APPENDIX A

Detailed Cost Estimates of Waste Energy Recovery Systems*

*Reference: Internal memorandum from R. A. Chapman to D. Keller, Environmental Protection Agency, Solid Waste Research Laboratory, dated March 2, 1973.

Cost Estimates for Various Solid Waste Disposal Systems

- Size = 600 ton/day (197,000 ton/year @ 90 percent utilization)
- Capital amortization at 20 year life, 6 percent municipal interest, 16 percent private interest
- Credit given for sale of glass, ferrous metals and non-ferrous metals when shredding and air classification are included in the process
- Credit not given for sale of materials when shredding is not included in the process because additional revenue gained from material recovery will approximately cover added cost of shredding and air classification.
- When shredding and air classification are used, there is a 5 percent loss of moisture and a 15 percent loss of inerts. Therefore, "as fired" solid waste = 80 percent of the "as received" solid waste.
- Solid waste composition and heating values used are those experienced in the CPU-400 testing using Palo Alto municipal solid waste. They are as follows:

  "As received" solid waste = 29 percent moisture, 29.4 percent inerts, lower heating value = 3325 Btu/lb.

  "As fired solid waste = 30 percent moisture, 18 percent inerts, lower heating value = 4160 Btu/lb.

- The lower heating values correspond to 8000 Btu/lb for moisture and inert free solid waste.

MATERIAL RECOVERY SYSTEM 600 T/D (197,000 T/Y @ 90% utilization)

Capital Cost[1]	$579,370	
Annual Capital Cost (20 yrs, @ 6%)	$ 50,500	
Unit Capital Cost		$ 0.26/ton
Unit Operating Cost[2]		$ 0.47/ton
Labor	$ 0.32/T	
Maintenance	$ 0.15/T	
Total Unit Cost		$ 0.73/ton
Unit Income[3]		$ 2.95/ton
Net Income		$ 2.22/ton

Notes

1. Basic system including magnetic separator, combustible material removal, glass/inert screens, aluminum/metal separator delivered on site. $ 416,400

   Installation and checkout $ 110,300

   Contingencies @ 10% $ 52,670

   Total Capital Cost $ 579,370

2. Labor (1/shift) @ $12,500/Y $ 50,000/Y
   Payroll extras @ 25% $ 12,500/Y

   Total labor $ 62,500/Y
   $62,500/197,000 = $ 0.32/T

   Maintenance $ 30,000/Y
   $30,000/197,000 = $ 0.15/T

3. | | | |
   |---|---|---|
   | Ferrous @ 5% of "as received" s.w. | @ $15/ton | $ 0.75 |
   | Aluminum @ 0.5% " " | @ $200/ton | $ 1.00 |
   | Glass, sand, etc, @ 15% " " | @ $3/ton | $ 0.45 |
   | Other metals @ 0.25% " " | @ $300/ton | $ 0.75 |

   Total Income $ 2.95/ton

STEAM GENERATION 600 T/D (197,000 T/Y @ 90 % utilization)

Capital Cost[1]	$12,800,000	
Annual Capital Cost (20 yrs @ 6%)	$1,114,000/Y	
Unit Capital Cost		$ 5.66/ton
Unit Operating Cost[2]		$ 5.60/ton
Maintenance & Utilities	$ 2.00	
Labor	$ 3.60	
Total Unit Cost		$11.26/ton
Unit Income for Steam[3]		$ 2.00/ton
Net Disposal Cost		$ 9.26/ton

Notes

1. Chicago N.W. incinerator (1600 T/D) cost $23,000,000 (corrected to 1/27/72). Using scale up factor of 0.6, then $(1600/600)^{.6} = 1.8$ and $(23,000,000)/1.8 = \$12,800,000$.

2. Operating cost @ Chicago N.W. incinerator are $4.00/ton. Assume $2.00/ton for labor & $2.00/ton for maintenance and utilities. Assume cost/ton for maintenance and utilities is independent of scale and that a 0.6 scale factor is applied to labor. Therefore, labor cost = ($2.00/T)1.8 = $3.60/ton.

3. 1 lb solid waste yields 1 to 3.5 lbs steam (2 lbs average) worth $1/T. Therefore, 1 ton solid waste produces $2 worth of steam. This assumes that the steam is sold. At Chicago N.W. incinerator it is not. Therefore, it must be condensed at an added expense and the water reused. Steam must be generated as a means of cooling the exhaust prior to the electrostatic precipitators.

COMBUSTION OF WASTE AS A FOSSIL FUEL SUBSTITUTE 600 T/D[1] (197,000 T/Y @ 90% utilization)

(St. Louis Demonstration Plant)

	Municipality		Utility	
Capital Cost	$ 1,710,000[2]		$995,000[3]	
Annual Capital Cost[4]	$ 149,100		$167,800	
Unit Capital Cost		$ 0.76/T		$ 0.89/T
Unit Operating Cost		$ 2.18/T		$ 0.78/T
Labor	$ 0.75[5]		$ 0.64[6]	
Maintenance & Utilities	$ 1.43[7]		$ 0.14[8]	
Transportation Cost		$ 1.12/T[9]		$ 0.00
Total Cost		$ 4.06/T		$ 1.67/T
Unit Income[10]		$ 0.92/T		$ 1.67/T
Net Disposal Cost		$ 3.14/T		0
Unit Income for Material Recovery		$ 2.22/T		
Net Disposal Cost		$ 0.92/T		

Notes

1. A 100,000 kw boiler at 76 percent utilization, burning 15 percent solid waste by heat value would consume 197,000 T/Y.

2. Solid waste processing subsystem with building $1,320,000
   Storage and transportation loading $ 268,000
   Receiving $ 122,000
   Total $1,710,000

3. Handling & firing capital equipment including solid waste storage & recovery, air-lock feeder valves, pneumatic transport blowers & piping, burners, and control system. $ 995,000

4. 20 years, 6% interest for municipality, 20 years, 16% for utility.

5. Labor - 10 men (4 shifts, 7 day operation) $ 118,000
   Payroll extras @ 25% $ 29,500
   Total labor $ 147,500

   Unit labor cost ($147,000/Y)/(197,000 T/Y) = $ 0.75/T

6. Labor - 8 men (4 shifts, 7 day operation) $ 100,000
Payroll extras @ 25% $ 25,000
Total labor $ 125,000

Unit labor cost = ($125,000/Y)/(197,000 T/Y) = $ 0.64/T

7. Shredding equipment maintenance @ $1.00/T = $ 197,000
Maintenance supplies @ 1% of equipment capital cost $ 5,200
Total annual maintenance costs $ 202,200

Utilities (1000 kw @ $0.01/kwh) $ 79,000
Total maintenance and utilities $ 281,200

Unit cost = ($281,200/Y)/(197,000 T/Y) = $ 1.43/T

8. Annual maintenance on handling & firing equipment @ 2% of capital installed cost = $ 20,000
Utilities (100 kw @ $0.01/kwh) $ 7,900
Total annual maintenance and utilities $ 27,900

Unit cost = ($27,900/Y)/(197,000 T/Y) = $ 0.14/T

9. Assume 20 mile transfer distance at $0.07/ton-mile.
With 80% loss on shredding and air classification, only 80% of the incoming waste is transported.
Cost = ($0.07)(.80)(20) = $1.12/T

10. Solid waste fuel value estimated at $0.45/MBtu, 3600* Btu/lb delivered to utility, 20% weight loss on shredding - air classification.
Annual value = (197,000 T/Y)(.80)(2000 lb/T)(3600 Btu/lb) ($0.45 x 10^{-6}/Btu) = $511,000

Unit fuel value = ($511,000/Y)/(197,000 T/Y) = $ 2.59/T

Assume the utility receives an income equivalent to its costs and the municipality receives the balance.

* Solid waste heat rate is about 86% of the coal heat rate when fired in a coal burning steam plant. This is due primarily to its moisture content and chemical composition that yield an exhaust gas composition different than for coal. Therefore, effective Btu value = (4160 Btu/lb)(.86) = 3600 Btu/lb.

POWER GENERATION FROM COMBUSTION GASES 600 T/D (197,000 T/Y @ 90% utilization)

(CPU-400 with water injection, 3 power modules)

Capital Cost[1]	$6,721,000		
Annual Capital Cost (20 yrs @ 6%)	$586,000		
Unit Capital Cost		$ 2.98/ton	
Unit Operating Cost[2]		$ 4.24/ton	
Maintenance & Utilities	$ 2.30/T		
Labor	$ 1.94/T		
Total Unit Cost		$ 7.22/ton	
Unit Income for Electricity[3]		$ 3.89/ton	
Net Disposal Cost			$ 3.33/ton
Unit Income for Material Recovery		$ 2.22/ton	
Net Disposal Cost			$ 1.11/ton

Notes

1. 3 power modules @ $1,050,000 each $3,150,000
   Solid waste processing system $1,000,000
   Facility $1,000,000
   Steam turbine etc., for waste heat $ 560,000
   Organization & startup $ 400,000
   Contingency @ 10% $ 611,000
   Total $6,721,000

2. Labor - 24 men (4 shifts, 7 day operation) $ 306,000
   Payroll extras @ 25% $ 76,500
   Total Labor $ 382,500
   Unit cost ($382,500/Y)/(197,000 T/Y) $ 1.94/T
   Maintenance
   Gas turbine $ 90,000
   Hot gas subsystem $ 40,000
   S.W. subsystem @ $1.00/T $ 197,000
   Control subsystem $ 20,000
   Supplies $ 26,000
   Total Maintenance $ 373,000

Utilities

Electricity (1000 kw @ $0.010 kwh)	$ 79,000	
Water (255 lb/min @ $0.30/1000 gal)	$ 2,700	
Total Maintenance & Utilities	$ 454,700	
Unit cost ($454,700/Y)/(197,000 T/Y)		$ 2.30/T

3. Gas turbine generating capacity (3 modules @ 3 mw each 9.0 mw
Steam turbine generating capacity 3.15 mw
Total capacity 12.15 mw

Plant power output = (generating capacity)(utilization factor) = (12,150 kw)(.9) = 10,920 kw

Assume 8 mills/kwh income.
Income = (10,920 kw)(24 H/D)(365 D/Y)($.008/kwh) = $766,000/yr
Unit income = ($766,000/Y)/(197,000 T/Y) = $ 3.89/ton

POWER GENERATION FROM COMBUSTION GASES 600 T/D (197,000 T/Y @ 90% utilization)

(CPU-400 with sludge disposal, 3 power modules)

Capital Cost[1]	$6,886,000		
Annual Capital Cost (20 yrs @ 6%)	$ 600,000		
Unit Capital Cost		$ 3.04/ton	
Unit Operating Cost[2]		$ 4.26/ton	
Maintenance & Utilities	$ 2.32		
Labor	$ 1.94		
Total Unit Cost		$ 7.30/ton	
Unit Income[3]		$ 5.32/ton	
Net Disposal Cost			$ 1.98/ton
Unit Income for Material Recovery		$ 2.22/ton	
Net Disposal Cost			-$0.24/ton

Notes

1.

