	0521-0003-1155-5501-0620	DOI
102. Liquid Fuels from Oil Shale Synthetic Liquid Fuels from Coal: Homogeneous Catalytic and Solvation Processes	0532-2202-1055-0302-0763	DOD
103. Development of Jet Fuels from Coal Liquefaction Processes	0533-1203-1055-0102-0795	DOD
104. Research on Combustion of Coal in a Fluidized Bed	0504-1410-1055-0103-0760	NASA
105. High Gradient Pre-conversion Magnetic Separation	0521-1402-1180-5501-0761	DOI

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
106. Pressurized Fluidized Bed (Research)	0521-1402-1295-0103-1762	DOI
107. Air Pollution Control Technology-Combustion Fossil Fired Furnace using Pure Oxygen Instead of Air (Coal or Oil) (1) Process or product development	0505-1405-1281-0102-0730	EPA
108. Air Pollution Control Technology Disposal of High Sulfur Refinery Residues by Gasification in a Fluidized Bed and Combustion in a Boiler	0505-2105-1279-5501-0733	EPA
109. Air Pollution Control Technology - Flue Gas Cleaning Electric Power Generation from Coal Combustion with Adequate Fine Particulate Control using Electrostatic Precipitators	0505-1405-1278-5503-0734	EPA
110. Air Pollution Control Technology Flue Gas Cleaning Electric Power Generation from Coal Combustion with Adequate Fine Particulate Control Using Fabric Filter Systems	0505-1405-1279-5503-0735	EPA
111. Air Pollution Control Technology - Flue Gas Cleaning Electric Power Generation from Coal Combustion with Adequate Fine Particulate Control by Development and Use of Novel Devices	0505-1405-1276-5503-0792	EPA

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
112. Air Pollution Control Technology-Flue Gas Cleaning Electric Power Generation from Coal Combustion with Adequate Fine Particulate Control Using Low Energy Scrubber Systems	0505-1405-1278-5503-0736	EPA
113. Air Pollution control Technology-Flue Gas Cleaning	0505-1405-1277-5501-0737	EPA
114. Air Pollution control Technology-Flue Gas Cleaning Demonstration of the combined Wellman-Lord/Allied Flue Gas Desulfurization Process with Modifications to Minimize Energy Consumptions	0505-1405-1279-5503-0738	EPA
115. Air Pollution Control Technology-Flue Gas Cleaning Demonstration of a Coal-fired Utility flue Gas Desulfurization Process Integrated with the Power Cycle for Maximum Energy Conservation and Utilization	0505-1405-1280-5502-0739	EPA
116. Increased Utilization of Fossil fuel Reserves as an Energy Source through Adequate Control of Gaseous Toxic and Carcinogenic Emissions	0505-1405-1279-5503-0740	EPA
117. Air Pollution Control Technology- Development and Demonstration of Modified Combustion Technology for Utility Boilers	0505-1405-1278-5503-0741	EPA
118 Air Pollution Control Technology-Fluidized Bed Combustion	0505-1405-1276-5501-0742	EPA

Subpanel 5 — Coal & Shale Processing Combustion

Sub-program Title	Identification Number	Proponent
119. Air Pollution Control Technology Development and Demonstration of Modified Combustion control Technology for Utility Gas Turbines	0505-3105-1283-5503-0743	ERA
120. Clean-Fuel Combustion Technology for Power Systems Low-NO_x Combustion of Reformed Fuels	0504-2105-2080-0102-0746	NASA
121. Control Technology By-Product Utilization Development and Demonstration of Technology for the Production of Elemental Sulfur from Regenerable Flue Gas Desulfurization Systems by Use of Alternate Reductants	0505-8209-1278-5502-0717	EPA
122 Control Technology By-Product Utilization Using Sulfur By-Products from Flue Gas Desulfurization of Coal-Fired Electric Utilities to Supplant Other Materials Requiring Energy to Produce	0505-0009-1295-5502-0716	EPA

