ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

RATING

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	
TOTAL *(Carry forward to summary sheet)* ▷			5.6	5.6	6.8	6.8	6
Performing Organization: Esso Research & Engineering Co.							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION	0.2	0.2	1.0	1.0	0.5	0.5	
Performing Organization: Pope, Evans and Robbins, and other							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION			3.2	3.2	2.4	2.4	
Performing Organization: Combustion Power Co.							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION			0.6	0.6	0.7	0.7	
Performing Organization: Contractor to be selected							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION	—	—	—	—	—	—	

(Continued)

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

IDENTIFICATION NUMBER:
05-02-55-05-12-75-56-01

(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 PLUS 7	
	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outl
	6.8	6.1	6.1	10.7	10.7	37.3	37.3	66.5	66.5	58.0	58.0	124.5	124.
	0.5	0.8	0.8					2.3	2.3	—	—	2.3	2.3
	2.4	1.5	1.5	1.5	1.5	1.5	1.5	10.1	10.1	—	—	10.1	10.1
	0.7	0.6	0.6					1.9	1.9	—	—	1.9	1.9
	—	—	—	6.0	6.0			6.0	6.0	—	—	6.0	6.0

(Continue on Separate Sheet)

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

...RATING

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
TOTAL *(Carry forward to summary sheet)* ▷						
...of Performing Organization: Contractor to be selected						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION	—	—	—	—	2.4	2.4
...of Performing Organization: Contractor to be selected						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION	—	—	—	—	—	—
...of Performing Organization: Contractor to be selected						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION	—	—	—	—	—	—
...of Performing Organization: Contractor to be selected						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION	—	—	—	—	—	—

Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05-02-55-05-12-75-56-01

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXPLORATORY FY 1974 (Col. 7	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
1.2	1.2	1.2	1.2	—	—	4.8	4.8	—	—	4.8	4.8
—	—	—	—	10.0	10.0	10.0	10.0	20.0	20.0	30.0	30.0
—	—	—	—	22.5	22.5	22.5	22.5	—	—	22.5	22.5
—	—	—	—	1.8	1.8	1.8	1.8	35.0	35.0	36.8	36.8

on Separate Sheet)

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

L OF FUNDING REQUIREMENTS - Federal Government Only *(In millions of dollars)*

RATING

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
TOTAL *(Carry forward to summary sheet)* ▷						
of Performing Organization: NASA						
MANPOWER						
MATERIALS						
MAJOR PROCUREMENTS						
ALL OTHER						
TOTAL FOR THIS PERFORMING ORGANIZATION	—	—	0.8	0.8	0.8	0.8
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						

(Contin

Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05-02-55-05-12-75-55-01

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL FY 1975	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
2.0	2.0	2.0	2.0	1.5	1.5	7.1	7.1	3.0	3.0	10.1	10.1

* on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

'STRUCTION

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	F Obls.
TOTAL *(Carry forward to summary sheet)* >								
ect, Location *(State and County)* and Total Estimated Cost ... each item separately identified with a brief ... of the item) ... *(Not to exceed 30 characters and spaces.)* ... pressurized plant County: Union TEC *(in millions)*:	Item No. (1)							
...ide continuous operating data for ...-up of pressurized systems. Con- ...ction has been completed under ... funding.								
...ROJECT *(Not to exceed 30 characters and spaces.)* ... atmospheric plant County: Marion TEC *(in millions)*:	(2)							
...ide data for scale-up of atmos- ...ic system. Total construction ...equipment cost to this program ...t.') is $6.3 million.								
...ROJECT *(Not to exceed characters and spaces.)* adiabatic plant County: San Mateo TEC *(in millions)*:	(3)							
...ide data for scale-up of adiabatic ...em. Total construction plus ...pment cost to this program (Govt.') ...0.8 million.								

Level of Effort:

- ☐ MAXIMUM
- ☑ ORDERLY
- ☐ MINIMUM

IDENTIFICATION NUMBER:
05-02-55-05-12-75-56-01

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

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

CONSTRUCTION

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
TOTAL *(Carry forward to summary sheet)* ▷						
Project, Location *(State and County)* and Total Estimated Cost [illegible] each item consecutively). Every project costing one million or more should be separately identified with a brief statement of why it is required. Item No.						
TLE OF PROJECT *(Not to exceed 30 characters and spaces.)* (4) [illegible] pressurized plant County | TEC *(in millions)* [illegible] construction plus equipment cost this program (Govt.') is $6.8 million, [illegible]ming 50% industry co-sponsorship. [illegible]vide data for scale-up of pressur- [illegible]d system.						
TLE OF PROJECT *(Not to exceed 30 characters and spaces.)* (5) [illegible] adiabatic plant [illegible]e | County | TEC *(in millions)* [illegible]tal construction plus equipment cost this program (Govt.') is $5.4 million. [illegible]ovide data for scale-up of adiabatic [illegible]stem.						
TLE OF PROJECT *(Not to exceed characters and spaces.)* (6) [illegible] pressurized plant [illegible] | County | TEC *(in millions)* [illegible]tal construction plus equipment cost [illegible]vt.') is $35.0 million, assuming 50% [illegible]ustry co-sponsorship. Demonstrate [illegible]ssurized system.						

Level of Effort:

- ☐ MAXIMUM
- ☒ ORDERLY
- ☐ MINIMUM

IDENTIFICATION NUMBER
05-02-55-05-12-75-56-1

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

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

ETAIL OF FUNDING REQUIREMENTS – Federal Government Only *(In millions of dollars)*

CONSTRUCTION

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	F Obls.
TOTAL *(Carry forward to summary sheet)* ▶							
* Project, Location *(State and County)* and Total Estimated Cost *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is required.	Item No.						
LE OF PROJECT *(Not to exceed 30 characters and spaces.)* 30 MW atmospheric plant Site: County / TLC *(In millions)* Comments: Total construction plus equipment cost (Govt.') is $126.0 million, assuming 50% industry co-sponsorship. Demonstrate atmospheric system.	(7)						
LE OF PROJECT *(Not to exceed 30 characters and spaces.)* 30 MW adiabatic plant Site: County / TLC *(In millions)* Comments: Total construction plus equipment cost (Govt.') is $43.2 million, assuming 0% industry co-sponsorship. Demonstrate adiabatic system.	(8)						
LE OF PROJECT *(Not to exceed characters and spaces.)* laboratory modelling unit Site: County / TLC *(In millions)* Comments: Provide data to confirm and upgrade mathematical model. Total construction plus equipment cost (Govt.') is $11 million.	(9)						

Level of Effort:

- ☐ MAXIMUM
- ☒ ORDERLY
- ☐ MINIMUM

IDENTIFICATION NUMBER:
05-02-55-05-12-75-56-01

76	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1976-79		(8) BALANCE TO COMPLETE		(9) TOTAL PROJECT FY 1976 [illegible]	
Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	O.

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

NL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

QUIPMENT

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 Obls.
[illegible] TOTAL *(Carry forward to summary sheet)* ▷							

e total construction plus equipment
gures given in 9b.

(Continued on Sepa

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

IDENTIFICATION NUMBER
05-02-55-05-12-75-56-01

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

/

(Separate Sheet)

2

FACT SHEET

1 IDENTIFICATI
05-02-55-05-1

2. a. [illegible]
b. SUBPROGRAM: Coal & Shale Processing Combustion
Improved Combustion Processes- Part 2 - Fluidized Bed (

3. a. PRINCIPAL AGENCY: DOI, EPA, NASA, AEC
b. SUPPORT

4. CONTRACTOR ASSIST

(No more than 42 characters and spaces for name of contractor; use standard abbreviations for states; up to 16 characters and spaces for county.)

NAME OF CONTRACTOR: Westinghouse Electric Corporation;Esso R.		
Site where work will be performed >	State:	County:
NAME OF CONTRACTOR: Pope, Evans and Robbins, Other		
Site where work will be performed >	State:	County:
NAME OF CONTRACTOR: Combustion Power Company, Other		
Site where work will be performed >	State:	County:
NAME OF CONTRACTOR: Argonne National Laboratory		
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 70 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.

Description similar to that indicated in the companion for "orderly" level of effort, with the exceptions tha adiabatic fluidized combustor program is deleted; 2) t range of the full-scale demonstration plants will be 1 (150-400 MW); and 3) demonstration of the pressurized pheric variations, and completion of the model, will b until FY-81/82.

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

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE	FISCAL YEAR >	1975	1976	1977	1978	
a. MANPOWER (in man years)	(1) Scientific	62	72	81	95	
	(2) Technical	52	72	167	217	
	(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.)		Coal-2,000 tons Limestone-400 tons	Coal-76,000 tons Limestone-2600 tons	Coal-75,000 tons Limestone-2,500 tons	Coal-995,000 tons Limestone-60,500 tons	Cc Li
c. LAND AREA REQUIRED	(1) Government					
	(2) Controlled					

FACT SHEET

PROGRAM	Coal & Shale Processing Combustion
	Improved Combustion Processes- Part 2 - Fluidized Bed Combustion
DEVELOPMENT AGENCY	DOI, EPA, NASA, AEC

CONTRACTOR ACCOUNTS

(more than 42 characters total for name of contractor, location abbreviation & status; 16 characters and spaces for city.)

NAME OF CONTRACTOR:	Westinghouse Electric Corporation;Esso R&E Co.,Other	
Site where work will be performed ▶	State:	County:
NAME OF CONTRACTOR:	Pope, Evans and Robbins, Other	
Site where work will be performed ▶	State:	County:
NAME OF CONTRACTOR:	Combustion Power Company, Other	
Site where work will be performing ▶	State:	County:
NAME OF CONTRACTOR:	Argonne National Laboratory	
Site where work will be performed ▶	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County:

BF DESCRIPTION OF PROPOSAL

(more than 24 lines of text to allow from 70 characters spaces per line)

(Fully outline nature and scope of work to be undertaken, including any new facilities that may have to be procured or constructed.

Description similar to that indicated in the companion form for "orderly" level of effort, with the exceptions that: 1) the adiabatic fluidized combuster program is deleted; 2) the size range of the full-scale demonstration plants will be lower (150-400 MW); and 3) demonstration of the pressurized and atmospheric variations, and completion of the model, will be delayed until FY-81/82.

2

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

7. MAJOR RESOURCE REQUIREMENTS

URCE	FISCAL YEAR ▶	1975	1976	1977	1978	1979
POWER	(1) Scientific	62	72	81	95	91
an years)	(2) Technical	52	72	167	217	202
	(3) Support					
	(4) Other					
MATERIALS		Coal-2,000 tons Limestone-400 tons	Coal-76,000 tons Limestone-2600 tons	Coal-75,000 tons Limestone-2,500 tons	Coal-995,000 tons Limestone-60,500 tons	Coal-875,000 tons Limestone-42,000 tons
pistorials and units of re below, such as tons of rols of oil, kilograms of ..., etc. Show amount of columns at right.)						
D AREA	(1) Contracted					
IRED	(2) Contracted					
	(3) Privately-owned			700		

BLANK PAGE

Site where work will be performed	State:	County:
NAME OF CONTRACTOR: Argonne National Laboratory		
Site where work will be performed	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed	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 (pilot or demonstration, including any new facilities which may have to be acquired or constructed.