3 power modules @ 1,050,000 each	$3,150,000
Solid waste processing system	$1,000,000
Facility	$1,000,000
Steam turbine etc., for waste heat	$ 560,000
Sludge pumps, tanks, etc.	$ 150,000
Organization & startup	$ 400,000
Contingency @ 10%	$ 626,000
Total	$6,886,000

2.

Labor - 24 men (4 shifts, 7 day operation)	$ 306,000	
Payroll extras @ 25%	$ 76,500	
Total Labor	$ 382,500	
Unit cost ($382,500/Y)/(197,000 T/Y)		$ 1.94/T
Maintenance		
Gas turbine	$ 90,000	
Hot gas subsystem	$ 40,000	
S.W. subsystem @ $1.00/T	$ 197,000	
Control subsystem	$ 20,000	
Sludge subsystem	$ 10,000	
Supplies	$ 26,000	
Total Maintenance	$ 383,000	

Utilities (1000 kw @ $0.010/kwh) $ 79,000

Total Maintenance & Utilities $ 462,000

Unit cost ($462,000/Y)/(197,000 T/Y) $ 2.32/T

3. Electrical Income

Gas turbine generating capacity (3 modules @ 3 mw each)	9.0 mw
Steam turbine generating capacity	3.15 mw
Total capacity	12.15 mw

Plant power output = (12,150 kw)(.9) = 10,920 kw

Assume 8 mills/kwh income.
Income = (10,920 kw)(24 H/D)(365 D/Y)($0.008/kwh) = $766,000/Y
Unit income for electricity = ($766,000/Y)(197,000 T/Y) = $ 3.89/t

Sludge Income
Assume 7 lb/cap./day solid waste and 0.20 lb/cap/day sewage solids generation. Therefore, for 197,000 T/Y solid waste, (0.20/7)(197,000) = 5630 T/Y sewage sludge solids will be generated at $50/ton disposal credit. This represents $282,000/Y or $ 1.43/ton of solid waste.

Total Income for Sludge and Electricity = $ 5.32/ton

PYROLYSIS - Oil Production 600 T/D (197,000 T/Y @ 90% utilization)

(Garrett Research - San Diego Demonstration Plant)

Capital Cost[1]	$6,800,000		
Annual Capital Cost (20 yrs @ 6%)	$ 592,000		
Unit Capital Cost		$ 3.00/ton	
Unit Operating Cost[2]		$ 6.74/ton	
Maintenance & Utilities	$ 3.78		
Labor	$ 2.96		
Total Unit Cost		$ 9.74/ton	
Unit Income[3]		$ 3.16/ton	
Net Disposal Cost			$ 6.58/ton
Unit Income for Material Recovery		$ 2.22/ton	
Net Disposal Cost			$ 4.36/ton
Unit Income for Sludge Disposal[4]		$ 0.29/ton	
Net Disposal Cost			$ 4.07/ton

Notes

1. 2000 T/D plant estimated to cost $14,000,000. Using scale factor of 0.6, then $(2000/600)^{.6} = 2.06$ and $14,000,000/2.06 = $6,800,000 capital cost.

2. Labor costs for 2000 T/D plant = $1,200,000/Y. This includes 60 operators & 13 administrative personnel. Assume a scale factor of 0.6, then 1,200,000/2.06 = $583,000/Y labor costs including 37 total personnel. This seems reasonable since the process is quite labor intensive. Unit labor cost = 583,000/197,000 = $2.96/T. This process uses 127 kWh of power/ton of solid waste. Therefore, utility costs @ 10 mills/kWh = (127)($0.01) = $ 1.27/ton. Maintenance costs for 2 stage shredding assumed to be $ 2.00/ton. Other plant maintenance cost estimated to be $ 100,000/year = $ 0.51/ton. Total maintenance & utilities = $ 3.78/ton.

3. One ton of solid waste generates 1.1 barrel of oil containing 5.28×10^6 Btu. At $ 0.60/MBtu, unit income for oil = (5.28)(0.60) = $ 3.16/ton of solid waste. Low sulfur oil is selling for up to $ 0.85 MBtu in some areas. However, the national average is about $.60/MBtu. Barge transportation for 18,000 barrels of oil (1 month's production from a 600 T/D plant) or pipeline transport costs about $.01/hundred miles/MBtu.

Therefore, transporting oil produced in the Midwest to the East Coast will cost about $.10 to $.15/MBtu and would allow the oil to be sold at $0.85/MBtu. This yields a net credit at the plant of $0.85-$0.15 = $0.70/MBtu under favorable conditions. If solid waste is to be pyrolyzed near its point of use I would think that gas production rather than oil production would be favored because it is worth more per Btu. On the other hand, if the solid waste pyrolysis products are to be transported great distances or stored, oil production may be favored.

4. This process is about 50 percent efficient in producing oil Btu's from solid waste. Assume the same efficiency for sewage sludge. One dry ton of sludge contains about (7000 Btu/lb)(2000 lb/D) = 14 x 10^9 Btu. With a 50 percent conversion to oil this yields about 7 MBtu/ton. At $0.80/MBtu this is equivalent to $4.20/ton of sewage sludge solics. With a 0.2/7 ratio of per capita sludge solids/solid waste generated, a population generating 197,000 tons of solid waste will produce 5630 t/y of sewage sludge solids.

Annual plant income for oil from sludge = (5630)($4.20) = $23,600.

Assume a cost for dewatering and drying the sludge to 75 percent solids at $35/dry ton or $197,000/y. The 75 percent solids sludge can then be dried further with the solid waste at no additional fuel costs by using the excess process heat available. Estimated annual capital and operating costs are about $50,000 exclusive of the dewatering/drying steps.

Therefore, total annual costs = $247,000.

Annual income for sludge disposal credit at $50/ton = $281,000.

Total annual income = $281,000 + $23,600 = $304,600.

Net annual income = $304,600-$247,000 = $57,600, or $0.29/ton of solid waste.

MILESTONE	THRU FY 74	FY 1975			FY 1976			AV: FY 77 – FY 81			TOT. FY 77
		INV	OPER	TOT	INV	OPER	TOT	INV	OPER	TOT	
THEORY ESTABLISHED											
ECONOMIC VIABILITY FORECASTED											
EXPERIMENT DESIGNED											
COMPONENT TESTING											
BENCH MODEL COMPLETED											
LABORATORY EXPERIMENTATION COMPLETED											
ENGINEERING DEVELOPMENT	4000			2850			2000			0	4,850
PILOT PLANT	2,000										
DEMONSTRATION PLANT	3,000			1500			3650			2167	11,650
FIRST COMMERCIAL APPLICATION											
SUBSEQUENT APPLICATION											None

MILESTONES	PERSONNEL			LAND AREA	WATER	FUELS		OTHE
	SCI.	TECH.	ADM.			TYPE	QUAN.	TYPE
THEORY ESTABLISHED								
ECONOMIC VIABILITY FORECASTED								
EXPERIMENT DESIGNED								
COMPONENT TESTING								
BENCH MODEL COMPLETED								
LABORATORY EXPERIMENTATION COMPLETED								
ENGINEERING DEVELOPMENT	2.0			ni	ni	na		na
PILOT PLANT								
DEMONSTRATION PLANT	4.0			ni	ni	na		na
FIRST COMMERCIAL APPLICATION								
SUBSEQUENT APPLICATION								

ENVIRONMENTAL IMPACT STATEMENT REQUIRED? Yes
FOR WHAT YEARS? 1975-1976

Development of Urban Waste-Fuel Technologies

	FY-75	FY-76	FY-77	FY-78	FY-79	Total FY-75-79
Government	4350	5650	5500	1000	-	16,500
Private Sector*	2700	6400	-	-	-	9,100
Total	7050	12050	5500	1000	-	25,600

*Private sector includes funding support by state and local governments

Pyrolysis Conversion of Solid Waste

MILESTONE	THRU FY 74	FY 1975			FY 1975			W: FY 77- FY'8			FY'76-FY'78-
		INV	OPER	TOT	INV	OPER	TOT	INV	OPER	TOT	
THEORY ESTABLISHED											
ECONOMIC VIABILITY FORECASTED											
EXPERIMENT DESIGNED											
COMPONENT TESTING											
BENCH MODEL COMPLETED											
LABORATORY EXPERIMENTATION COMPLETED				500							500
ENGINEERING DEVELOPMENT				300						677	2,300
PILOT PLANT							1500				1,500
DEMONSTRATION PLANT										2667	8,000
FIRST COMMERCIAL APPLICATION											
SUBSEQUENT APPLICATION											

MILESTONES	PERSONNEL			LAND AREA	WATER	FUELS		OTHE	
	SCI.	TECH.	ADM.			TYPE	QUAN.	TYPE	
THEORY ESTABLISHED									
ECONOMIC VIABILITY FORECASTED									
EXPERIMENT DESIGNED									
COMPONENT TESTING									
BENCH MODEL COMPLETED									
LABORATORY EXPERIMENTATION COMPLETED	0.25			n.i.	n.i.				
ENGINEERING DEVELOPMENT	1.0			n.i.	n.i.				
PILOT PLANT	1.0			n.i.	n.i.	Supplied by process			
DEMONSTRATION PLANT	2.0			n.i.	n.i.	Supplied by process			
FIRST COMMERCIAL APPLICATION	Same as demo			n.i.	n.i.	Supplied by process			
SUBSEQUENT APPLICATION									

ENVIRONMENTAL IMPACT STATEMENT REQUIRED? Yes

FOR WHAT YEARS? 1978

Pyrolysis Conversion of Solid Wastes

	FY-75	FY-76	FY-77	FY-78	FY-79	Total FY-75-79
Government	800	1500	2000	4000	4000	12300
Private Sector*	-	500	3500	4000	-	8000
Total	800	2000	5500	8000	4000	20300

*Private sector includes support by state and local government.