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Sub-program Title	Identification Number	Proponent
123. Alternative Energy Sources High Sulfur Combustor Power Boiler Demonstration	0505-1409-1285-5501-0718	EPA
124. Water Pollution Control Technology-Use of Chars in Wastewater Treatment	0505-1409-1255-5503-0720	EPA
125 Air Pollution Control Technology Development and Demonstration of Modified Combustion Technology for Industrial Process Furnaces	0505-1408-1280-5502-0721	EPA
126 Air Pollution Control Technology Flue Gas Cleaning Development and Demonstration of Flue Gas Desulfurization Process for Application to Coal-Fired Industrial Boilers	0505-1407-1275-5501-0722	EPA
127 Air Pollution Control Technology - Industrial Boilers	0505-1407-1277-5503-0723	EPA
128. Air Pollution Control Technology Development and Demonstration of Modified Combustion Technology for Industrial Boilers	0505-1407-1277-5503-0724	EPA

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Sub-program Title	Identificaiton Number	Proponent
129. Air Pollution Control Technology-Flue Gas Cleaning Minimizing Energy Required Desulfurization of Flue Gas from Coal Fired Utility Boilers	0505-1405-1278-5502-0726	EPA
130. Air Pollution Control Technology-Flue Gas Cleaning Demonstration of an Advanced Regenerable Flue Gas Desulfurization Process for Coal-Fired Utility Boilers	0505-1405-1280-5502-0727	EPA
131. Air Pollution Control Technolgoy-Flue Gas Cleaning Lime/Limestone Scrubbing of Flue Gas-Advanced Process Development and Waste Disposal Evaluation/Demonstration	0505-1405-1276-5501-0728	EPA
132. Fluidized Bed Oil Gasification: Utilization of High Sulfur Refinery Residue for Clean Power Generation by Fluidized Bed Gasification Desulfurization	0505-2403-1078-0302-0917	EPA

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Sub-program Title	Identificational Number	Proponent
133. Simultaneous SO_2-NO_x Removal	0522-1402-1278-0101-0948	DOI
134. Fluidized Bed Combustion Boiler	0514-1405-1280-0301-0909	Westinghouse EPA, OCR, TVA Argonne NL, CR, NL, Esso, BCURA, etc.
135. Simultaneous Catalytic Reduction of SO_x and NO_x in Stack Gas.	0514-0005-2055-0302-1088	AIF-Combustion DIV.
136. Coal Liquefaction	0514-1103-1055-0303-1093	AIF-Combustion DIV.
137. Synthetic Pipeline Gas from Coal	0514-1103-1055-0303-1093	AIF-Combustion Division

Subpanel 5 — Coal & Shale Processing & Combustion

Sub-program Title	Identification Number	Proponent
138. Air Pollution Control Technology Fuel Gas Cleaning fine Particulates-Commercial & Home Heating Units	0505-1407-1278-5502-0896	EPA
139. Chemistry of Process reactions for Clean Energy from Coal	0503-1403-1079-0102-0682	DOC
140. Uranium Recovery from Coal Ash & Other Waste Products	0514-4101-1053-0302-1048	ANS
141. Research in Support of Converting Coal to Clean Liquid & Gaseous Fuels	0501-1203-1055-0202-0633	AEC
142. Hydrogen From Coal	0522-1103-1180-0301-0599	DOI
143. Hydrogen Production by Coal Gasification	0504-0003-1255-0101-0601	NASA
144. Catalyst Development	0508-1410-1055-5502-0528	NSF
145. Improved Gas/Solid/ Liquid Separation Systems	0508-1410-1055-5503-0526	NSF
146. Process Research	0521-0003-2055-5502-0614	DOI

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Sub-Program Title	Identification Number	Proponent
147. Utilization of a Sludge-Type Waste Produced through Neutralization of Acid Coal Mining Drainage	0514-1409-2055-0302-0033	DOI
148. Reclamation of Coal Mining Waste Areas	0522-1402-2072-5502-0040	DOI
149. Support Studies for Mining Systems Tech.	0521-1410-5501-1072-0041	DOI
150. Production of Hydrogen, Methane and Metharel from Coal	0514-1103-1283-0301-0598	IND
151. Acetylene from Coal by the Arc Coal Process	0521-1103-1155-0101-0236	DOI
152. Development of Central Fuel Processing and Cleanup Techniques	0514-3305-1077-0301-0261	IND
153. Utilization of Coal in Intermediate and Small-Sized Power Plants	0532-1405-1055-0302-0713	DOD
154. Hydrogen Production by Thermochemical Process	0504-0003-1155-0202-0602	NASA
155. Flue-Gas Cleanup System Waste Management	0514-1405-1255-0303-1075	IND
156. Innovative Approaches to Coal Conversion	0508-1410-1055-5503-0522	NSF
157. Fundamentals of Chemical-Physical Processes and Properties of Coal	0508-1410-1055-5503-0523	NSF
158. Utilization and Disposal of Conversion Plant Wastes	0521-8209-2055-5502-0043	DOI