Description similar to that indicated in the companion form for "orderly" level of effort, with the exceptions that: 1) the adiabatic fluidized combustor program is deleted; 2) the size range of the full-scale demonstration plants will be lower (150-400 MW); and 3) demonstration of the pressurized and atmospheric variations, and completion of the model, will be delayed until FY-81/82.

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

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE ▽	FISCAL YEAR ▷	1975	1976	1977	1978	1979
MANPOWER	(1) Scientific	62	72	81	95	91
(in man years)	(2) Technical	52	72	167	217	202
	(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.)*		Coal-2,000 tons Limestone-400 tons	Coal-76,000 tons Limestone-2600 tons	Coal-75,000 tons Limestone-2,500 tons	Coal-995,000 tons Limestone-60,500 tons	Coal-875,000 tons Limestone-42,000 tons
LAND AREA REQUIRED	(1) Developed					
	(2) Undeveloped					
(in acres)	(3) Previously Developed			700		
	(4) Other					
OTHER RESOURCES NEEDED *(Specify item and unit of measure below. Show quantity of each in columns at right.)*	(1)					

3

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (CONTINUED)

[redacted]

☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
05-02-55-05-12-75-56-

6. JUSTIFICATION: [illegible] the problem or opportunity, [illegible] the project will contribute to the solution of the problem or obtain the benefit [illegible] expected to be [illegible] the objectives or solve the problem, for which the project is proposed. Outline the risks/uncertainties (R/U), plans to minimize R/U, and costs for proceeding in face of R/U. Quantification data should be used to the fullest extent.

Similar to that indicated in the companion form for the "orderly" level of effort. Due to the delay in completing the "minimum" program, and to reduction in the size and number of demonstration plants, the rate of implementation of fluidized boilers would probably be somewhat less than in the case of the "orderly" program.

INSTRUCTIONS: Complete one sheet of this form for each R&D project described on the Data Summary Form. Use as many sheets as necessary to describe the project adequately. Attach additional sheets as necessary to provide a complete description of the project. Use the two supplemental sheets to summarize R&D needs for processing in lieu of R&D. Quantitative data should be used to the fullest extent.

Similar to that indicated in the companion form for the "orderly" level of effort. Due to the delay in completing the "minimum" program, and to reductions in the size and number of demonstration plants, the rate of implementation of fluidized boilers would probably be somewhat less than in the case of the "orderly" program.

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

5. *(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
(1) Complete 0.6 MW pressurized plant	71	2	75	4
(2) Complete 30 MW atmospheric plant	73	2	75	4
(3) Complete 30 MW pressurized plant	75	2	78	4
(4) Complete 400 MW atmospheric plant	75	2	80	4
(5) Complete 150 MW pressurized plant	78	2	81	4
(6) Complete upgraded mathematical model	75	1	81	4

Level of Effort
☐ MAXIMUM
☐ OTHERWISE
☒ MINIMUM

IDENTIFICATION NUMBER
05-02-55-05-12-75-3A-[illegible]

TES

9. DEVELOPMENT MILESTONES *(continued)*

Complete FY	Q	*(Limit Title of Milestone to 60 characters and spaces)*	Start FY	[illegible]
75	4			
75	4			
78	4			
80	4			
81	4			
81	4			

(Continue on separate sheet)

Page [illegible]

2

[illegible] Federal Government Only (In millions of dollars)

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 Outlays
Fluidized-Bed Combustion								
[illegible]			1.8		1.3		7.2	
[illegible]			8.0		4.4		37.0	
-- Atmospheric								
-- Adiabatic								
-- Support			5.8		5.8		2.0	
TOTAL			15.6		11.5		46.2	5

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funding. A brief description o[illegible] [illegible] provided in the above format.

☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
05-02-55-05-12-75-54-01

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Estimated FY 1974 (Cont'd)	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
.3		7.2		11.4		12.4		34.1		24.0		58.1	
.4		37.0		37.0		37.0		123.4		0		123.4	
8		2.0		2.0		1.5		17.1		3.0		20.1	
.5		46.2		50.4		50.9		174.6		27.0		201.6	

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

Page

2

4. CONTRACTOR ACTIVITY

(No more than 40 characters and spaces for name of contractor, one statement of location of contractor activity, up to 10 contractors and spaces for county.)

NAME OF CONTRACTOR: [illegible]		
Site where work will be performed:	State:	County:
NAME OF CONTRACTOR: [illegible]		
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 70 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.

Methods for assuring the environmentally acceptable combustion utilization of domestic fuels will be reduced to commercial prac Processes will be developed and demonstrated for improved contro particulate, sulfur oxide, and hazardous pollutant emissions fro combustion flue gases. Methods for environmentally sound coal conversion and shale oil recovery will be reduced to commercial practice. Technology for the physical and chemical separation o pollutant - forming constituents from coal will be demonstrated. Methods for assuring the environmental integrity of major conver technologies will be developed, and conversion process by-produc recovery/utilization will be developed. Pilot-scale and demonst (50% co-funded by the private sector) facilities will be constru for major technology developments to support program objectives.

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

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE	FISCAL YEAR	1975	1976	1977	1978	197
a. MANPOWER *(in man years)*	(1) Scientific	80	80	80	80	70
	(2) Technical	25	30	30	25	20
	(3) Support	30	30	25	25	18
	(4) Other					
b. RAW MATERIALS *(List materials and units of measure (i.e., tons as tons of coal, barrels of oil, kilograms of uranium, etc.). Show amount of each in columns at right.)*						
c. LAND AREA REQUIRED *(in acres)*	(1) Government-owned					
	(2) Contractor					
	(3) Private ownership					
	(4) Other					

	75-06-03-01-12-25-00
	Improved Utilization of Coal
	Environmental Control Technology Laboratory, Office of Mines, Office of Coal Research, National Science Foundation
CONTRACTOR/GRANTEE	NAME OF CONTRACTOR: A large number of competitive and sole source 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:

BRIEF DESCRIPTION OF PROPOSAL

(not 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 new facilities which may have to be acquired or constructed.

Methods for assuring the environmentally acceptable combustion and utilization of domestic fuels will be reduced to commercial practice. Processes will be developed and demonstrated for improved control of particulate, sulfur oxide, and hazardous pollutant emissions from combustion flue gases. Methods for environmentally sound coal conversion and shale oil recovery will be reduced to commercial practice. Technology for the physical and chemical separation of pollutant - forming constituents from coal will be demonstrated. Methods for assuring the environmental integrity of major conversion technologies will be developed, and conversion process by-product recovery/utilization will be developed. Pilot-scale and demonstration (50% co-funded by the private sector) facilities will be constructed for major technology developments to support program objectives.

2

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

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE	FISCAL YEAR ▶	1975	1976	1977	1978	1979
MANPOWER (man years)	(1) Scientific	80	80	80	80	70
	(2) Technical	25	30	30	25	20
	(3) Support	30	30	25	25	18
	(4) Other					
FUNDS						
MATERIALS (materials and units of measure, such as tons of coal, barrels of oil, kilograms of plutonium, etc. Show amount of each in columns at right.)						
LAND AREA REQUIRED (acres)	(1) Government					
	(2) Commercial					
	(3) Private ownership					
	(4) Other					

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(If more than 42 characters and spaces for name of contractor, use standard abbreviations. Limit to 10 characters and spaces for county.)

Site(s) where work is to be performed	State:	County:
NAME OF CONTRACTOR:		
Site(s) where work is to be performed	State:	County:
NAME OF CONTRACTOR:		
Site(s) where work is to be performed	State:	County:
NAME OF CONTRACTOR:		
Site(s) where work is to be performed	State:	County:

5. 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 new facilities which may have to be acquired or constructed.

Methods for assuring the environmentally acceptable combustion & utilization of domestic fuels will be reduced to commercial practi Processes will be developed and demonstrated for improved control particulate, sulfur oxide, and hazardous pollutant emissions from combustion flue gases. Methods for environmentally sound coal conversion and shale oil recovery will be reduced to commercial practice. Technology for the physical and chemical separation of pollutant - forming constituents from coal will be demonstrated. Methods for assuring the environmental integrity of major conversi technologies will be developed, and conversion process by-product recovery/utilization will be developed. Pilot-scale and demonstra (50% co-funded by the private sector) facilities will be construct for major technology developments to support program objectives.

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

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE V	FISCAL YEAR ▷	1975	1976	1977	1978	1979
a. MANPOWER (in man years)	(1) Scientific	80	80	80	80	70
	(2) Technical	25	30	30	25	20
	(3) Support	30	30	25	25	18
	(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.)						
c. LAND AREA REQUIRED (in acres)	(1) Construction					
	(2) Operation					
	(3) Facility (permanent)					
	(4) Other					
d. OTHER RESOURCES NEEDED (Specify item and unit of measure below, show quantity of each in columns at right.)						
(1)	(1)					

3

05-06-05-05-12-75

6. [illegible] Continued and expanded domestic fuel utilization to supply U.S. energy needs will re[quire] development of means for improved environmental control in view of the severe environmen[tal] degradation which would occur without such control.

Burning coal for the generation of electricity, combined with stack gas cleaning, of[fers] the most assured solution, in the short term, to the problem of satisfying consumer dem[and] for power under existing environmental constraints. In contrast to some "solutions" tha[t] have been proposed, stack gas cleaning has the distinct advantage of being adaptable to [existing] existing power plants. For many of these plants, the only current alternative is to bur[n] low-sulfur oil or gas, much of which must be imported. Without gas cleaning, compliance [with] clean air standards could preclude the use of up to 150 million tons of coal per year by [1985]. Several processes for stack gas cleaning are in the process of field development and dem[on]stration, but work on application aspects can speed wide-scale application. Work is nee[ded] the areas of waste disposal and by-product production, application to smaller industrial [coal] boilers, and advanced process development. Within the limited time frame for meeting th[e] increasing demand for electricity and complying with environmental regulations, domestic [high] and medium-sulfur coal can be fully utilized only if a concentrated effort is made soon [to] facilitate the commercialization of stack gas cleaning.

Future control requirements for fine particulates and hazardous pollutants require [new] control technology developments in these areas.

Flue gas cleaning alone will not completely satisfy domestic needs. Total retrofit [of] application to relatively small fuel users will not be possible. Thus, programs for cle[an] of coal (both physical and chemical) will be developed to supply utility requirements as [well] as requirements for industrial and commercial users. This technology will maintain the [basic] physical characteristics of the coal and could thus be implemented with little or no cha[nge] of the national energy system.