MILESTONE	THRU FY 74	FY 1975			FY 1976			AVG FY 77 – FY 7[illegible]			TOT. FY'75-
		INV	OPER	TOT	INV	OPER	TOT	INV	OPER	TOT	
THEORY ESTABLISHED											
ECONOMIC VIABILITY FORECASTED				20			50				70
EXPERIMENT DESIGNED											
COMPONENT TESTING											
BENCH MODEL COMPLETED											
LABORATORY EXPERIMENTATION COMPLETED	300			480			450			533	1930
ENGINEERING DEVELOPMENT							500			567	2200
PILOT PLANT							2000			2677	10,000
DEMONSTRATION PLANT		Commercial demonstration in 25 tpd plant module shown under pilot plant									
FIRST COMMERCIAL APPLICATION											
SUBSEQUENT APPLICATION											

MILESTONES	PERSONNEL			LAND AREA	WATER	FUELS		OT
	SCI.	TECH.	ADM.			TYPE	QUAN.	TYPE
THEORY ESTABLISHED								
ECONOMIC VIABILITY FORECASTED								
EXPERIMENT DESIGNED								
COMPONENT TESTING								
BENCH MODEL COMPLETED								
LABORATORY EXPERIMENTATION COMPLETED	0.5							
ENGINEERING DEVELOPMENT	2.0							
PILOT PLANT	2.0				obtained from untreated sewage	supplied by proce		
DEMONSTRATION PLANT			SAME AS PILOT PLANT					
FIRST COMMERCIAL APPLICATION			SAME AS PILOT PLANT					
SUBSEQUENT APPLICATION	0	0	0	n.i.	obtained from untreated sewage	supplied by proce		

ENVIRONMENTAL IMPACT STATEMENT REQUIRED? Yes

FOR WHAT YEARS? 1977

Biochemical Conversion of Urban Wastes

	FY-75	FY-76	FY-77	FY-78	FY-79	Total FY-75-79
Government	500	3000	8000	1500	1200	14200
Private Sector*	-	-	5000	-	-	5000
Total	500	3000	13000	1500	1200	19200

*Private sector includes funding by state and local government.

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 1977 Obls.	(4) FY 1977 Outlays
OPERATING *(See p. for detail)* Total Operating Requirements *(from Detail Sheet)*	0.2	0.5	8.0	8.0	9.0	9.0	10.0	10.0
CONSTRUCTION *(See p. for detail)* Total Construction Requirements *(from Detail Sheet)*	0	0	5.0	5.0	5.0	5.0	5.0	5.0
EQUIPMENT *(See p. for detail)* Total Equipment Requirements *(from Detail Sheet)*	0	0	5.0	3.3	6.0	6.0	6.0	7.0
GRAND TOTAL—OBLIGATIONS	0.2		18.0		19.0		21.0	
GRAND TOTAL—OUTLAYS		0.5		16.3		20.0		22

Level of Effort:

- ☐ MAXIMUM
- ☒ ORDERLY
- ☐ MINIMUM

IDENTIFICATION NUMBER: 0-1-550-[illegible]

1978	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Excluding FY 1974 (Col. 7 & 8)	
Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
9.0	10.0	10.0	9.8	9.8	9.7	9.7	46.4	46.4	10.6	10.6	57.0	57.0
5.0	5.0	5.0	5.0	5.0	5.0	5.0	25.0	25.[illegible]	10.0	10.0	35.0	35.[illegible]
6.0	6.0	7.0	4.0	5.0	4.0	3.7	25.0	25.0	15.0	15.0	40.0	[illegible]
	21.0		18.8		18.7		96.4		35.6		122.0	
20.0		22.0		19.8		18.4		96.4		35.6		[illegible]

		[ ] PROGRAM	1. IDENTIFICATION NO. 0604210[illegible]30301
2. a. PROGRAM	Energy Conversion		
b. SUBPROGRAM	Low BTU Gasification From Coal		
3. a. PROPONENT AGENCY	Department of Interior, NASA, EPA, AEC		
b. SUBUNIT	Office of Coal Research		
4. CONTRACTOR AND SITE (No more than 42 characters and spaces for name of contractor; use standard abbreviation for states up to 16 characters and spaces for county.	NAME OF CONTRACTOR: Various		
	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:) TOTAL U.S.
	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.

Generation of low BTU gas from coal that is non polluting and ut
all grades of coal indigenous to the U.S. This program provides
alternative to natural gas and petroleum as fuels for clean elec
power generation at high efficiency (initially over 40% and late
the 50% range) and to meet industrial demand for gas, both as a
as chemicls feed stocks. These accomplishments will help curb e
reliance on imported oil and LNG by enabling high-sulfur coals t
for power generation with due regard to environment. Two pilot/
tion plants 30 MWe to 50 MWe are constructed and operated in 19

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	200	300	350	350	
	(2) Technical	700	900	1000	1000	
	(3) Support	80	100	100	100	
	(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.)		600 Tons Coal/Day	700 Tons Coal/Day	1200 Tons Coal/Day	1700 Tons Coal/Day	200 Co
c. LAND AREA REQUIRED (In acres)	(1) Govt-owned	1200	3500	5000	5000	5
	(2) Govt-leased	--	--	1500	1500	1
	(3) Privately-owned	100	200	400	400	
	(4) Other					

GRAM	Energy Conversion
PROGRAM	Low BTU Gasification From Coal
PONENT AGENCY	Department of Interior, NASA, EPA, AEC
UNIT	Office of Coal Research
ACTOR AND SITE (than 42 characters and or name of contractor; ard abbreviation for state; characters and spaces for	NAME OF CONTRACTOR: Various 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: TOTAL U.S. NAME OF CONTRACTOR: Site where work will be performed ▶ State: County: NAME OF CONTRACTOR: Site where work will be performed ▶ State: County:
DESCRIPTION OF AL (than 24 lines of text more than 70 characters ers per line) outline nature and scope to be undertaken, g any new facilities y have to be acquired ucted.	Generation of low BTU gas from coal that is non polluting and utilizes all grades of coal indigenous to the U.S. This program provides an alternative to natural gas and petroleum as fuels for clean electric power generation at high efficiency (initially over 40% and later into the 50% range) and to meet industrial demand for gas, both as a fuel and as chemicla feed stocks. These accomplishments will help curb excessive reliance on imported oil and LNG by enabling high-sulfur coals to be used for power generation with due regard to environment. Two pilot/demonstration plants 30 MWe to 50 MWe are constructed and operated in 1977-78.

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

7. MAJOR RESOURCE REQUIREMENTS

CE	FISCAL YEAR ▶	1975	1976	1977	1978	1979
WER	(1) Scientific	200	300	350	350	300
ears)	(2) Technical	700	900	1000	1000	900
	(3) Support	80	100	100	100	100
	(4) Other					
TERIALS (erials and units of below, such as tons of s of oil, Kilograms of etc. Show amount of lumns at right.)		600 Tons Coal/Day	700 Tons Coal/Day	1200 Tons Coal/Day	1700 Tons Coal/Day	2000 Tons Coal/Day
REA ED	(1) Govt-owned	1200	3500	5000	5000	5000
	(2) Govt-leased	--	--	1500	1500	1500
	(3) Privately-owned	100	200	400	400	400
	(4) Other					
ESOURCES NEEDED						

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b. SUBPROGRAM	Low BTU Gasification From Coal
3. a. PROPONENT AGENCY	Department of Interior, NASA, EPA, AEC
b. SUBUNIT	Office of Coal Research

4. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR: Various			
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:	TOTAL U.S.
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.