APPENDIX D

B. PROPOSAL ASSIGNMENT BY SUBPROGRAM

Subprogram	Proposals
1. Pipeline Quality Gas from Coal	9, 19, 20, 39, 66, 67, 69, 70, 71, 81, 88, 137
2. Clean Burning Liquids from Coal	5, 12, 13, 14, 15, 16, 17, 18, 21, 31, 32, 33, 34, 47A, 47B, 55, 56, 65, 75, 76, 77, 78, 80, 83, 84, 103, 136
3. Oil Shale Processing and Development	102A
4. Improved Combustion Process	4, 45, 50, 51, 52, 53, 59, 104, 106, 117, 118, 119, 120, 125, 128, 153
5. Improved Environmental Control	29, 30, 42, 74, 85, 86, 94, 95, 96, 97, 98, 99, 100, 105, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 121, 122, 123, 124, 126, 127, 129, 130, 131, 132, 133, 138, 140, 145, 147, 148, 155, 158
6. Support Research to Achieve Coal and Shale Processing and Combustion Program Obligations	2, 3, 6, 7, 8, 11, 24, 37, 38, 40, 41, 43, 44, 46, 48, 49, 54, 57, 58, 68, 73, 82, 87, 90, 91, 92, 93, 135, 139, 141, 142, 143, 144, 146, 149, 151, 154, 156, 157

Note: Rejected Proposals not listed above.

APPENDIX D

Subpanel #V: COAL & SHALE PROCESSING & COMBUSTION

LIST OF REJECTED PROPOSALS

Subprogram I Pipeline Quality Gas from Coal

No. 10 work is covered in No. 39

No. 72 is a duplicate of No. 9

Subprogram II Clean Burning Liquids from Coal

No. 35 is a duplicate of No. 34

No. 36 is a summary only and therefore rejected

No. 79 is a duplicate of No. 5

No. 102B covers catalytic process of liquid from coal. Insufficient data is presented to judge the merits of the proposal.

Subprogram IV Improved Combustion Processes

No. 26 - The proposed effort was to construct a pulverized fired test boiler. A similar facility with the same capabilities is currently in operation. Proposal is rejected as unnecessary.

No. 61 is a duplicate of No. 26

No. 89 is a duplicate of No. 53

No. 134 is a duplicate of No. 45

Subprogram V Improved Environmental Control

No. 22 was rejected on basis of very low applicability if technology was developed.

No. 23 proposed effort would not advance technology to a degree that is not available or is being developed.

No. 25 was rejected as technology has primarily been investigated. The potential does not warrant support. Other technology that would achieve improved results are more advanced in development.

No. 27 work is already being developed.

No. 28 is similar to No. 22 and rejected on the same basis -- questionable technology and low potential.

No. 60 is a duplicate of No. 27

No. 62 is a duplicate of No. 25

No. 64 is a duplicate of No. 23

Subprogram VI Support to Achieve Coal and Shale Processing and Combustion Program Objectives

No. 1 is a duplicate of No. 2

No. 63 is a duplicate of No. 24

No. 101 addresses the problem of using perm selective membrane for separating and upgrading hydrocarbon production. Conventional distillations processes are judged to be satisfactory for this purpose. Cost of research does not match benefits.

No. 152 supported work in development of central fuel processing and cleanup techniques for application in fuel cells. The panel could not identify specifics of the proposal and did not feel that the work even if specific, merited consideration.

No. 154 Hydrogen production by thermochemical processes. Initial phase of program was included to determine economic feasibility. Balance of program was not recommended.

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