Clean liquid [illegible] gaseous fuels to meet future domestic demand for these fuels will b[e] provided from [illegible]opment of environmentally sound coal conversion and shale oil recover[y] systems. These systems will be adequately developed to insure their environmental int[egrity] at the time of technology commercialization. Also, adequate waste disposal and by-produ[ct] utilization methods will be developed to enhance implementation of these systems.

This proposal will obtain the above objectives by federal funding of the followi[ng] "crash" R&D program (in millions):

FY-75	FY 76-79	Post-79	Total
118.694	240.696	-	359.390

This maximum effort, while providing the funds for the most rapid development of tech-nology, will be associated with major uncertainties regarding the timely assembly and utilization of needed personnel and hardware to implement the program. This risk may produce a waste of obligated funds and a lack of important new technology development

☒ [illegible]
☐ [illegible]
☐ [illegible]

[illegible] 05-06-05-05-12-75-56-01

[illegible] project is proposed. Outline the [illegible] uncertainties [illegible] U, and plans for [illegible] of U. Court [illegible] to the fullest extent.

ad expanded domestic fuel utilization to supply U.S. energy needs will require eans for improved environmental control in view of the severe environmental ch would occur without such control.

l for the generation of electricity, combined with stack gas cleaning, offers d solution, in the short term, to the problem of satisfying consumer demand existing environmental constraints. In contrast to some "solutions" that sed, stack gas cleaning has the distinct advantage of being adaptable to plants. For many of these plants, the only current alternative is to burn or gas, much of which must be imported. Without gas cleaning, compliance with ards could preclude the use of up to 150 million tons of coal per year by 1975. es for stack gas cleaning are in the process of field development and demon- ork on application aspects can speed wide-scale application. Work is needed in ste disposal and by-product production, application to smaller industrial vanced process development. Within the limited time frame for meeting the nd for electricity and complying with environmental regulations, domestic high ur coal can be fully utilized only if a concentrated effort is made soon to commercialization of stack gas cleaning.

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FY-75	FY 76-79	st-79	Total
118.694	240.696	-	359.390

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2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

DULE *(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	
. Fine Particulate Pilot Plant Development/Utility			75		26.
. Fine Particulate Control Demonstration/Utility			77		
. Fine Particulate Pilot Plant/Industrial			76		27.
. Fine Particulate Demonstration/Industrial			78		28.
. Toxic Emission Control Demonstration			78		29.
. SO_x Control Demonstration/Limestone			76		30.
. Alkaline Ash Pilot Plant Development			76		31.
. Alkaline Ash SO_x Control Demonstration			77		32.
. Citrate Engineering Development			75		33.
. Citrate SO_x Control Demonstration			77		34.
. Cat-Ox Engineering Development			75		35.
. Integrated Cat-Ox Demonstration			77		36.
. Engineering Development of Advanced SO_x Control Systems			75		
. Demonstration of Advanced SO_x Control Systems			76		
. Demonstration of Industrial Boiler SO_x Control			77		
. Engineering Development of Wellman-Lord			75		
. Wellman-Lord Demonstration for SO_x Control			76		
. Pilot Plant for Chemical Treatment of Coal			75		
. Chemical Treatment of Coal Demonstration			78		
. Pilot Plant for Magnetic Separation of Pyrite from Coal			76		
. Pilot Testing of Conversion Process Control Components			79		
. Engineering Development for Shale Oil Control			79		
. Engineering for Refinery Hydrocarbon Recovery			75		
. Demonstration of Refinery Hydrocarbon Recovery			78		
. Fuel conversion Process Phase Separation Technology			77		

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05-06-05-05-12-75-56-01

a. DEVELOPMENT MILESTONES *(continued)*

DATES Complete FY	DATES Complete Q	*(Limit Title of Milestone to 60 characters and spaces)*	DATES Start FY	DATES Start Q	DATES Complete FY	DATES Complete Q
75		26. Engineering Development for Refinery Waste use in CAFB			78	
77		27. Demonstration of Refinery Waste use in CAFB			77	
76		28. Pilot Testing of Alternative Reductants for Flue Gas Cleaning			75	
78		29. Lab Experimentation on Lime Sludge Utilization			78	
76		30. Pilot Study of Gasification By-Product Recovery			75	
76		31. Demonstration of Gasification By-Product Utilization			78	
77		32. Development of Strip Mining Reclamation			78	
75		33. Engineering Development for New Sulfur Uses			75	
77		34. Demonstration of Sulfur By-Product Utilization			78	
75		35. Engineering Development of High Sulfur Combustor			75	
77		36. Demonstration of High Sulfur Combustor			78	
75						
76						
77						
75						
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75						
78						
76						
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79						
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77						

(Continue on separate sheet)

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

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	(FY Obls.
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			118.694		87.930		66.707
e. GRAND TOTAL—OUTLAYS							

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funding. A brief desc

Level of Effort:

XX MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
05-06-05-05-12-75-56-01

(3)	(4)		(5)		(6)		(7)		(8)		(9)	
1975	FY 1977		FY 1978		FY 1979		Subtotal FY 1975-79		Balance To Complete		Total Estimated FY 1974 [illegible]	
Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	[illegible]
	66.707		52.405		33.654		359.390		--		359.390	

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

2

ENERGY R[illegible] & DEVELOPMENT FACT SHEET (Continued)

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

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
TOTAL *(Carry forward to summary sheet)* >						
Particulate Control Technology						
Fine Particulate/Electrical Power Generation*			10.140		4.200	
Fine Particulate/Industrial & Commercial Sources*			4.162		4.162	
[illegible] & Other Pollutant Control						
[illegible] Toxic Emission Control*			2.850		1.542	
Operational Control/NO_x and Trace Emissions*			1.067		1.284	
Control Technology						
1 & 10 MW Pilot Plant			2.025		1.935	
Alkaline Ash*			1.265		2.128	
Lime/Limestone*			3.0		1.5	
Control-Regenerable						
Citrate*			1.15		9.2	
Ammonia-Bisulfate			0.6		0.6	
Integrated Cat-Ox*			11.5		0.345	
Metal Oxides *			2.116		1.495	
Advanced Systems*			5.75		3.25	
Industrial Boiler*			0.978		0.767	
Wellman-Lord/Allied*			8.7		0.5	

(Continue

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05-06-05-05-12-75-561

(3)	(4)		(5)		(6)		(7)		(8)		(9)	
976	FY 1977		FY 1978		FY 1979		SUBTOTAL FY 1975-79		BALANCE TO COMPLETE		TOTAL PROJECT FY 1975-	
Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	4.200		4.200									
	3.320		3.320									
	1.542		1.542									
	1.284		1.284									
	1.135											
	1.438											
	3.45											
	0.25											
	0.345		0.345									
	1.495											
	0.384											

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

TAIL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

ITEM (Each item not to exceed 60 characters and spaces)	(1) FY 1974 (Non-Add) Obls.	Outlays	(2) FY 1975 Obls.	Outlays	(3) FY 1976 Obls.	Outlays	O
TOTAL *(Carry forward to summary sheet)* >							
Cleaning							
Physical Treatment of Coal*			7.74		2.3		2.3
Physical & Chemical Removal of Sulfur			1.0		1.0		1.0
High Gradient Magnetic Separation			1.035		2.3		
Conversion and Process Control							
Development and Demonstration of Control Components			9.15		20.2		13.0
Development and Demonstration for Shale Oil Control			4.35		7.5		11.6
Control of Fine Particulates from Fuel Extraction Processing Plants			2.587		1.648		1.64
Recovery of Petroleum Refining Hydrocarbon Losses*			5.348		0.825		0.82
Elimination and Disposal of Conversion Plant Wastes			0.5		0.5		
Improved gas-solid-liquid separation			3.0		5.0		5.0
Disposal and By-Products							
Disposal of High Sulfur Refinery Waste by CAFD*			3.738		2.013		1.15
Alternate Reductants from Regen. Flue Gas Cleaning Systems			0.7		0.2		

(Continued on Sep

Level of Effort:
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05-06-05-05-12-70-04-

(3) FY 1976 Outlays	(4) FY 1977 Obls.	(4) FY 1977 Outlays	(5) FY 1978 Obls.	(5) FY 1978 Outlays	(6) FY 1979 Obls.	(6) FY 1979 Outlays	(7) SUBTOTAL FY 1976-79 Obls.	(7) SUBTOTAL FY 1976-79 Outlays	(8) BALANCE TO COMPLETE Obls.	(8) BALANCE TO COMPLETE Outlays	TOTAL FY 1976- Obls.
	2.3		2.3								
	1.0		1.0		1.0						
	13.002		13.002		13.002						
	11.697		11.697		11.697						
8	1.648		1.648		2.3						
5	0.825		0.825								
	5.0										
3	1.15										

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

ITEM (Limit items 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 Obls
TOTAL *(Carry forward to summary sheet)* >							
Coal and By-Products (continued)							
of sulfur as asphalt substitute*			1.15		0.767		0.767
sulfur combustor demonstration*			16.905		4.6		4.6
sludge waste utilization			0.163		0.18		0.22
e by-product from gasification*			4.025		2.989		2.989
-ash strip mining reclamation			2.0		3.0		2.666

l obligations assume at least 50% demonstration co-funding by the private sector.

(Continue on Sc

Level of Effort:
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
05-06-05-05-12-75-56-01

	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL [illegible] FY [illegible]	
Yr.	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	0.767		0.767									
	4.6		4.6									
	0.22		0.22									
	2.989		2.989		2.989							
	2.666		2.666		2.666							

sector.

(Use an Separate Sheet)

2

...RESEARCH & DEVELOPMENT
FACT SHEET

Level of ...
☐ MAJOR
☒ ORIGINAL
☐ REVISED

1. IDENTIFICATION NUMBER
05-06-05-05-12-75-56-01

2. PROGRAM	Coal and Shale Processing and Combustion
SUB-PROGRAM	Improved Environmental Control
PROPONENT AGENCY	Environmental Protection Agency; Tennessee Valley Authority; Bureau
SUBUNIT	of Mines; Office of Coal Research; National Science Foundation
CONTRACTOR AND SITE	NAME OF CONTRACTOR: A large number of competitive and sole source contractor
No more than 42 characters and spaces for name of contractor, no abbreviations. For state, 16 characters and spaces for units.	Site where work will be performed ▶ State: County:
	NAME OF CONTRACTOR: Illinois Power/Monsanto
	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:

BRIEF DESCRIPTION OF PROPOSAL

No more than 24 lines of text and no more than 72 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.

Methods for assuring the environmentally acceptable combustion and utilization of domestic fuels will be reduced to commercial practice. Processes will be developed and demonstrated for improved control of particulate, sulfur oxide, and hazardous pollutant emissions from combustion flue gases. Methods for environmentally sound coal conversion and shale oil recovery will be reduced to commercial practice. Technology for the physical and chemical separation of pollutant - forming constituents from coal will be demonstrated. Methods for assuring the environmental integrity of major conversion technologies will be developed, and conversion process by-product recovery/utilization will be developed. Pilot-scale and demonstratio (50% co-funded by the private sector) facilities will be constructed for major technology developments to support program objectives.