Generation of low BTU gas from coal that is non polluting and uti all grades of coal indigenous to the U.S. This program pro ides alternative to natural gas and petroleum as fuels for clean elect power generation at high efficiency (initially over 40% and later the 50% range) and to meet industrial demand for gas, both as a f as chemicla feed stocks. These accomplishments will help curb e: reliance on imported oil and LNG by enabling high-sulfur coals tc for power generation with due regard to environment. Two pilot/d tion plants 30 MWe to 50 MWe are constructed and operated in 1977

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	200	300	350	350	30
	(2) Technical	700	900	1000	1000	90
	(3) Support	80	100	100	100	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.)		600 Tons Coal/Day	700 Tons Coal/Day	1200 Tons Coal/Day	1700 Tons Coal/Day	2000 Coal
c. LAND AREA REQUIRED (In acres)	(1) Govt-owned	1200	3500	5000	5000	500
	(2) Govt-leased	—	—	1500	1500	150
	(3) Privately-owned	100	200	400	400	40
	(4) Other					
d. OTHER RESOURCES NEEDED (Specify item and unit of measure below. Show quantity of each in columns at right.) (1)	(1)					

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

Clean Low-B.t.u. Gas

t is contemplated that R&D for low-B.t.u. gas will be of importance (a) to provide another lternative for clean electric power generation at high efficiency, and (b) to meet industr emand for gas. These functions are expected to help curb excessive reliance on imported o nd LNG by enabling high-sulfur coals to be used for power generaion and other purposes wit ollution.

wo co-funded pilot/demonstration plants are planned with initial operation estimated for th Y 1977-78 period, thereby providing a basis for wide commercial application by the early 1

research effort for low-B.t.u. clean fuel gas from coal will integrate with research on g urbines. The bulk of the research will be expended by contract, supplemented by work in overnment laboratories. The major efforts will seek to develop low-B.t.u. gasification echniques as an outgrowth of past Departmental programs. A single commercial-size gasifie apable of producing sufficient low-B.t.u. gas for a 1000-megawatt powerplant, and the gasi nd its associated cleanup equipment can be tailored to a conventional plant, a gas turbine: lant, or an advanced gas-turbine/steam-turbine plant.

ontract work began in July 1972. Individual unit processes in the high-B.t.u. gasificatio rogram contribute to the low-B.t.u. gas technology. It is possible to accelerate the demo tration phase of the low-B.t.u. gas program without going through a prolonged program. Ho ich acceleration requires a pronounced increase in the level of funding.

his program involves research and development directed toward fluidized-bed, fixed-bed, an ntrained-flow gasifiers. Pilot plant demonstration will be constructed to handle up to 50 coal per hour. The plants will range from 120 to 200 megawatts generating capacity. Eac ill include a gas cleanup system to remove sulfur and particulate matter. In addition deve nt is proceeding on a hot gas cleanup system, operating at gasification temperatures in or o increase efficiency and improve the economy of the processes.

with the high-B.t.u. gasification program, the development of reliable and feasible hardw r plant operation requires investigation of a variety of processes, with the possibility fferent processes will be optimum for different coals.

st of this program was initiated in FY 1973, thus the projects are still in an early stage velopment. However, some significant results have already been obtained, including (a) co on of design of a 1200-pound-per-hour fluidized-bed gasifier; (b) conceptual design of an mospheric pressure, entrained-flow gasifier for a 550 megawatt combined power system; and mpletion of design of a laboratory scale pilot plant for removal of sulfur from fuel gas b ans of a fused salt scrubber system.

FY 1974 the three types of gasifier systems (fluidized-bed, entrained-flow, and fixed-bed ll all be developed further.

ocurement of major hardware items will be initiated. Research on high-temperature sulfur moval systems will be accelerated, and an additional one or two projects in this area wil started.

suming availability of funds in FY 1975 in conjunction with industry funding for these pur e low-B.tu. gasification will move forward at a faster rate, with pilot plant construction beginning in FY 1975-76 capable of converting 50 tons of coal per hour to low-B.tu. gas.

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EARCH AND DEVELOPMENT FACT SHEET (Continued)

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☐ ORIGINALITY
☐ MINIMUM

IDENTIFICATION NUMBER
0604210512830301

ON–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 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.

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Clean Low-B.t.u. Gas

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led pilot/demonstration plants are planned with initial operation estimated for the period, thereby providing a basis for wide commercial application by the early 1980's.

effort for low-B.t.u. clean fuel gas from coal will integrate with research on gas The bulk of the research will be expended by contract, supplemented by work in laboratories. The major efforts will seek to develop low-B.t.u. gasification as an outgrowth of past Departmental programs. A single commercial-size gasifier is producing sufficient low-B.t.u. gas for a 1000-megawatt powerplant, and the gasifier ociated cleanup equipment can be tailored to a conventional plant, a gas turbine, n advanced gas-turbine/steam-turbine plant.

rk began in July 1972. Individual unit processes in the high-B.t.u. gasification tribute to the low-B.t.u. gas technology. It is possible to accelerate the demon- se of the low-B.t.u. gas program without going through a prolonged program. However, ration requires a pronounced increase in the level of funding.

n involves research and development directed toward fluidized-bed, fixed-bed, and ow gasifiers. Pilot plant demonstration will be constructed to handle up to 50 tons hour. The plants will range from 120 to 200 megawatts generating capacity. Each e a gas cleanup system to remove sulfur and particulate matter. In addition develop- ceeding on a hot gas cleanup system, operating at gasification temperatures in order efficiency and improve the economy of the processes.

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of major hardware items will be initiated. Research on high-temperature sulfur ms will be accelerated, and an additional one or two projects in this area will

lability of funds in FY 1975 in conjunction with industry funding for these purposes gasification will move forward at a faster rate, with pilot plant construction FY 1975-76 capable of converting 50 tons of coal per hour to low-B.tu. gas.

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

8. 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		Comp
	FY	Q	FY
(1) Fluidized Bed Low BTU Gasification - Proposal #84 and #90	76	3	77
(2) Fluidized Bed (Pressure and Hydro) Pilot Plant - Proposal #90	75	2	77
(3) Entrained Bed Low BTU Combined Cycle Pilot/Demo - Proposal #108	74	1	77
(4) Fluidized Bed Pressure Pilot/Demo - Proposal #109	74	1	77
(5) Suspension Bed Gasification - Proposal #111	74	2	76
(6) 3 Stage Atmospheric Fluid Bed - Product Dev. Unit - Proposal #86	73	1	74
(7) Synthane Converted to Low BTU - Proposal #85	74	3	75.3
(8) Circular Traveling Grate (Modification) - Proposal #93	74	4	76
(9) Molten Salt Bath Gasifier - Proposal #113	74	4	79
(10) Molten Iron Gasification - Proposal #41	74	3	76
(11) Slurry Firing with Cleanup - Proposal #91	74	4	79
(12) Pressure Bed Stirred Demo - Proposals #85, #92, #110	73	2	75
(13) Entrained Bed - Pilot - Proposals #88, #115, #116, #117	74	1	78
(14) Agglomorating Bed - Demo Plant	75	2	78
(15) High Temp. Gas Cleanup Pilot P. - Dolomite - Proposal #89, #126	73	4	78
(16) High Temp. Gas Cleanup - Demo Plant Fused Salt - Proposal #114, #129			
(17) Low BTU Retrofit of Existing Boilers - Proposal #49, #128 - Demo	75	2	78

Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0604210512830301

b. DATES Start Q	Start FY	Complete FY	Complete Q	a. DEVELOPMENT MILESTONES (continued) (Limit Title of Milestone to 60 characters and spaces)	b. DATES Start FY	Start Q	Complete FY
3	77	2		(18) Exploratory Research - Low BTU Gasification - Proposal #87	72	1	79
2	77	1		(19) Engineering Evaluation - Continuing			
1	77	2		(20) General Process Support Activities	72	2	85
1	77	4					
2	76	1					
1	74	2					
3	75	3					
4	76	1					
4	79	1					
3	76	1					
4	79	1					
2	75	1					
1	78	3					
2	78	3					
4	78	1					
2	78	3					

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 1977 Obls.	(4) FY 1977 Outlays
a. OPERATING *(See p. for detail)* Total Operating Requirements *(from Detail Sheet)*	11.84	10.4	13.37	12.0	16.96	17.5	31.07	30.0
b. CONSTRUCTION *(See p. for detail)* Total Construction Requirements *(from Detail Sheet)*	12.85	12.0	68.0	60.0	122.45	118.0	90.2	96.0
c. EQUIPMENT *(See p. for detail)* Total Equipment Requirements *(from Detail Sheet)*	0.75	0.75	3.05	2.8	19.60	18.0	30.70	27.0
d. GRAND TOTAL—OBLIGATIONS	25.44		84.42		159.01		151.97	
e. GRAND TOTAL—OUTLAYS		23.15		74.8		153.50		153.00

Level of Effort:

☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0604210512830301

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Excl. FY 1974 (Co	
ls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	C
.96	17.5	31.07	30.0	38.27	40.0	34.07	35.0	145.58	144.9	23.20	23.88	168.78	16
..45	118.0	90.2	96.0	38.50	40.0	23.50	40.0	355.5	354.0	15.0	16.5	370.5	37
.60	18.0	30.70	27.0	14.20	18.0	5.40	7.0	73.70	72.80	2.0	2.90	75.70	7
.01		151.97		90.97		62.97		574.78		40.2		614.98	
	153.50		153.00		98.0		82.00		571.7		43.28		6

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

b. CONSTRUCTION

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	(4) FY 19 Obls.
TOTAL *(Carry forward to summary sheet)* ▶		5.0	4.5	20.0	18.0	25.0	24.0	15.0
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is required.								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* Entrained Bed (Pressure)	(3)							
State: — County: — TEC *(in millions)*: 100.0								
Statement: Provides pilot/demonstration scale operation of low BTU gas and gas turbine and steam turgine electric power at 30-50 MWe size in an existing utility.								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* Entrained Bed Atmosphere	(13)	0.1	0.1	1.5	1.2	5.0	5.1	4.0
State: — County: — TEC *(in millions)*: 19.0								
Statement: Provides large scale test at 5 tons per hour of a novel design approach. POU have been successfully operated.								
TITLE OF PROJECT *(Not to exceed characters and spaces.)* Fluidized Bed Press.	(4)	3.5	3.9	9.0	9.3	10.0	10.5	15.0
State: — County: — TEC *(in millions)*: 125.0								
Statement: Pilot/demonstration scale operation of low BTU gas and gas turbine and steam turbine electric power at 30-50 MWe size in an existing utility								

(Continue on Separate

☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0604210512[illegible]0301

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXC FY 1974 IC
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls
5.0	24.0	15.0	18.0	2.0	2.5	-		62.0	62.0	-		62.0
.0	5.1	4.0	4.2	0.5	0.5	-		11.1	11.1	-	-	11.1
.0	10.5	15.0	14.0	20.0	19.0	20.0	17.3	74.0	74.0	15.0	15.0	89.0

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

b. 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	(4) FY 1977 Obls.	(4) FY 1977 Outlays
TOTAL *(Carry forward to summary sheet)* ▶		0.1		1.5		19.0		2.0	
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is required.	Item No.								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* Fluid Bed (Press and Hydro) State: / County: / TEC *(in millions)*: 45.9 Statement: New approach for indicated good economics to be done at pilot scale cost shared 2/3 US/1/3 industry.	(2)								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* Suspension Bed Gasification State: / County: / TEC *(in millions)*: 12.0 Statement: This process produces coke low BTU gas and chemicals. A multi purpose flexible process.	(5)	0.8		5.0		6.0		1.0	
TITLE OF PROJECT *(Not to exceed characters and spaces.)* Slurry Firing with Cleanup State: / County: / TEC *(in millions)*: 32.0 Statement: Indicates an efficient feed system for gasifiers with apparent system simplicity. Can be a major entry for future gasifiers.	(11)	-		2.5		6.5		11.0	

(Continue on Separate Sheet)

Level of Effort

☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER

0604210512830301

(3) 1976	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXC FY 1974 (C	
Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	
	2.0		0.5		-		23.0	23.0	-		23.0	
	1.0		—		-		8.7		-		8.7	
	11.0		1.0		-		21.0		-		21.0	

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

b. 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	(4) FY 1977 Obls.	(4) FY 1977 Outla
TOTAL *(Carry forward to summary sheet)* ▶									
		0.1	0.1	7.0	6.0	12.0	10.0	9.0	12.
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is required.	Item No.								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* Fluidized Bed Atmospheric State: — County: — TEC *(in millions)*: 38.0 Statement: Pilot scale operation of promising gasifier concept at scale size allowing inclusion in major process with assurance	(1)								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* Fused Salt Gasification State: — County: — TEC *(in millions)*: 33.0 Statement: A molten salt (carbonate) bath carries on submerged combustion with pollutants and ash dissolved in salt which is regenerated. Clean gas the product.	(9)	0.5	0.2	8.0	6.3	9.0	8.2	2.0	2.
TITLE OF PROJECT *(Not to exceed characters and spaces.)* Fluid Bed Press and Atmos. State: — County: — TEC *(in millions)*: 38.0 Statement: Pilot scale operation of a promising gasifier concept at scale size allowing later inclusion in major process with assurance	(1)	0.3		7.0		10.0		8.0	

(Continues on Separate Sheet)

☐ MAXIMUM
☒ OBLIGATORY
☐ MINIMUM

0604210512830301

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL PROJECT FY 1975-C...	
...ls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obl.	...
0	10.0	9.0	12.0	0.5	0.5	-		28.6	28.6	-	-	28.6	
0	8.2	2.0	2.6	0.5	0.9	-	-	19.5	19.5	-	-	19.5	
0		8.0		0.5		-		25.5	25.5	-		25.5	

(Continued on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

b. 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	(4) FY 1977 Obls.	(4) FY 1977
TOTAL *(Carry forward to summary sheet)* ▶									
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is required.		0.15		1.0		4.0		6.0	
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* High Temp Gas Clean Up State: — County: — TEC *(in millions)*: 21.5 Statement: Hot dolomite in a reactor vessel scrubs contaminants and particulates from raw hot gas stream at 1500° - 2000°F saving sensible heat of gas pilot scale	Item No. (15)								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* High Temp Gas Cleanup State: — County: — TEC *(in millions)*: 20.5 Statement: A fused salt is used as the receptor. Chemical kinetics are proven but regeneration efficiency to be investigated at pilot scale	(16)	-		0.1		1.2		5.0	
TITLE OF PROJECT *(Not to exceed characters and spaces.)* Engineering evaluation State: — County: — TEC *(in millions)*: 2.3 Statement:	(19)	0.1		0.2	0.2	0.2	0.2	0.2	0.

(Continue on Separate Sh

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

IDENTIFICATION NUMBER: 0604210S12S30301

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXC FY 1974 IC	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	
4.0		6.0		1.0		-		12.0		-		12.0	
1.2		5.0		4.0		1.0		11.3		-		11.3	
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.1	1.1	1.2	1.2	2.3	2.3

(Continue on Separate Sheet)

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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

5. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

b. 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	(4) FY 1977 Obls.	(4) FY 1977 Co
TOTAL *(Carry forward to summary sheet)* ▶									
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is required.		0.3		1.5		7.0		11.0	
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* Agglomerating Bed Gasifier State | County | TEC *(in millions)* 48.0 Statement: Ash generated in the process is circulated and fluidized between two vessels and removed as required. Pilot level.	(Item No. 14)								
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* Synthane Converted to Low BTU State | County | TEC *(in millions)* Statement: Convert the existing high BTU pilot plant to burn air instead of O_2 and to disconnect	(7)								
TITLE OF PROJECT *(Not to exceed characters and spaces.)* Fixed Bed Press. Stirred State | County | TEC *(in millions)* 26.9 Statement: Modification of existing fixed bed gasifier to include a rabble arm which prevents caking of the gasifier bed.	(2)	2,0	2.0	4.3	4.3	5.35	5.35	0.9	0.

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Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
0[illegible]2051285030I

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXC FY 1974 (Co	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	(
.0		11.0		6.0		0.5		26.0	26.0	-		26.0	0.0
.35	5.35	0.9	0.9	0.9	0.9	0.9	0.9	12.35	12.35	-	-	12.35	

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

a. 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 197 Obls.	(4) FY 197 Ou
For each major performing organization, show total equipment funds, with a separate identification of each item of equipment costing one-half million dollars or more. **TOTAL** *(Carry forward to summary sheet)* ▶								
Federal Laboratories	0.25	0.25	1.0	0.9	3.6	3.0	4.0	4
Industry & Academia	0.50	0.50	2.05	1.9	16.0	15.0	26.7	22

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Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0604210512830301

ays	(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 EXCLUD FY 1974 (Cols. 2 & Obls.	(9) TOTAL EXCLUD FY 1974 (Cols. 2 & Outla
	4.0	4.2	4.2	4.2	4.0	4.0	73.7	72.8	2.0	2.9	75.7	75.
	26.7	22.8	10.0	13.8	1.4	3.0						

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

Level of Effort
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

1. IDENTIFICATION NUMBER: 060421051280030I

2. a. PROGRAM	Energy Conversion
b. SUBPROGRAM	Low BTU Gasification from Coal
3. a. PROPONENT AGENCY	Department of Interior NASA, EPA, AEC
b. SUBUNIT	Office of Coal Research

4. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR: Various		
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: TOTAL U.S.		
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.

Generation of low BTU gas from coal that is non polluting and utilizes all grades of coal indigenous to the U.S. This progra provides an alternative to natural gas and petroleum as fuels clean electric power generation at high efficiency (initially over 40% and later into the 50% range) and to meet industrial demand for gas. Both as a fuel and as chemical feedstocks. These accomplishments wil help curb excessive relaince on impo oil and LNG by enabling high-sulfur coals to be used for power generation with due regard to environment. 4 pilot/demonstrat plants plus 1 demonstration/commercial (300 MWe to 500 MWe) are operated prior to 1980.

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 (In man years)	(1) Scientific	240	370	440	440	3
	(2) Technical	800	1100	1300	1500	11
	(3) Support	80	120	150	100	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.)*		600 Tons coal/day	700 tons coal/day	1800 tons coal/day	2500 tons coal/day	4000 coal
c. LAND AREA REQUIRED (In acres)	(1) Govt-owned	1400	4500	8000	8000	80
	(2) Govt-leased	-	-	2000	2000	20
	(3) Privately-owned	150	300	500	500	5
	(4) Other					
d. OTHER						

...HCH & DEVELOPMENT
...CT SHEET

Level of Effort
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

1. IDENTIFICATION NUMBER
060421051280050l

	Energy Conversion
...M	Low BTU Gasification from Coal
AGENCY	Department of Interior NASA, EPA, AEC
	Office of Coal Research

AND SITE			
...characters and ...of contractor; ...reviation for state ...s and spaces for	NAME OF CONTRACTOR: Various		
	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: TOTAL U.S.		
	Site where work will be performed ▶	State:	County:
	NAME OF CONTRACTOR:		
	Site where work will be performed ▶	State:	County:

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lines of text 70 characters ac)

ture and scope ...scribed. ...facilities ...be acquired

Generation of low BTU gas from coal that is non polluting and utilizes all grades of coal indigenous to the U.S. This program provides an alternative to natural gas and petroleum as fuels for clean electric power generation at high efficiency (initially over 40% and later into the 50% range) and to meet industrial demand for gas. Both as a fuel and as chemical feedstocks. These accomplishments wil help curb excessive relaince on imported oil and LNG by enabling high-sulfur coals to be used for power generation with due regard to environment. 4 pilot/demonstration plants plus 1 demonstration/commercial (300 MWe to 500 MWe) are operated prior to 1980.

2

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

7. MAJOR RESOURCE REQUIREMENTS

FISCAL YEAR ▶	1975	1976	1977	1978	1979
Scientific	240	370	440	440	370
Technical	800	1100	1300	1300	1100
Support	80	120	150	100	120
Other					
units of ...h as tons of Kilograms of ...w amount of ...ight.)	600 Tons coal/day	700 tons coal/day	1800 tons coal/day	2500 tons coal/day	4000 tons coal/day
Govt-owned	1400	4500	8000	8000	8000
Govt-leased	-	-	2000	2000	2000
...rivately-owned	150	300	500	500	500
Other					
...CES NEEDED					

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a. PROGRAM	Energy Conversion
b. SUBPROGRAM	Low BTU Gasification from Coal
3. a. PROPONENT AGENCY	Department of Interior NASA, EPA, AEC
b. SUBUNIT	Office of Coal Research

4. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR: Various		
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: TOTAL U.S.		
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.

Generation of low BTU gas from coal that is non polluting and utilizes all grades of coal indigenous to the U.S. This program provides an alternative to natural gas and petroleum as fuels for clean electric power generation at high efficiency (initially over 40% and later into the 50% range) and to meet industrial demand for gas. Both as a fuel and as chemical feedstocks. These accomplishments wil help curb excessive relaince on imported oil and LNG by enabling high-sulfur coals to be used for power generation with due regard to environment. 4 pilot/demonstration plants plus 1 demonstration/commercial (300 MWe to 500 MWe) are operated prior to 1980.