JUSTIFICATION *(Use a separate sheet(s). See Item 5. on Instruction Sheet.)*

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE ▼	FISCAL YEAR ▶	1975	1976	1977	1978	1979
MANPOWER *(in man years)*	(1) Scientific	60	65	70	65	55
	(2) Technical	20	20	20	15	15
	(3) Support	7	8	10	10	10
	(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.)*						
LAND AREA REQUIRED *(in acres)*	(1) Controlled					
	(2) Developed					
	(3) Private Ownership					
	(4) Other					

...DEVELOPMENT SHEET

Level of ...
☐ MAXIMUM
☒ ORDINARY
☐ MINIMUM

1. IDENTIFICATION NUMBER
05-00-05-05-12-75-56-01

	Coal and Shale Processing and Combustion Improved Environmental Control
...NCY	Environmental Protection Agency; Tennessee Valley Authority; Bureau of Mines; Office of Coal Research; National Science Foundation
SITE ...ractor, ...ll states ...ll spaces for	NAME OF CONTRACTOR: A large number of competitive and sole source contractors Site where work will be performed ▶ State: ... County:
	NAME OF CONTRACTOR: Illinois Power/Monsanto 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:

...OF

...e of text ...ractors

...and scope ...ion, ...ities acquired

Methods for assuring the environmentally acceptable combustion and utilization of domestic fuels will be reduced to commercial practice. Processes will be developed and demonstrated for improved control of particulate, sulfur oxide, and hazardous pollutant emissions from combustion flue gases. Methods for environmentally sound coal conversion and shale oil recovery will be reduced to commercial practice. Technology for the physical and chemical separation of pollutant - forming constituents from coal will be demonstrated. Methods for assuring the environmental integrity of major conversion technologies will be developed, and conversion process by-product recovery/utilization will be developed. Pilot-scale and demonstration (50% co-funded by the private sector) facilities will be constructed for major technology developments to support program objectives.

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

7. MAJOR RESOURCE REQUIREMENTS

...L YEAR ▶	1975	1976	1977	1978	1979
...ntific	60	65	70	65	55
...nical	20	20	20	15	15
...port	7	8	10	10	10
...er					
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...ovided					
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...ovided					
...r					
...NEEDED					

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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:

BRIEF DESCRIPTION OF PROPOSAL

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

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5. JUSTIFICATION *(Use a separate sheet(s). See Item 5. on Instruction Sheet.)*

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE ▼	FISCAL YEAR ▶	1975	1976	1977	1978	1979
a. MANPOWER	(1) Scientific	60	65	70	65	55
(in man years)	(2) Technical	20	20	20	15	15
	(3) Support	7	8	10	10	10
	(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.)*						
c. LAND AREA REQUIRED *(in acres)*	(1) Co-located					
	(2) Controlled					
	(3) Private sector					
	(4) Other					
d. OTHER RESOURCES NEEDED *(Specify item and unit of measure below. Show quantity of each in columns at right.)*						
(1)	(1)					

☒ CRITICAL
☐ NON-CRITICAL

05-06-05-05-12-75-

6. JUSTIFICATION: Show how the energy problem or deficiency is being met, how the proposed will contribute to the solution of the prob... as well as the consequences of failure to initiate the project. Indicate any relationship to other projects. Also indicate the general... expected benefits from the project (i.e., the extent to which the project is expected to solve the problems for which it is proposed. Outline the risks/uncertainties (technical, time to completion, E.O., and costs) for proceeding in face of E.O. Quantitative data should be used to the fullest extent.

Continued and expanded domestic fuel utilization to supply U.S. energy needs will re development of means for improved environmental control in view of the severe environmer degradation which would occur without such control.

Burning coal for the generation of electricity, combined with stack gas cleaning, of the most assured solution, in the short term, to the problem of satisfying consumer dema for power under existing environmental constraints. In contrast to some "solutions" tha have been proposed, stack gas cleaning has the distinct advantage of being adaptable to existing power plants. For many of these plants, the only current alternative is to bur low-sulfur oil or gas, much of which must be imported. Without gas cleaning, compliance clean air standards could preclude the use of up to 150 million tons of coal per year by Several processes for stack gas cleaning are in the process of field development and dem stration, but work on application aspects can speed wide-scale application. Work is nee the areas of waste disposal and by-product production, application to smaller industrial boilers, and advanced process development. Within the limited time frame for meeting th increasing demand for electricity and complying with environmental regulations, domestic and medium-sulfur coal can be fully utilized only if a concentrated effort is made soon facilitate the commercialization of stack gas cleaning.

Future control requirements for fine particulates and hazardous pollutants require s control technology developments in these areas.

Flue gas cleaning alone will not completely satisfy domestic needs. Total retrofit application to relatively small fuel users will not be possible. Thus, programs for cle of coal (both physical and chemical) will be developed to supply utility requirements as as requirements for industrial and commercial users. This technology will maintain the physical characteristics of the coal and could thus be implemented with little or no cha of the national energy system.

Clean liquid and gaseous fuels to meet future domestic demand for these fuels will b provided from development of environmentally sound coal conversion and shale oil recover systems. These systems will be adequately developed to insure their environmental inte at the time of technology commercialization. Also, adequate waste disposal and by-produ utilization methods will be developed to enhance implementation of these systems.

Risks and uncertainties inherent to the achievement of the above goals will result f lack of program development funding. Minimization of the program uncertainties will be achieved through the initiation of the strong and orderly federal R&D program shown belo (in millions):

FY-75	FY-76-79	Post-79	Total
69.459	187.6215	4.599	261.6795

This program will provide the technology needed to continue and expand domestic fuel reserve utilization to meet domestic energy needs while maintaining acceptable environmer quality.

[illegible] DEVELOPMENT FACT SHEET (Rev. [illegible])

[illegible]

[illegible]

[illegible] | [illegible]

05-06-05-05-[illegible]

[illegible]- State the specific energy problem or objective. Briefly [illegible] will contribute to the solution of the problem. [illegible] for selection of [illegible] proposed or possible new [illegible]. Also indicate the [illegible] derived from meeting the objectives or solving the problem for which the project is proposed. Outline the risks/uncertainties to minimize R.U. and basis for proceeding in face of R.U. Quantitation of risk should be used to the fullest extent.

nued and expanded domestic fuel utilization to supply U.S. energy needs will require
nt of means for improved environmental control in view of the severe environmental
on which would occur without such control.

ng coal for the generation of electricity, combined with stack gas cleaning, offers
assured solution, in the short term, to the problem of satisfying consumer demand
under existing environmental constraints. In contrast to some "solutions" that
proposed, stack gas cleaning has the distinct advantage of being adaptable to
power plants. For many of these plants, the only current alternative is to burn
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FY-75	FY-76-79	Post-79	Total
69.459	187.6215	4.599	261.6795

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utilization to meet domestic energy needs while maintaining acceptable environmental

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

5 *(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	
Dilute Particulate Engineering Development/Utility			75		26.
Dilute Particulate Control Demonstration/Utility			78		27.
Dilute Particulate Pilot Plant/Industrial			77		28.
Dilute Particulate Demonstration/Industrial			79		29.
Toxic Emission Control Demonstration			79		30.
SO_x Control Demonstration/Limestone			76		31.
Alkaline Ash Pilot Plant Development			76		32.
Alkaline Ash SO_x Control Demonstration			78		33.
Citrate Engineering Development			75		34.
Citrate SO_x Control Demonstration			78		35.
Cat-Ox Engineering Development			76		36.
Integrate Cat-Ox Demonstration			79		37.
Engineering Development of Advanced SO_x Control Systems			75		38.
Demonstration of Advanced SO_x Control Systems			76		
Engineering Development of Industrial Boiler SO_x Control			75		
Industrial Boilers Pilot Plant for SO_x Control			76		
Demonstration of Industrial Boiler SO_x Control			79		
Engineering Development of Wellman-Lord			75		
Wellman-Lord Demonstration for SO_x Control			77		
Pilot Plant for Chemical Treatment of Coal			75		
Chemical Treatment of Coal Demonstration			78		
Pilot Plant for Magnetic Separation of Pyrite from Coal			77		
Pilot Testing of Conversion Process Control Components			79		
Engineering Development for Shale Oil Control			79		
Pilot Plant for Refinery Hydrocarbon Recovery			76		

Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05-06-05-05-12-75-51-01

a. DEVELOPMENT MILESTONES *(continued)*

Complete FY	Complete Q	(Limit Title of Milestone to 60 characters and spaces)	Start FY	Start Q	Finish FY
75		26. Demonstration of Refinery Hydrocarbon Recovery			79
78		27. Fuel Conversion Process Phase Separation Technology			79
7		28. Engineering Development for Refinery Waste use in CAFB			79
9		29. Demonstration of Refinery Waste use in CAFB			79
9		30. Pilot Testing of Alternative Reductants for Flue Gas Cleaning			78
6		31. Lab Experimentation on Lime Sludge Utilization			79
6		32. Pilot Stduy of Gasification By-Product Recovery			79
8		33. Demonstration of Gasification By-Product Utilization			79
5		34. Development of Strip Mining Reclamation			79
8		35. Engineering Development for New Sulfur Uses			79
6		36. Demonstration of Sulfur By-Product Utilization			79
9		37. Engineering Development of High Sulfur Combustor			79
5		38. Demonstration of High Sulfur Combustor			79
6					
5					
6					
3					
5					
7					
5					
9					
7					
3					
3					

2

Federal Government Only (in millions of dollars)

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	FY Obls.
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			69.459		76.535		41.042
e. GRAND TOTAL–OUTLAYS							

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funding. A brief e

☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
05-06-05-05-12-75-56-01

(3) FY 1976 Outlays	(4) FY 1977 Obls.	(4) FY 1977 Outlays	(5) FY 1978 Obls.	(5) FY 1978 Outlays	(6) FY 1979 Obls.	(6) FY 1979 Outlays	(7) Subtotal FY 1975-79 Obls.	(7) Subtotal FY 1975-79 Outlays	(8) Balance To Complete Obls.	(8) Balance To Complete Outlays	(9) Total FY 197[illegible] Obls.	(9) Total FY 197[illegible] [illegible]
35	41.0433		57.1572		62.8872		257.0805		4.599		261.6795	

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

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

L OF FUNDING REQUIREMENTS–Federal Government Only *(In millions of dollars)*

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	(4) FY 19 Obls.
TOTAL *(Carry forward to summary sheet)* >							
Sulfate Control Technology							
Fine Particulate/Electrical Power Generation*			3.600		4.850		3.500
Fine Particulate/Industrial & Commercial Sources*			2.300		2.500		2.7667
Other Pollutant Technology							
Noxious Toxic Emission Control			1.850		3.000		0.6185
Operational Control/NOx and Trace Emissions*			0.460		0.810		1.070
Control Technology							
1 & 10 MW Pilot Plant			2.025		1.935		1.135
Alkaline Ash*			1.1		0.6		1.25
Lime/Limestone*			3.0		1.5		
Control-Regenerable							
Citrate*			1.0		8.0		1.5
Ammonia-Bisulfate			0.6		0.6		0.25
Integrated Cat-Ox*			10.0				0.3
Metal Oxides*			0.43		1.41		1.3

(Continued on Separate)

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
05-06-05-05-12-75-56-01

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL ESTIMATED FY 1975 thru 79	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
3.500		3.500		3.500							
2.7667		2.7667		2.7667							
0.6185		0.6185		0.6185							
1.070		1.070		1.070							
1.135											
1.25		1.25									
1.5		1.5									
0.25											
0.3		0.3		0.3							
1.3		1.3									

(Use Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

L OF FUNDING REQUIREMENTS – Federal Government Only *(in millions of dollars)*

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 Obls.
TOTAL *(Carry forward to summary sheet)* ➤							
Coal-Dependent (continued)							
ed Systems*			5.75		3.25		
trial Boiler*			0.85		0.5		0.167
ss-Lorl/Allied*			4.5		8.7		.5
Coal							
al Treatment of Coal*			2.581		4.15		2.0
al & Chemical Removal of Sulfur			1.0		1.0		1.0
Gradient Magnetic Separation			0.25		0.65		2.0
nversion and Process Control							
ment and Demonstration of Control hnents			6.1		10.1		4.334
opment and Demonstration for Shale Control			1.45		2.5		3.899
ol of Fine Particulates from Fuel raction Processing Plants			1.25		1.0		1.433
ery of Petroleum Refining Hydrocarbon ses*			2.45		2.2		0.717
ization and Disposal of Conversion nt Wastes			0.5		0.5		
id gas-solid-liquid separation			2.9		2.85		1.983

(Continued on Sepa

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
05-06-05-05-12-75-56-01

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		TOTAL FY [illegible]	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
0.167		0.167		0.167							
.5											
2.0		2.0		2.0							
1.0		1.0		1.0							
2.0											
4.334		4.334		4.334							
3.899		3.899		3.899							
1.433		1.433		1.433				2.0			
0.717		0.717		0.717							
1.983		1.983		1.983							

(Use on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

AIL OF FUNDING REQUIREMENTS – Federal Government Only *(In millions of dollars)*

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	(4) FY 1977 Obls.	(4) FY 1977 Outl
TOTAL *(Carry forward to summary sheet)* >								
Disposal and By-Products								
osal of High Sulfur Refinery Waste			3.25		1.25		0.5	
te Reductants from Regen. Flue Gas ing Systems			0.7		0.2			
of Sulfur as Asphalt Substitute*			0.5		0.5		0.667	
Sulfur Combustor Demonstration*			6.4		8.3		4.0	
sulfide waste utilization			0.163		0.18		0.22	
e by-product from gasification*			1.5		2.0		2.599	
-ash strip mining reclamation			1.0		1.5		1.333	

al obligations assume at least 50% demonstration co-funding by the private sector.

(Continue on Separate Sh

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05-06-05-05-18-75-5401

	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		TOTAL ESTIMATED FY 1975 TO COMPLETION	
ays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	0.5		0.5		0.5							
	0.667		0.667		0.667							
	4.0		4.0		4.0							
	0.22		0.22									
	2.599		2.599		2.599				2.599			
	1.333		1.333		1.333							

ector.

Use on Separate Sheet)

2

	05-06-05-05-12-75-56-0
b. SUPPORT	[illegible] Environmental Control [illegible] Department of Interior, Tennessee Valley Authority; Bureau of Mines, Office of R & D Research; National Science Foundation
4. CONTRACTOR(S) OR SITE (No more than 10 characters and spaces for name of contractor, one standard abbreviation for each state, up to 10 characters and spaces for county.)	NAME OF CONTRACTOR: A large number of competitive and sole source cont Site where work will be performed: State: County: trac 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 21 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 new facilities which may have to be acquired or constructed.

Methods for assuring the environmentally acceptable combustion utilization of domestic fuels will be reduced to commercial pract Processes will be developed and demonstrated for improved control particulate, sulfur oxide, and hazardous pollutant emissions from combustion flue gases. Methods for environmentally sound coal conversion and shale oil recovery will be reduced to commercial practice. Technology for the physical and chemical separation of pollutant - forming constituents from coal will be demonstrated. Methods for assuring the environmental integrity of major convers technologies will be developed, and conversion process by-product recovery/utilization will be developed. Pilot-scale and demonstr (50% co-funded by the private sector) facilities will be construc for major technology developments to support program objectives.

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

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE ▽	FISCAL YEAR ▷	1975	1976	1977	1978	1979
a. MANPOWER (in man years)	(1) Scientific	50	50	50	50	50
	(2) Technical	15	15	15	15	10
	(3) Support	7	7	10	12	12
	(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.)						
c. LAND AREA REQUIRED (in acres)	(1) Developed					
	(2) Undeveloped					
	(3) Total (Developed and Undeveloped)					

05-06-05-05-12-75-56-01

Fossil and Nuclear Environmental Control

AGENCY
CONTRACT

Energy Research and Development Administration; Environmental Protection Agency; Tennessee Valley Authority; Bureau of Mines; Office of Coal Research; National Science Foundation

CONTRACTOR/SUBSITE

(more than 12 characters and ½ for name of contractor. Select abbreviation for research & 16 characters and spaces for ty.

NAME OF CONTRACTOR: A large number of competitive and sole source 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:

NAME OF CONTRACTOR:

Site where work will be performed ▶ State: County:

F DESCRIPTION OF POSAL

(more than 24 lines of text no more than 75 characters spaces per line)

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Methods for assuring the environmentally acceptable combustion and utilization of domestic fuels will be reduced to commercial practice. Processes will be developed and demonstrated for improved control of particulate, sulfur oxide, and hazardous pollutant emissions from combustion flue gases. Methods for environmentally sound coal conversion and shale oil recovery will be reduced to commercial practice. Technology for the physical and chemical separation of pollutant - forming constituents from coal will be demonstrated. Methods for assuring the environmental integrity of major conversion technologies will be developed, and conversion process by-product recovery/utilization will be developed. Pilot-scale and demonstration (50% co-funded by the private sector) facilities will be constructed for major technology developments to support program objectives.

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

f

7. MAJOR RESOURCE REQUIREMENTS

URCE	FISCAL YEAR ▶	1975	1976	1977	1978	1979
POWER	(1) Scientific	50	50	50	50	50
an years)	(2) Technical	15	15	15	15	10
	(3) Support	7	7	10	12	12
	(4) Other					
MATERIALS *materials and units of ure below, such as tons of barrels of oil, kilograms of um, etc. Show amount of in columns at right.)*						
SPACE JIRED *ns)*	(1) Construction					
	(2) Operations					
	(3) Research					
	(4) Other					

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4. CONTRACTOR AND SITE

(No more than 42 characters and spaces for name of contractor, use standard abbreviations if necessary. Limit to 16 characters and spaces for county.

NAME OF CONTRACTOR: A large number of competitive and sole source co			
Site where work will be performed	▶ State:	County:	tr
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 31 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.

Methods for assuring the environmentally acceptable combustion utilization of domestic fuels will be reduced to commercial prac Processes will be developed and demonstrated for improved contro particulate, sulfur oxide, and hazardous pollutant emissions fro combustion flue gases. Methods for environmentally sound coal conversion and shale oil recovery will be reduced to commercial practice. Technology for the physical and chemical separation o pollutant - forming constituents from coal will be demonstrated. Methods for assuring the environmental integrity of major conver technologies will be developed, and conversion process by-produc recovery/utilization will be developed. Pilot-scale and demons; (50% co-funded by the private sector) facilities will be constru for major technology developments to support program objectives.

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

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE ▼	FISCAL YEAR ▶	1975	1976	1977	1978	19
a. MANPOWER	(1) Scientific	50	50	50	50	5
(in man years)	(2) Technical	15	15	15	15	1
	(3) Support	7	7	10	12	1
	(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.)*				3		
c. LAND AREA REQUIRED *(in acres)*	(1) Government					
	(2) Commercial					
	(3) Private-owned					
	(4) Other					
d. OTHER RESOURCES NEEDED *(Specify items and unit of measure below. Show quantity of each in columns at right.)*						
(1)	(1)					

...FACT SHEET (Continued)

IDENTIFICATION:
05-06-05-05-12-75

6. JUSTIFICATION: ... (R/D), plans to minimize R/D, and costs for proceeding in lieu of R.D. Quantitative data should be used to the fullest extent.

Continued and expanded domestic fuel utilization to supply U.S. energy needs will r development of means for improved environmental control in view of the severe environme degradation which would occur without such control.

Burning coal for the generation of electricity, combined with stack gas cleaning, c the most assured solution, in the short term, to the problem of satisfying consumer der for power under existing environmental constraints. In contrast to some "solutions" th have been proposed, stack gas cleaning has the distinct advantage of being adaptable to existing power plants. For many of these plants, the only current alternative is to bu low-sulfur oil or gas, much of which must be imported. Without gas cleaning, compliance clean air standards could preclude the use of up to 150 million tons of coal per year b Several processes for stack gas cleaning are in the process of field development and de stration, but work on application aspects can speed wide-scale application. Work is nc the areas of waste disposal and by-product production, application to smaller industria boilers, and advanced process development. Within the limited time frame for meeting t increasing demand for electricity and complying with environmental regulations, domesti and medium-sulfur coal can be fully utilized only if a concentrated effort is made soor facilitate the commercialization of stack gas cleaning.

Future control requirements for fine particulates and hazardous pollutants require control technology developments in these areas.

Flue gas cleaning alone will not completely satisfy domestic needs. Total retrofi application to relatively small fuel users will not be possible. Thus, programs for cl of coal (both physical and chemical) will be developed to supply utility requirements a as requirements for industrial and commercial users. This technology will maintain the physical characteristics of the coal and could thus be implemented with little or no ch of the national energy system.

Clean liquid and gaseous fuels to meet future domestic demand for these fuels will provided from development of environmentally sound coal conversion and shale oil recov systems. These systems will be adequately developed to insure their environmental int at the time of technology commercialization. Also, adequate waste disposal and by-prod utilization methods will be developed to enhance implementation of these systems.

The above program will be funded at the following minimum level of effort (in millions):

FY 75	FY 76-79	Post-79	Total
30.992	141.555	65.039	237.586

This minimal level of funding obligations for achievement of program objectives will the time required for technology development. The time extensions coupled with futur federal funding levels and priorities may produce a high uncertainty on the adequate development of needed energy R&D programs.