3

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	240	370	440	440	370
	(2) Technical	800	1100	1300	1300	1100
	(3) Support	80	120	150	100	120
	(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.)*		600 Tons coal/day	700 tons coal/day	1800 tons coal/day	2500 tons coal/day	4000 tons coal/day
c. LAND AREA REQUIRED *(In acres)*	(1) Govt-owned	1400	4500	8000	8000	8000
	(2) Govt-leased	-	-	2000	2000	2000
	(3) Privately-owned	150	300	500	500	500
	(4) Other					
OTHER RESOURCES NEEDED *(Specify item and unit of measure below. Show quantity of each in columns at right.)*						
(1)	(1)					

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.

Clean Low-B.t.u. Gas

It is contemplated that R&D for low-B.t.u. gas will be of importance (a) to provide another alternative for clean electric power generation at high efficiency, and (b) to meet industrial demand for gas. These functions are expected to help curb excessive reliance on imported oil and LNG by enabling high-sulfur coals to be used for power generation and other purposes with pollution.

Two co-funded pilot/demonstration plants are planned with initial operation estimated for the FY 1977-78 period, thereby providing a basis for wide commercial application by the early 1980's.

A research effort for low-B.t.u. clean fuel gas from coal will integrate with research on gas turbines. The bulk of the research will be expended by contract, supplemented by work in Government laboratories. The major efforts will seek to develop low-B.t.u. gasification techniques as an outgrowth of past Departmental programs. A single commercial-size gasifier is capable of producing sufficient low-B.t.u. gas for a 1000-megawatt powerplant, and the gasifier and its associated cleanup equipment can be tailored to a conventional plant, a gas turbine, plant, or an advanced gas-turbine/steam-turbine plant.

Contract work began in July 1972. Individual unit processes in the high-B.t.u. gasification program contribute to the low-B.t.u. gas technology. It is possible to accelerate the demonstration phase of the low-B.t.u. gas program without going through a prolonged program. However such acceleration requires a pronounced increase in the level of funding.

This program involves research and development directed toward fluidized-bed, fixed-bed, and entrained-flow gasifers. Pilot plants demonstration will be constructed to handle up to 50 tons of coal per hour. The commercial demonstration plant will range from 300 MWe to 500 MWe generating capacity. The plants will range from 120 to 200 megawatts generating capacity. Each will include a gas cleanup system to remove sulfur and particulate matter. In addition development is proceeding on a hot gas cleanup system, operating at gasification temperatures in order to increase efficiency and improve the economy of the processes.

As with the high-B.t.u. gasification program, the development of reliable and feasible hardware for plant operation requires investigation of a variety of processes, with the possibility that different processes will be optimum for different coals.

Most of this program was initiate in FY 1973, thus the projects are still in an early stage of development. However, some significant results have already been obtained, including (a) completion of design of a 1200-pound-per-hour fluidized-bed gasifier; (b) conceptual design of an atmospheric pressure, entrained-flow gasifer for a 550 megawatt combined power system; and (c) completion of design of a laboratory scale pilot plant for removal of sulfur from fuel gas by means of a fused salt scrubber system.

In FY 1974 the three types of gasifier systems (fluidized-bed, entrained-flow, and fixed-bed) will all be expedited.

ICN - State the specific energy problem or objective, and specify how the proposed work contributes 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 problem for which the project is proposed. Outline the risks/uncertainties to be overcome (R&D, and tasks for proceeding in face of R&D. Quantitative data should be used to the fullest extent.

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In FY 1974 the three types of gasifier systems (fluidized-bed, entrained-flow, and fixed-bed) will all be expedited.

Procurement of major hardware items will be initiated. Research on high-temperature sulfur removal systems will be accelerated, and an additional one or two projects in this area will be started.

Assuming availability of funds in FY 1975 in conjunction with industry funding for these purposes, the low-B.t.u. gasification will move forward at a faster rate, with pilot plant construction beginning in FY 1975-76 capabl- of converting 50 tons of coal per hour to low-B.t.u. gas.

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

B. 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		Compl	
	FY	Q	FY	
(1) Fluidized bed low BTU gasification				
Proposal #84 and # 90	76	3	77	2
(2) Fluidized bed (pressure and hydro) pilot plant proposal #90	75	2	77	
(3) Entrained bed low BTU combined cycle pilot/demo - proposal #108	74	1	77	
(4) Fluidized bed pressure pilot/demo proposal #109	74	1	77	
(5) Suspension bed gasification - proposal #111	74	2	76	1
(6) 3 stage atmospheric fluid bed - product dev. unit proposal #86	73	1	74	2
(7) Synthane converted to low BTU proposal #85	74	3	75	3
(8) Circular traveling grate (modification) proposal #93	74	4	76	1
(9) Molton salt bath gasifier proposal #113	74	4	79	1
(10) Molton iron gasification proposal #41	74	3	76	1
(11) Slurry firing with clean up proposal #91	74	4	79	1
(12) Pressure bed stirred demon proposals #85,#92,#110	73	2	75	1
(13) Entrained bed - pilot, proposals #88,#115,#116,#117	74	1	78	3
(14) Agglomorating bed - demo. plant	75	2	78	3

Level of Effort:
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER:
0504210512S00301

b. DATES				a. DEVELOPMENT MILESTONES (continued) (Limit Title of Milestone to 60 characters and spaces)	b. DATES			
Start		Complete			Start		Co	
FY	Q	FY	Q		FY	Q	FY	
				(15) High temp. gas clean-up pilot P. = Dolante proposal #89, #126	73	4	78	1
	3	77	2	(16) High temp gas clean-up = demo plant fused salt propo-	74	1	78	3
3	2	77	1	sal #114, #129				
4	1	77	2	(17) Low BTU retrofit of existing boilers proposal #49,	75	2	78	3
4	1	77	4	#128 = Demo				
4	2	76	1	(18) Exploratory Research - low BTR gasification proposal #87	72	2	79	1
3	1	74	2	(19) Engineering evaluation - continuing				
4	3	75	3	(20) General process support activities	72	2	85	1
4	4	76	1	(21) Demonstration/commercial combine cycle plant	75	1	79	1
4	4	79	1					
4	3	76	1					
4	4	79	1					
3	2	75	1					
4	1	78	3					
3	2	78	3					

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	(4) FY 1977 Obls.	(4) FY 1977 Outlays
a. OPERATING *(See p. for detail)* Total Operating Requirements *(from Detail Sheet)*	11.84	10.4	25.4	23.0	37.0	35.0	56.0	54.0
b. CONSTRUCTION *(See p. for detail)* Total Construction Requirements *(from Detail Sheet)*	12.85	12.0	92.6	82.0	212.5	200.0	170.0	185.0
c. EQUIPMENT *(See p. for detail)* Total Equipment Requirements *(from Detail Sheet)*	0.75	0.75	7.0	5.0	34.5	32.0	51.0	48.0
d. GRAND TOTAL—OBLIGATIONS	25.44	123.	125.0		284.0		277.0	
e. GRAND TOTAL—OUTLAYS		23.15		110.0		267.0		287.0

Level of Effort:

☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0604210512S00501

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Est FY 1974 (C	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	
7.0	35.0	56.0	54.0	68.0	72.4	41.0	43.0	227.4	227.4	-	-	227.4	227.4
2.5	200.0	170.0	185.0	53.5	59.5	25.5	27.6	554.1	554.1	-	-	554.1	
4.5	32.0	51.0	48.0	19.5	24.0	6.5	9.5	118.5	118.5	-	-	118.5	
1.0		277.0		141.0		73.0		900.0		-	-	900.0	
	267.0		287.0		155.9		80.1		900.0				

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ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

Level of Effort:
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

1. IDENTIFICATION NUMBER
060555051283560l

a. PROGRAM	Conversion Techniques
b. SUBPROGRAM	Gas Turbines
a. PROPONENT AGENCY	AEC, NASA, DOD
b. SUBUNIT	

2. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County: Competitive Bidding
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.

The double thrust of this program is the investigation, design, c and test operate by 1979 a 1500°F helium closed cycle gas turbine at the 275MW(e) capacity using a fossile fired heater for future to a high temperature gas reactor in a direct cycle and to invest: design, construct, and test by 1977 a 2500°F open cycle industria turbine of 100MW(e) capacity as the prime power source burning cl fuels in a combined cycle configuration.

All design aspects of the closed cycle gas turbine and associated components (recuperator, precoolar, heater, valves, etc.,) will b confirmed along with the development of the control system, and th compressor performance will be determined.

For the 2500°F gas turbine, research and development on water cool blades, catalytic combustion, and application of ceramic materials be carried out to produce the most reliable and advanced gas turbi possible.

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 (In man years)	(1) Scientific	166	352	387	194	12
	(2) Technical	104	235	482	678	43
	(3) Support	104	293	579	581	37
	(4) Other	41	293	482	484	31
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.)				3.74×10^5 bbl oil	18×10^5 bbl oil	28 X bbl oil
c. LAND AREA REQUIRED (In acres)	(1) Govt-owned	200				
	(2) Govt-leased					
	(3) Privately-owned					

ARCH & DEVELOPMENT
FACT SHEET

Level of Effort:
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

1. IDENTIFICATION NUMBER
060555051283560l

RAM	Conversion Techniques
	Gas Turbines
T AGENCY	AEC, NASA, DOD

II AND SITE

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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: Competitive Bidding

NAME OF CONTRACTOR:
Site where work will be performed ▶ State: County:

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Site where work will be performed ▶ State: County:

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nature and scope ndertaken, w facilities to be acquired

The double thrust of this program is the investigation, design, construct. and test operate by 1979 a 1500°F helium closed cycle gas turbine system at the 275MW(e) capacity using a fossile fired heater for future joining to a high temperature gas reactor in a direct cycle and to investigate, design, construct, and test by 1977 a 2500°F open cycle industrial gas turbine of 100MW(e) capacity as the prime power source burning clean fuels in a combined cycle configuration.