[illegible] FACT SHEET (Continued)

IDENTIFICATION NUMBER
05-06-05-05-12-75-56-01

[illegible] to minimize R.U. and costs for proceeding in face of R.U. Quantitative data should be used to the fullest extent.

ued and expanded domestic fuel utilization to supply U.S. energy needs will require t of means for improved environmental control in view of the severe environmental n which would occur without such control.

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FY 75	FY 76-79	Post-79	Total
30.992	141.555	65.039	237.586

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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

3 (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
Fine Particulate Engineering Development/Utility			75	
Fine Particulate Control Demonstration/Utility			79	
Fine Particulate Pilot Plant/Industrial			78	
Fine Particulate Demonstration/Industrial			80	
Toxic Emission Control Demonstration			80	
SO_x Control Demonstration/Limestone			76	
Alkaline Ash Pilot Plant Development			78	
Alkaline Ash, SO_x Control Demonstration			80	
Citrate Engineering Development			76	
Citrate SO_x Control Demonstration			80	
Cat-Ox Engineering Development			77	
Integrated Cat-Ox Demonstration			81	
Demonstration of Advanced SO_x Control Systems			78	
Engineering Development of Industrial Boiler SO_x Control			76	
Demonstration of Industrial Boiler SO_x Control			79	
Engineering Development of Wellman-Lord			75	
Wellman-Lord Demonstration for SO_x Control			77	
Pilot Plant for Chemical Treatment of Coal			75	
Chemical Treatment of Coal Demonstration			81	
Pilot Plant for Magnetic Separation of Pyrite from Coal			77	
Pilot Testing of Conversion Process Control Components			79	
Engineering Development for Shale Oil Control			79	
Engineering for Refinery Hydrocarbon Recovery			76	
Demonstration of Refinery Hydrocarbon Recovery			80	
Fuel Conversion Process Phase Separation Technology			79	

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
05-06-05-05-12-75-56-01

6. DEVELOPMENT MILESTONES (continued)

(Limit Title of Milestone to 60 characters and spaces)

		b. DATE	
		Start	
		FY	Q
26.	Engineering Development for Refinery Waste use in CAFB		76
27.	Demonstration of Refinery Waste use in CAFB		81
28.	Pilot Testing of Alternative Reductants for Flue Gas Cleaning		78
29.	Lab Experimentation on Lime Sludge Utilization		79
30.	Engineering of Gasification By-Product Recovery		77
31.	Demonstration of Gasification By-Product Utilization		81
32.	Development of Strip Mining Reclamation		79
33.	Engineering Development for New Sulfur Uses		76
34.	Demonstration of Sulfur By-Product Utilization		81
35.	Engineering Development of High Sulfur Combustor		77
36.	Demonstration of High Sulfur Combustor		82

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

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 197 Obls.	(4) FY 197 Ou
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			30,992		43,955		55,295	
e. GRAND TOTAL—OUTLAYS								

... the program was proposed. Indicate the amount by year of both private and Federal government funding. A brief descrip

Level of Effort:

☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
05-06-05-05-13-75-56-01

	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Estimate FY 1974 (C.T. 7.5.1)	
s	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	35.295		32.985		29.322		172.547		65.059		237.586	

2

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

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

TAIL OF FUNDING REQUIREMENTS–Federal Government Only *(In millions of dollars)*

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	(4) FY 1977 Obls.	(4) FY 1977 Outla
TOTAL *(Carry forward to summary sheet)* >								
ulate Control Technology								
ne Particulate/Electrical Power Generation*			2.500		2.975		2.975	
ne Particulate/Industrial & Commercial Sources*			2.000		2.000		2.000	
ous & Other Pollutant Control Technology								
Toxic Emission Control*			1.500		2.000		.750	
ational Control/NO_x and Trace Emissions*			.460		.500		.500	
ntrol Technology								
& 10 MW Pilot Plant			0.849		0.849		0.849	
Saline Ash*			0.7		0.7		0.7	
ne/Limestone*			3.0		1.5			
ntrol-Regenerable								
rate*			0.5		2.0		4.0	
nonia-Disulfate			0.363		0.363		0.363	
tegrated Cat-Ox*			1.0		3.0		3.0	
tal Oxides*			0.74		0.74		0.74	
vanced Systems*			2.25		2.25		2.25	
Industrial Boiler*			0.425		0.25		0.167	
Chemico-Lord/Allied*			4.5		8.7		0.5	

(Continue on Separate Shee

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
05-06-05-05-12-75-56-01

6	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL ESTIMATED FY 1974 TO COMPLETION	
utlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	2.975		3.500		3.500				3.500			
	2.000		2.000		2.000				2.000			
	.750		.750		.750				.750			
	.500		1.000		1.000				1.000			
	0.849		0.849		0.849				0.849			
	0.7		0.7		0.7				0.7			
	4.0		2.5		2.5				0.5			
	0.363		0.363									
	3.0		3.0		0.3				0.6			
	0.74		0.74		0.74				0.74			
	2.25		2.25									
	0.167		0.167		0.167							
	0.5											

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

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	FY 1976 Obls.	FY 1976 Outlays	Obl
TOTAL *(Carry forward to summary sheet)* ▷							
Luminv							
...mical Treatment of Coal*			1.819		1.819		1.81
...sical & Chemical Removal of Sulfur			0.5		0.5		0.5
...h Gradient Magnetic Separation			0.125		0.325		.25
Conversion and Process Control							
...elopment and Demonstration of Control ...ponents			1.0		3.0		2.0
...elopment and Demonstration for Shale ...il Control			0.29		0.5		0.78
...trol of Fine Particulates from Fuel ...traction Processing Plants			0.625		0.5		0.71
...overy of Petroleum Refining Hydrocarbon ...sses*			0.45		2.0		2.2
...lization and Disposal of Conversion ...lant Wastes			0.25		0.25		0.25
...proved gas-solid-liquid separation			0.725		0.713		0.49
...Disposal and By-Products							
...sposal of High Sulfur Refinery Waste ...y CAFU*			1.0		2.0		1.25
...ernate Reductants from Regen. Flue ...as Cleaning Systems			0.35		0.2		

(Continue on Sep...

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
05-06-05-05-12-75-5

(3) FY 1976 Obls.	(3) FY 1976 Outlays	(4) FY 1977 Obls.	(4) FY 1977 Outlays	(5) FY 1978 Obls.	(5) FY 1978 Outlays	(6) FY 1979 Obls.	(6) FY 1979 Outlays	(7) SUBTOTAL FY 1975-79 Obls.	(7) SUBTOTAL FY 1975-79 Outlays	(8) BALANCE TO COMPLETE Obls.	(8) BALANCE TO COMPLETE Outlays	(9) TOTAL FY 1975-[illegible] Obls.	(9) TOTAL FY 1975-[illegible] Outlays
.819		1.819		1.819		1.819				3.638			
.5		0.5		0.5		0.5							
.325		.25											
.0		2.0		2.0		2.0				19.2			
.5		0.78		0.78		0.78				12.517			
.5		0.717		0.717		0.717				1.0			
.0		2.2		.717		.717				.717			
.25		0.25		0.25									
.713		0.496		0.496		0.496							
.0		1.25		0.25		0.25				0.5			
.2													

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

TAIL OF FUNDING REQUIREMENTS--Federal Government Only *(In millions of dollars)*

ITEM (Each item not to exceed 30 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	(4) FY 1977 Obls.	(4) FY 1977 Outl
TOTAL *(Carry forward to summary sheet)* ▷								
Disposal and By-Products								
of sulfur as asphalt substitute*			0.429		0.429		0.429	
sulfur combustor demonstration*					1.0		3.0	
sludge waste utilization			0.157		0.157		0.157	
te by-product from gasification*			1.985		1.985		1.985	
-ash strip mining reclamation			0.5		0.75		0.666	

ral obligations assume at least 50% demonstration co-funding by the private sector.

(Continue on Separate

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
05-06-03-05-12-75-36-01

(3) FY 1976 Outlays	(4) FY 1977 Obls.	(4) FY 1977 Outlays	(5) FY 1978 Obls.	(5) FY 1978 Outlays	(6) FY 1979 Obls.	(6) FY 1979 Outlays	(7) SUBTOTAL FY 1975-79 Obls.	(7) SUBTOTAL FY 1975-79 Outlays	(8) BALANCE TO COMPLETE Obls.	(8) BALANCE TO COMPLETE Outlays	(9) TOTAL FY 1975-[illegible] Cost	(9) TOTAL FY 1975-[illegible] [illegible]
	0.429		0.429		0.429				0.858			
	3.0		4.4		6.3				12.0			
	0.157		0.157		0.157							
	1.985		1.985		1.985				3.97			
	0.666		0.666		0.666							

ate sector.

(Continued on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

Level of Effort
[X] MAXIMUM
[ ] ORDERLY
[ ] MINIMUM

1. IDENTIFICATION NUM
05 05 55 03 10 55 56

2. a. PROGRAM: Coal and Shale Conversion and Utilization
b. SUBPROGRAM: Supporting Research to Advanced Coal and Shale Processing-Carbonization

3. a. PROPONENT AGENCY: ERDA-OCR, ALO, DOE-HQ, OM, NMP, PA-DMS, NASA (Program C
b. SUBUNIT:

4. CONTRACTOR AND SITE
(No more than 42 characters and spaces for name of contractor, use standard abbreviations for state up to 16 characters and spaces for county.

NAME OF CONTRACTOR: Various contractors in many locations both intra
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 75 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 shale processing and combustion are proposed. This sub-program is an integral part of the national program to obtain energy from domes resources of coal and shale in an environmentally-acceptable mann The work in the present sub-program will be done on a laboratory scale, thus requiring only moderate cost while still providing th 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 o present conversion and combustion systems and development of new, more efficient systems are proposed.

A number of independent small-scale facilities for testing materi

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

7. MAJOR RESOURCE REQUIREMENTS be required.

RESOURCE ▽	FISCAL YEAR ▷	1975	1976	1977	1978	197
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 amounts of each in columns at right.)		Neglible	Neglible	Neglible	Neglible	Negli
c. LAND AREA REQUIRED (In acres)	(1) Government	"	"	"	"	"
	(2) Gov't-leased	"	"	"	"	"
	(3) Privately-owned	"	"	"	"	"
	(4) Other	"	"	"	"	"
d. OTHER RESOURCES NEEDED						

ESEARCH & DEVELOPMENT
FACT SHEET

Level of Effort
[3] MAXIMUM
[ ] PRIORITY
[ ] MINIMUM

1. IDENTIFICATION NUMBER
05 05 55 03 10 55 56 02

AM	Coal and Shale Conversion and Utilization
OGRAM	Supporting Research to Improve Coal and Shale Processing-Combustion
NSOR AGENCY	DOI-OCR, ASD, DOI-B of M, WPR, PRDMA, NASA /Program Objectives
NIT	

TOR AND SITE

Item 12 characters and me of contractor. Abbreviation for state racters and spaces for

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:

CRIPTION OF

24 lines of text (han 72 characters r line)

nature and scope undertaken, new facilities 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.

2

ON (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					
LS *id units of ches tons of d, Kilograms of ss amount of t right.)*	Neglible	Neglible	Neglible	Neglible	Neglible
-) Govt-owned	"	"	"	"	"
) Govt-leased	"	"	"	"	"
) Privately-owned	"	"	"	"	"
Other	"	"	"	"	"
CES NEEDED					

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CONTRACTOR AND SITE			
No more than 12 characters and spaces for name of contractor, use standard abbreviations for state. 9 to 16 characters and spaces for county.	NAME OF CONTRACTOR Various contracts 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:

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 new facilities which may have to be acquired or constructed.

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,

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

7. MAJOR RESOURCE REQUIREMENTS be required.

SOURCE ▼	FISCAL YEAR ▶	1975	1976	1977	1978	1979
MANPOWER	(1) Scientific					
(man years)	(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	(1) Cultivated	"	"	"	"	"
	(2) Grazing	"	"	"	"	"
(acres)	(3) Forest/wooded	"	"	"	"	"
	(4) Other	"	"	"	"	"
OTHER RESOURCES NEEDED *(Specify item and unit of measure below. Show quantity each in columns at right.)*		(1)				

N/A

C. JUSTIFICATION. State the 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 approach over other alternatives. Also include the benefits expected but not derived from successful achievement of the objectives or specific technical goals for which the project is proposed. Outline the risk/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.

Justification

This subprogram involves technology development and supporting research for the lar program c coal and shale processing and combustion. Most of the quantitative data sh the economic benefits of the program and the U. S. foreign policy strategic need for t program are given in the fact sheets for the coal gasification, coal liquefaction, coal combustion and environmental sub-programs in this overall program. These data will no repeated here. The justification for the present sub-program is that the other sub-pr in this coal and shale program could not be pursued economically or rationally without technology development and supporting research in these areas. The chemical processes and thermodynamic data, equipment components and materials required in all the various of coal and shale processing systems have numerous common features and are not truly d 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 alr demonstrated, ultimate economic practicality of these energy sources may depend either development of new procedures for at least part of these processes or on the gradual im of existing processes, materials and equipment. Specific areas where technology develc and support research are needed include:

A. Equipment Development

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

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

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

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

(4) Improved stack gas cleaning devices are needed, as described in the subprogram 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, needed to allow improved screening of materials used in conversion devices.

AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
050555031055602

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

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

basic feasibility of producing gas and oil from coal and shale has already been timate economic practicality of these energy sources may depend either on the w procedures for at least part of these processes or on the gradual improvement esses, materials and equipment. Specific areas where technology development arch are needed include:

velopment

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pers, sealing devices, valves and slurry pumps used to feed coal into pressure vessels have been found subject to frequent failure. Reliable feed devices ed as well as reliable devices to discharge char and ash from the reactor.

equipment for filtration and separation/purification processes is needed.

ntation is needed for continuous monitoring and managing of solids and gases temperature, high pressure systems.

stack gas cleaning devices are needed, as described in the subprogram on ental aspects of coal and shale processing and combustion.

e is to develop methods for service life prediction, test methods for materials materials for coal processing equipment.

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nce to erosive wear
nce to stress corrosion cracking
nce to sulfidation and other general corrosion processes
ity when in contact with molten slag and coal ash/materials
nce to various types of slow mechanical failure
ing properties in firebox refractories
nsfer characteristics in heat exchange tubes

2

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

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repeated here. The justification for the present sub-program is that the other sub-progra in this coal and shale program could not be pursued economically or rationally without para technology development and supporting research in these areas. The chemical processes, kir and thermodynamic data, equipment components and materials required in all the various type of coal and shale processing systems have numerous common features and are not truly separ 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 already demonstrated, ultimate economic practicality of these energy sources may depend either on t development of new procedures for at least part of these processes or on the gradual improv of existing processes, materials and equipment. Specific areas where technology development and support research are needed include:

A. Equipment Development

The objective of the equipment development program is to develop independent of pilot a 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 devic 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 gase 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 properti include:

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(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 a reliability of materials in highly erosive, corrosive environments. Better measur and methods of measuring critical properties listed above in Section B.1, a-g, are 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 technica 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 processes

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environmental sub-programs in this overall program. These data will not be
The justification for the present sub-program is that the other sub-programs
nd shale program could not be pursued economically or rationally without parallel
elopment and supporting research in these areas. The chemical processes, kinetic
nic data, equipment components and materials required in all the various types
ale processing systems have numerous common features and are not truly separable
n to another. Thus, these are all treated together in this sub-program.

e basic feasibility of producing gas and oil from coal and shale has already been
ultimate economic practicality of these energy sources may depend either on the
new procedures for at least part of these processes or on the gradual improvement
ocesses, materials and equipment. Specific areas where technology development
search are needed include:

Development

ive of the equipment development program is to develop independent of pilot and
ion plants, new reliable coal injections systems for high pressure, char and ash
systems, solids monitoring instruments, valves and other key components required
rocessing.

oppers, sealing devices, valves and slurry pumps used to feed coal into pressure
on vessels have been found subject to frequent failure. Reliable feed devices
ded as well as reliable devices to discharge char and ash from the reactor.

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

mentation is needed for continuous monitoring and managing of solids and gases
n temperature, high pressure systems.

ed stack gas cleaning devices are needed, as described in the subprogram on
mental aspects of coal and shale processing and combustion.

ve is to develop methods for service life prediction, test methods for materials
d materials for coal processing equipment.

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

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

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

ations, handbooks and analyses

ve is to advance the development of coal processing by developing a technical,
economic information data base.

plections and measurements are needed on

operties of coal
netic and thermodynamic data on process chemistry of coal conversion
netic and thermodynamic data on sulfur compounds and other pollutants
sulting from coal conversion

nd evaluations of data for conversion processes

6. 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.

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

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

(3) Standard reference materials are need to aid in chemical analyses for trace pollut 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 neec

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 develc

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

(2) Catalysts for coal liquefaction processes need work to establish optimum conditior develop improved catalysts, including
   (a) Cobalt molybdate catalysts for Synthoil process
   (b) Catalysts to improve hydrocracking processes and the up-grading of coal c 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 (pretrea coal)
   (b) Combustion of coal with pre-treatment or additives being applied to reduce tant emissions.
   (c) Kinetics and mechanisms of hydrogenation, carbonization and methanation re 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 and r of polymerization and depolymerization.
   (g) Development of liquid/solid separation methods by filtration, precipitatio centrifugation and use of hydrocIones.
   (h) Kinetics of reactions by solids in contact with gases, including fluidizec 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 hydrogen

EARCH AND DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUMBER
0505550310555602

ION - State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits to be derived 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.

Engineering data books on coal conversion processes should be published

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

ndard reference materials are need to aid in chemical analyses for trace pollutants toxic effluents from coal or shale conversion.

tral information center is neeeded to provide ready access, probably computer-aided, all data related to coal conversion.

lyses of economic and manpower implication of coal conversion programs are needed.

lysts and chemical kinetics for conversion processes.

oved catalysts are needed for methanation, coal gasification and liquefaction, and chemical kinetics necessary for improved coal processing systems must be developed.

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

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

talysts for the shift reations in high BTU processes should be optimized.

2

ic studies of chemical kinetics are needed including studies on:
- (a) Physical/chemical modifications of coal to control its reactivity (pretreatment o coal)
- (b) Combustion of coal with pre-treatment or additives being applied to reduce pollutant emissions.
- (c) Kinetics and mechanisms of hydrogenation, carbonization and methanation reactions 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 and rates of polymerization and depolymerization.
- (g) Development of liquid/solid separation methods by filtration, precipitation, centrifugation and use of hydrocliones.
- (h) Kinetics of reactions by solids in contact with gases, including fluidized beds, 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 hydrogen in

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   (a) Mechanism of sulfur poisoning or trace metal poisoning of presently used based catalysts and way of altering the catalyst or the process stream to such poisoning
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   (d) Reaction of char with carbon dioxide flue gas to yield fuel
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   (g) Development of liquid/solid separation methods by filtration, precipitatic centrifugation and use of hydrocloncs.
   (h) Kinetics of reactions by solids in contact with gases, including fluidized 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 hydrogen product stream following methanation, in order to avoid ammonia formation

E. Process Developm

- The objective is to advance the development of coal processing by research on the u operations of coal processing (i.e., fluidized bed technology) and by developing ne 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, conveya and pretreatment of coal

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...l data related to coal conversion.

...ses of economic and manpower implication of coal conversion programs are needed.

...sts and chemical kinetics for conversion processes.

...ed catalysts are needed for methanation, coal gasification and liquefaction, and ...emical kinetics necessary for improved coal processing systems must be developed. ...thanation catalysts and processes need considerable work, including

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(c) Improved catalysts for Fisher-Tropsch process
(d) Other coal liquefaction catalysts

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...c studies of chemical kinetics are needed including studies on:

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c) Kinetics and mechanisms of hydrogenation, carbonization and methanation reactions 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 and rates of polymerization and depolymerization.
g) Development of liquid/solid separation methods by filtration, precipitation, centrifugation and use of hydroclones.
h) Kinetics of reactions by solids in contact with gases, including fluidized beds, dilute phase or entrained beds, and fixed beds.
i) Kinetics of coal agglomeration
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Level of Effort
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0505550310555602

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 achieved from meeting the objectives or solving the problems for which the project is proposed. Outline the risk/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.

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 of 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 hydroge rich gases from non-petroleum sources for near and mid-term coal and oil shale proc.
1. Candidate processes should be investigated on a laboratory scale first with a pi plant only for the most promising techniques.
(a) Steam-oxygen process for H_2 production from coal and residue chars (ready for p plant studies)
(b) Methods using thermochemical cycles at low temperatures so that heat from meth 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 ($18M 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 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 technology U. S. is an active field.

B. Materials ($14M in FY 75)
1. Benefits -- Fracture, erosion and corrosion of materials used in coal conversion might require unnecessarily frequent rebuilding of conversion reactors and their accessories and possibly cause frequent unexpected shut downs, all of which coul easily raise costs 10%. If coal and shale conversion became a primary source of gas and oil, a 10% reduction in price would result in billions of dollars of cos 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 ($8M 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

☒ MAXIMUM
☐ ORDINARY
☐ MINIMUM

IDENTIFICATION NUMBER
050550310355602

O'. State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem of the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits achieved from meeting the objectives and/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.