All design aspects of the closed cycle gas turbine and associated components (recuperator, precooler, heater, valves, etc.,) will be confirmed along with the development of the control system, and the turbin compressor performance will be determined.

For the 2500°F gas turbine, research and development on water cooling of blades, catalytic combustion, and application of ceramic materials will be carried out to produce the most reliable and advanced gas turbine possible.

2

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

7. MAJOR RESOURCE REQUIREMENTS

FISCAL YEAR ▶	1975	1976	1977	1978	1979
) Scientific	166	352	387	194	125
) Technical	104	235	482	678	437
Support	104	293	579	581	374
) Other	41	293	482	484	312
S d units of uch as tons of , Kilograms of ue amount of t right.)			3.74×10^5 bbl oil	18×10^5 bbl oil	28×10^5 bbl oil
) Govt-owned	200				
) Govt-leased					
) Privately-owned					
Other					

BLANK PAGE

NAME OF CONTRACTOR:			
Site where work will be performed ▶	State:	County:	Competitive Bidding
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:	

Spaces for name of contractor, use standard abbreviation for state, up to 16 characters and spaces for 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.

The double thrust of this program is the investigation, design, co and test operate by 1979 a 1500°F helium closed cycle gas turbine at the 275MW(e) capacity using a fossile fired heater for future j to a high temperature gas reactor in a direct cycle and to investi design, construct, and test by 1977 a 2500°F open cycle industrial turbine of 100MW(e) capacity as the prime power source burning cle fuels in a combined cycle configuration.

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For the 2500°F gas turbine, research and development on water cool blades, catalytic combustion, and application of ceramic materials be carried out to produce the most reliable and advanced gas turbi possible.

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	166	352	387	194	125
	(2) Technical	104	235	482	678	437
	(3) Support	104	293	579	581	374
	(4) Other	41	293	482	484	312
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.)*				3.74×10^5 bbl oil	18×10^5 bbl oil	$28 \times$ bbl oil
c. LAND AREA REQUIRED *(In acres)*	(1) Govt-owned	200				
	(2) Govt-leased					
	(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)					

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flow, and fixed-bed) will all be expedited.

...mation for state... ...n and spaces for	NAME OF CONTRACTOR:		
	Site where work will be performed ▶	State:	County: Competitive Bidding
	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:

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lines of text 70 characters ic)

ture and scope lertaken, facilities be acquired

The double thrust of this program is the investigation, design, construct, and test operate by 1979 a 1500°F helium closed cycle gas turbine system at the 275MW(e) capacity using a fossile fired heater for future joining to a high temperature gas reactor in a direct cycle and to investigate, design, construct, and test by 1977 a 2500°F open cycle industrial gas turbine of 100MW(e) capacity as the prime power source burning clean fuels in a combined cycle configuration.

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

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units of ...h as tons of Kilograms of ...w amount of ...right.)			3.74×10^5 bbl oil	18×10^5 bbl oil	28×10^5 bbl oil
Govt-owned	200				
Govt-leased					
Privately-owned					
Other					
CES NEEDED *unit of ...ual quantity ...at right.)*	(1)			4	

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUM
0605550512835601

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.

Several advantages can be realized by combining the closed cycle gas turbine with the temperature gas-cooled reactor (HTGR), and the high temperature open cycle gas turbin exhausting into a heat exchanger which in turn produces steam for a steam turbine. T nuclear gas turbine (1500°F-Helium cooled) is to be pilot demonstrated by 1979 and th high temperature combined cycle is to be demonstrated by 1977 with increased efficien in the mid forties. These gas turbine programs will lower power costs, reduce enviro effects, and support the optimum use of all fuels. Technical development (mat and design) will be required in the areas of gas turbine combusters, and the hot end turbo compressor. This maximum effort will demonstrate the main thrusts at least 2 earlier.

DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUMBER
0605550512835601

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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

8. 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
(1.) Closed Cycle Gas Turbine System				
Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	1	79	4
Technical Support General support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc.	75	2	Cont.	
Component Test Individual testing of main components to determine specific performance of the components in an isolated situation (turbine, compressor, recuperator, precooler, etc.)	76	2	79	2
Component Integration Determination of the interaction between components and the dynamic characteristics of the conversion system.	78	2	78	1
Experimental Facility Demonstration Construct total 275MW(e) power system and put into operation using clean fuel.	79	2	83	4

Level of Effort:
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
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b. DATES Start FY	Start Q	Complete FY	Complete Q	a. DEVELOPMENT MILESTONES (continued) (Limit Title of Milestone to 60 characters and spaces)	b. DATES Start FY	Start Q	Complete FY	Complete Q
				Open Cycle Gas Turbine System				
75	1	79	4	**Theory Design** Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	1	76	
75	2	Cont.		**Technical Support** General, blade cooling, ceramic hot end applications, catalytic combustion, etc.	75	2	Cont.	
76	2	79	2	**Component Test** Individual testing of main components to determine specific performance of the component (gas turbine, heat exchangers, control systems, etc.)	76	1	76	
78	2	78	1	**Component Integration** Determination of the interaction between components and major subsystems of the combined cycle.	76	2	76	
79	2	83	4	**Experimental Facility Demonstration** Full-scale demonstration at the 100MW(e) (prime move) level using clean fuel.	76	2	80	

(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	F Obls.
a. OPERATING *(See p. for detail)* Total Operating Requirements *(from Detail Sheet)*			50		102		154
b. CONSTRUCTION *(See p. for detail)* Total Construction Requirements *(from Detail Sheet)*			15		30		65
c. EQUIPMENT *(See p. for detail)* Total Equipment Requirements *(from Detail Sheet)*			18		88		112
d. GRAND TOTAL—OBLIGATIONS			83		220		331
e. GRAND TOTAL—OUTLAYS				83		220	

Level of Effort:

☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0605550512835601

(3)	(4)		(5)		(6)		(7)		(8)		(9)	
1976	FY 1977		FY 1978		FY 1979		Subtotal FY 1975-79		Balance To Complete		Total Estimate FY 1974 (Cont.)	
Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	154		77		27		410		0		410	
	65		200		190		500		0		500	
	112		55		17		290		0		290	
	331		332		234		1200		0		1200	
220		331		332		234		1200		0		1,20

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. 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
TOTAL *(Carry forward to summary sheet)* ▶	—	—	50		102	
( ) 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						

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Other

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

IDENTIFICATION NUMBER
0605550512835601

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLU FY 1974 (Cols	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	C-
102		154		77		27		410		0		410	

(Continue on Separate Sheet)

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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

b. 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	FY .. Obls.
TOTAL *(Carry forward to summary sheet)* ▶		---	---	15		30		65
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is 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:								

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☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER

0605550512835601

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1974 (Col. 7 + 8)	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
		65		200		190		500		0		500	

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(In millions of dollars)*

c. EQUIPMENT

ITEM *(Each item not to exceed 60 characters and spaces)*		(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	(4) FY 1977 Obls.	(4) FY 1977 Out
For each major performing organization, show total equipment funds, with a separate identification of each item of equipment costing one-half million dollars or more.	TOTAL *(Carry forward to summary sheet)* ▶	---	---	18		88		112	

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Level of Effort:
☒ MAXIMUM
☐ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0605550512835601

(3) 176 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 EXCLUDING FY 1974 (Cols. 7 & 8) Obls.	(9) TOTAL EXCLUDING FY 1974 (Cols. 7 & 8) Outlays
	112		55		17		290		0		290	

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

a. OPERATING

ITEM	(1) FY 1974 (Non-Add)		(2) FY 1975		(3) FY 1976		(4) FY 1[illegible]
	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.
TOTAL *(Carry forward to summary sheet)* ▶	--	--	28.8		34		80
( ) 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							

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Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBE
060550512835603

75	(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EX FY 1974 (
utlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls
	34		80		49		38.2		230		101.2		331.2

(Continue on Separate Sheet)

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ENERGY RESEARCH & DEVELOPMENT

FACT SHEET

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

1. IDENTIFICATION NUMB
0605550512835601

2. a. PROGRAM	Conversion Techniques
b. SUBPROGRAM	Gas Turbine Systems
3. a. PROPONENT AGENCY	NASA/AEC/DOD
b. SUBUNIT	

4. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County: Competitive bidding
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.

The double thrust of this program is the investigation, design, construct, and test operate by 1981 a 1500°F Helium closed gas tur system at the 275MW(e) capacity using a fossile fired heater for f joining to a high temperature gas reactor in a direct cycle and to investigate, design, construct, and test by 1979 a 2500°F open cyc industrial gas turbine of 100MW(e) capacity as the prime power sou burning clean fuels in a combined cycle configuration.

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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	83	112	188	124	75
	(2) Technical	51	75	234	433	263
	(3) Support	51	93	282	371	226
	(4) Other	20	93	234	309	188
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.*)					3.74 X 10^5 bbl oil	7.48 X bbl o:
c. LAND AREA REQUIRED (In acres)	(1) Govt-owned		200			
	(2) Govt-leased					
	(3) Privately-owned					
	(4) Other					
d. OTHER RESOURCES NEEDED (*Specify item and unit of*						

RESEARCH & DEVELOPMENT

FACT SHEET

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

1. IDENTIFICATION NUMBER
0605550512835601

PROGRAM	Conversion Techniques
PROGRAM	Gas Turbine Systems
PONENT AGENCY	NASA/AEC/DOD
UNIT	

CTOR AND SITE

re than 42 characters and name of contractor; dent abbreviation for state characters and spaces for

NAME OF CONTRACTOR:		
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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:
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Site where work will be performed ▶	State:	County:

DESCRIPTION OF AL

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EA	(1) Govt-owned		200			
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	(3) Privately-owned					
	(4) Other					
ESOURCES NEEDED	*and unit of*					

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(No more than 42 characters and spaces for name of contractor; use standard abbreviation for state; up to 16 characters and spaces for county.)			
	NAME OF CONTRACTOR:		
	Site where work will be performed ▶	State:	County: Competitive bidding
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	(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)					

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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort:

- ☐ MAXIMUM
- ☐ ORDERLY
- ☐ MINIMUM

IDENTIFICATION NUMBER

0605550512835601

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.