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2

<u>gen production for use in coal conversion processes</u>

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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

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

ment ($15M in FY75)
enefits--Frequent breakdown of equipment or inefficient operation coal and shale conersion plants because of poor equipment could easily raise costs 10%. If coal and shal became 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 th . S. is an active field.

ials ($14M in FY 75)
enefits -- Fracture, erosion and corrosion of materials used in coal conversion devic ight require unnecessarily frequent rebuilding of conversion reactors and their ccessories and possibly cause frequent unexpected shut downs, all of which could asily 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 avings.
isks/Uncertainties -- Monitoring deterioration and measurement of properties of aterials is a straight forward procedure. The major uncertainty here lies in hether new and improved test methods and materials can be developed. Based on revious experience, the possibility of significant achievement here appears good.

compilations, handbooks and analyses ($6M in FY 75)
enefits — In designing pilot and demonstration plants, engineering data are needed the construction materials used, coal itself and chemical processes. Economic nalyses also are needed. Serious engineering problems and inefficient designs can esult from lack of suitably analyzed data, which might lead to long delays in achievi

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(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

3

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1. Candidate processes should be investigated on a laboratory scale first with a plant only for the most promising techniques.
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The recommended spending rate for FY75 benefits and risks/uncertainties in each of the objectives areas A-F above are:

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2. Risks/uncertainties--Development of equipment is subject to some uncertainties high temperature reactors under pressure are often involved. Nevertheless, th possibility of significant achievement appears good, as high pressure technolo U. S. is an active field.

B. Materials ($14M 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 e

C. Data compilations, handbooks and analyses ($6M 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 design 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, inefficient design or the need for costly design could easily raise costs for and demonstration plants by 20 to 50 per cent, equal to many millions of dolla
2. Risks/Uncertainties -- The collection and analysis of data although time-consu is more certain of accomplishment than most R&D work.

D. Catalysts and chemical kinetics for conversion processes ($25 M in FY75)
1. Benefits -- Some of the most important reactions in coal and liquefaction dep Catalysts with catalytic stages representing perhaps 30% the total cost in the processes. Even minor improvements in catalysis or in chemical processes woul in massive savings in coal and shale processing.
2. Risks/uncertainties -- As with all research programs, the fractional improvem [illegible] cannot be definitely stated. Still definite

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operations involved in liquefaction
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

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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:

4

ment ($15M in FY75)

nefits--Frequent breakdown of equipment or inefficient operation coal and shale conersion plants because of poor equipment could easily raise costs 10%. If coal and shal came a primary source of U. S. gas and oil, a 10% reduction in price would esult 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.

ais ($14M in FY 75)

enefits -- Fracture, erosion and corrosion of materials used in coal conversion devic 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. s 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 aterials 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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enefits -- In designing pilot and demonstration plants, engineering data are needed n the construction materials used, coal itself and chemical processes. Economic nalyses also are needed. Serious engineering problems and inefficient designs can esult from lack of suitably analyzed data, which might lead to long delays in achievi uitable operation. Loss of time even in an orderly program is irreplaceable, whereas nefficient design or the need for costly design could easily raise costs for pilot nd demonstration plants by 20 to 50 per cent, equal to many millions of dollars.

isks/Uncertainties -- The collection and analysis of data although time-consuming s more certain of accomplishment than most R&D work.

ysts and chemical kinetics for conversion processes ($25M in FY75)

nefits -- Some of the most important reactions in coal and liquefaction depend on talysts with catalytic stages representing perhaps 30% the total cost in these ocesses. Even minor improvements in catalysis or in chemical processes would resul massive savings in coal and shale processing.

isks/uncertainties -- As with all research programs, the fractional improvement that [illegible] cannot be definitely stated. Still definite [illegible]

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort
[X] MAXIMUM
[ ] ORDERLY
[ ] MINIMUM

IDENTIFICATION
0505503105560

JUSTIFICATION: State the specific energy problem or objective and specify how the proposed work contributes to the solution of the proble or attainment of the objective. Include reasons for selecting the recommended approach over other approaches. Also include the benefits expected to be derived from meeting the objectives or goals of the program by selecting the project as proposed. Outline the risks/uncertainti (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 ($40M in FY75)

1. Benefits -- Even in existing pilot plants, a number of individual processe: been optimized. Individual optimization of various processes as listed ab: 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 do cost savings.
2. Risks/uncertainties -- Development programs have inherent uncertainties, b listedin this section should yield significant results.

F. Hydrogen Production for use in Coal Conversion Processes ($8M in FY75)

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

CH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort:
- [X] MAXIMUM
- [ ] OBJECTIVE
- [ ] MINIMUM

IDENTIFICATION NUMBER
0505563105596.02

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

breakthrough.

Development ($40M in FY75)

fits -- 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 ed in this section should yield significant results.

n Production for use in Coal Conversion Processes ($8M in FY75)

fits -- The economical production of hydrogen from residue chars or coal is ntial for the economical development of the Synthoil coal liquefaction process and ydrane and Hygas coal gasification processes In general, sources of hydrogen are ssary for any process which converts coal to gas or oil, since the chief chemical rence 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 ically feasible. The main uncertainty lies in the selection of an economic process particular coal conversion systems.

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Coal and Shale Pro
Supporting Research

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)

b. DATES			
Start		Complete	
FY	Q	FY	Q

Deci

1.

2.

3.

NOTE

(Continue to next column)

Coal and Shale Processing Combustion
Supporting Research

☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
05 05 55 03 10 55 56 02

Decision

a. [redacted] MILESTONES *(continued)*

(Limit Title of Milestone to 60 characters and spaces)

b. DATES Start FY	Start Q	Complete FY	Complete Q

b. DATES Start FY	Start Q	Complete FY	Complete Q
75	1	77	1
78	1	80	1
80	1	80	1

Decision Milestones for Individual Projects

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

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)

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

Coal and Shal
Combustion Su

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		110		140		160	
e. GRAND TOTAL—OUTLAYS		12		110		140		1

NOTE: If cooperative programs are proposed, indicate the amount by year of both private and Federal government funding. A brief descri

Level of Effort:

☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

Coal and Shale Processing and Combustion Supporting Research

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 Excluding FY 1974 (Col. 7 & 8)	
utlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	160		160		160		730		200		930	
140		160		160		160		730		200		930

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

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Coal and
Supporti

1. 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	F Obls.
TOTAL *(Carry forward to summary sheet)* ▷	12	12	110	110	140	140	160
) Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
) Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
) Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							
) Name of Performing Organization:							
MANPOWER							
MATERIALS							
MAJOR PROCUREMENTS							
ALL OTHER							
TOTAL FOR THIS PERFORMING ORGANIZATION							

(Continue on Supp

Coal and Shale Processing and Combustion Supporting Research

Level of Effort:
- [x] MAXIMUM
- [ ] ORDERLY
- [ ] MINIMUM

IDENTIFICATION NUMBER
05 03 55 03 10 35 [illegible]

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY [illegible]		(8) PAID TO COMPLETE		TOTAL	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	
140	140	160	160	160	160	160	160	730	730	[illegible]00	200	[illegible]30	[illegible]11

(Continue on Separate Sheet)

Page [illegible]

2

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

F 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	Obl
TOTAL *(Carry forward to summary sheet)*	D							
Title of Project, Location *(State and County)* and Total Estimated Cost (TEC) *(Group similar items consecutively. Every project must be separately identified with a brief statement of purpose as required.)*	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

☒ MAXIMUM
☐ GRIDFILY
☐ MINIMUM

05 05 55 03 10 55 04 [illegible]

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

on Separate Sheet)

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	(4) FY 1 Obls.
Each item of performing organization, for which equipment funds, with a separate item of such item of equipment to be at least 1 million dollars or more. TOTAL *(Carry forward to summary sheet)* ▷							

Included in 9a.

(Continue on Separate

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)	
	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays

(Separate Sheet)

Page of

2

FACT SHEET

[ ] MANPOWER
[X] OBLIGATION
[ ] EXPENDITURE

1. IDENTIFICATION: 05 05 55 03 10 55

2. a. PROGRAM: Coal and Shale Conversion and Utilization

b. SUB-PROGRAM: Environmental Support to Advanced Coal and Shale Processing Technology

3. a. PROGRAM AGENCY: Division of Fossil Fuels, Office of Coal, Shale, ERDA /Program

b. SUBAGENCY:

4. CONTRACTOR/GRANTEE (No more than 12 characters and spaces for name of contractor, use standard abbreviations for state up to 15 characters and spaces for county.)

NAME OF CONTRACTOR: Various contractors in many locations both in

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 70 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 improvemer present conversion and combustion systems and development of n more efficient systems are proposed.

A number of independent small-scale facilities for testing ma

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

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	Ne
c. LAND AREA REQUIRED (In acres)	(1) Government	"	"	"	"	
	(2) Contractor	"	"	"	"	
	(3) Private owned	"	"	"	"	
	(4) Other	"	"	"	"	
d. OTHER RESOURCES NEEDED						

FACT SHEET

[ ] MANUAL
[X] ORDERLY
[ ] EMERGENCY

1. IDENTIFICATION NUMBER
05 0[illegible] 03 10 [illegible] 02

RAM	Coal utilization [illegible] with Combustion
NT AGENCY	Supporting research to fully develop [illegible] Power Generation Systems
	DOE-COR, ASO, DOI-BOM, DOI-BCR, TVA, NSF, [illegible], ERDA

R AND SITE (42 characters and s of contractor, breviation for state acters and spaces for)

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:

IPTION OF (24 lines of text an 70 character line) nature and scope ach phase, ew facilities e to be acquired

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.

2

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

7. MAJOR RESOURCE REQUIREMENTS

FISCAL YEAR	1975	1976	1977	1978	1979
) Scientific					
) Technical					
) Support					
) Other					
LS (d units of ch as tons of , kilograms of w amount of t right.)	Neglible	Neglible	Neglible	Neglible	Neglible
) Govt-owned	"	"	"	"	"
) Govt-leased	"	"	"	"	"
) Privately-owned	"	"	"	"	"
) Other	"	"	"	"	"
CES NEEDED (unit of					

BLANK PAGE

spaces for name of contractor, use standard abbreviation for state up to 16 characters and spaces for county.	(if known)		
	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

(Do 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 new facilities which may have to be acquired or constructed.

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 dome. resources of coal and shale in an environmentally-acceptable man The work in the present sub-program will be done on a laboratory scale, thus requiring only moderate cost while still providing th necessary tests, data on materials, component development and chemical process development for the national program, which wil involve large pilot and demonstration plants. Both improvement present conversion and combustion systems and development of new more efficient systems are proposed.

A number of independent small-scale facilities for testing mater equipment and special chemical process be required.

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

7. MAJOR RESOURCE REQUIREMENTS

RESOURCE ▽	FISCAL YEAR ▷	1975	1976	1977	1978	197
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	Negli
c. LAND AREA REQUIRED *(In acres)*	(1) Government-owned	"	"	"	"	"
	(2) Controlled	"	"	"	"	"
	(3) Privately-owned	"	"	"	"	"
	(4) Other	"	"	"	"	"
d. OTHER RESOURCES NEEDED *(Specify item and unit of measure below. Show quantity of each in columns at right.)* [1]		(1)				

N/A

3