Several advantages can be realized by combinining the closed cycle gas turbine with the high temperature gas-cooled reactor (HTGR), and the high temperature open cycle gas turbine exhausting into a heat exchanger which in turn produces steam for a steam for a steam turbine. The nuclear gas turbine (1500°F - Helium cooled) is to be pilot demonstrated by 1981 and the high temperature combined cycle is to be demonstrated by 1979 with increased efficiency in the mid forties. These gas turbine programs will lower power costs, reduce environmental effects, and support the optimum use of all fuels. Technical development (material and design) will be required in the areas of gas turbine combusters, and the hot end of the turbo compressor.

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

8. 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	
(1.) **Closed Cycle Gas Turbine System**					
Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	1	79	4	Th
Technical Support General support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc.	75	2	Cont.		Tec
Component Test Individual testing of main components to determine specific performance of the components in an isolated situation (Turbine, compressor, recuperator, precooler, etc.)	77	2	79	2	Com
Component Integration Determination of the interaction between components and the dynamic characteristics of the conversion system.	78	2	79	1	Com
Experimental Facility Demonstration Construct total 275MW(e) power system and put into operation using clean fuel.	82	2	85	4	Exp

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Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER
0605550512835601

DATES Complete FY	DATES Complete Q	a. DEVELOPMENT MILESTONES (continued) (Limit Title of Milestone to 60 characters and spaces)	b DATES Start FY	b DATES Start Q	b DATES Complete FY	b DATES Complete Q
		Open Cycle Gas Turbine System				
79	4	Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	1	76	1
Cont.		Technical Support General, blade cooling, ceramic hot end applications, catalytic combustion, etc.	75	2	Cont.	
79	2	Component Test Individual testing of main components to determine specific performance of the component (gas turbine, heat exchangers, control systems, etc.)	76	1	76	4
79	1	Component Integration Determination of the interaction between components and major subsystems of the combined cycle.	76	3	77	2
85	4	Experimental Facility Demonstration Full-scale demonstration at the 100MW(e) (prime move) level using clean fuel.	78	1	82	4

2

(Continue on separate sheet)

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

5. 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 1977 Obls.	(4) FY 1977 Outlays
a. OPERATING *(See p. 5 for detail)* Total Operating Requirements *(from Detail Sheet)*			28.8		34		80	
b. CONSTRUCTION *(See p. 6 for detail)* Total Construction Requirements *(from Detail Sheet)*			5.0		15		35	
c. EQUIPMENT *(See p. 7 for detail)* Total Equipment Requirements *(from Detail Sheet)*			7.2		21		46	
d. GRAND TOTAL—OBLIGATIONS			41		70		161	
e. GRAND TOTAL—OUTLAYS				41		70		161

NOTE: If [illegible] are proposed, indicate the amount by yea[illegible]

Level of Effort:

☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER

0605550512835601

(3) 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Excluding FY 1974 (Col. 7 & 8)	
	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
		80		49		38.2		230		101.2		331.2	
		35		125		70.0		250		187.6		437.6	
		46		38		32.8		145		86.2		231.2	
		161		212		141		625		375		1000	
	70		161		212		141		625		375		1000

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

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. 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	(4) FY 1[illegible] Obls.	(4) FY 1[illegible] C[illegible]
TOTAL *(Carry forward to summary sheet)* ▶	—	—	28.8		34		80	
( ) 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 Sepa

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

IDENTIFICATION NUMBER: 060550512835601

(3) 1976	(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	Obls.	Outlays
	80		49		38.2		230		101.2		331.2	

(Continue on Separate Sheet)

2

(Specify item and unit of

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. 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	(FY Obls.
TOTAL *(Carry forward to summary sheet)* ▶	—	—	5		15		35
( ) 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 Sepa

OURCES NEEDED and unit of Show quantity					

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

IDENTIFICATION NUMBER: 0605550512835601

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1974 (Cols. 7 & 8)	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
15		35		125		70		250		187.6		437.6	

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

b. CONSTRUCTION

ITEM		(1) FY 1974 (Non-Add)		(2) FY 1975		(3) FY 1976		(4) FY
		Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.
TOTAL *(Carry forward to summary sheet)* ▷		—	—	7.2		21		46
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is 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 Separate

Level of Effort:

☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

IDENTIFICATION NUMBER

0605550512835601

(3) FY 1976		(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUDING FY 1974 (Cols. 7 & 8)	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
		46		38		32.8		145		86.2		231.2	

(Continue on Separate Sheet)

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. 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	(
TOTAL *(Carry forward to summary sheet)* ▶	--	--	28.8		34		
( ) 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

ıued)

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

IDENTIFICATION NUMBER: 060550312833001

ays	(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 1978-79 Obls.	(7) SUBTOTAL FY 1978-79 Outlays	(8) BALANCE TO COMPLETE Obls.	(8) BALANCE TO COMPLETE Outlays	TOTAL E FY 1978 Obls.
	34		80		49		38.2		230		101.2		331.2

(Continue on Separate Sheet)

Page of

2

...FACT SHEET

Level of Effort
( ) Maximum
(X) Orderly
( ) Minimum

1. IDENTIFICATION NUMBER 0605550512S35b01

a. PROGRAM	Conversion Techniques
b. SUBPROGRAM	Gas Turbines
a. PROPONENT AGENCY	AEC, NASA, DOD
b. SUBUNIT	

CONTRACTOR AND SITE

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

NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County: Competitive Bidding
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.

The double thrust of this program is the investigation, design, construct, and test operate by 1984 a 1500°F helium closed cycle gas turbine system at the 275MW(e) capacity using a fossile fired heater for future joining to a high temperature gas reactor in a cycle and to investigate, design, construct, and test by 1981 a 2500°F open cycle industrial gas turbine of 100MW(e) capacity as t prime power source burning clean fuels in a combined cycle config

All design aspects of the closed cycle gas turbine and associated components (recuperator, precooler, heater, valves, etc.,) will be confirmed along with the development of the control system, and th turbine compressor performance will be determined.

For the 2500°F gas turbine, research and development on water coo. of blades, catalytic combustion, and application of ceramic materi will be carried out to produce the most reliable and advanced gas turbine possible.

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 *(In man years)*	(1) Scientific	68	70	77	57	72
	(2) Technical	42	46	96	198	252
	(3) Support	42	57	116	170	216
	(4) Other	18	57	96	142	180
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) Govt-owned					200
	(2) Govt-leased					
	(3) Privately-owned					
	(4) Other					
OTHER RESOURCES NEEDED						

...T & DEVELOPMENT ...T SHEET

[ ] ORIGINAL
[ ] ORDERLY
[ ] MINIMUM

1. IDENTIFICATION NUMBER
060553051283500]

	Conversion Techniques
	Gas Turbines
AGENCY	AEC, NASA, DOD

NDSITE	NAME OF CONTRACTOR:		
haracters and contractor; ation for state and spaces for	Site where work will be performed ▶	State:	County:
	NAME OF CONTRACTOR:		
	Site where work will be performed ▶	State:	County: Competitive Bidding
	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:

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te and scope ...ken, ...acilities be acquired

The double thrust of this program is the investigation, design, construct, and test operate by 1984 a 1500°F helium closed cycle gas turbine system at the 275MW(e) capacity using a fossile fired heater for future joining to a high temperature gas reactor in a direct cycle and to investigate, design, construct, and test by 1981 a 2500°F open cycle industrial gas turbine of 100MW(e) capacity as the prime power source burning clean fuels in a combined cycle configuration.

All design aspects of the closed cycle gas turbine and associated components (recuperator, precooler, heater, valves, etc.,) will be confirmed along with the development of the control system, and the turbine compressor performance will be determined.

For the 2500°F gas turbine, research and development on water cooling of blades, catalytic combustion, and application of ceramic materials will be carried out to produce the most reliable and advanced gas turbine possible.

2

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

7. MAJOR RESOURCE REQUIREMENTS

CAL YEAR ▶	1975	1976	1977	1978	1979
Scientific	68	70	77	57	72
Technical	42	46	96	198	252
Support	42	57	116	170	216
Other	18	57	96	142	180
...nits of ...s tons of ...ograms of amount of ...ght.)					
Govt-owned					200
Govt-leased					
...ately-owned					
Other					
ES NEEDED					

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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:		
	Site where work will be performed ▶	State:	County:
	NAME OF CONTRACTOR:		
	Site where work will be performed ▶	State:	County: Competitive Bidding
	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.

The double thrust of this program is the investigation, design, construct, and test operate by 1984 a 1500°F helium closed cycle gas turbine system at the 275MW(e) capacity using a fossile fired heater for future joining to a high temperature gas reactor in a dir cycle and to investigate, design, construct, and test by 1981 a 2500°F open cycle industrial gas turbine of 100MW(e) capacity as the prime power source burning clean fuels in a combined cycle configura

All design aspects of the closed cycle gas turbine and associated components (recuperator, precooler, heater, valves, etc.,) will be confirmed along with the development of the control system, and the turbine compressor performance will be determined.

For the 2500°F gas turbine, research and development on water cooling of blades, catalytic combustion, and application of ceramic materials will be carried out to produce the most reliable and advanced gas turbine possible.

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 *(In man years)*	(1) Scientific	68	70	77	57	72
	(2) Technical	42	46	96	198	252
	(3) Support	42	57	116	170	216
	(4) Other	18	57	96	142	180
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) Govt-owned					200
	(2) Govt-leased					
	(3) Privately-owned					
	(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)

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

IDENTIFICATION NUM
0605550512835601

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.

Several advantages can be realized by combining the closed cycle gas turbine with the high temperature gas-cooled reactor (HTGR), and the high temperature open cycle gas turbine exhausting into a heat exchanger which in turn produces steam for a steam turbine. The nuclear gas turbine (1500°F-Helium cooled) is to be pilot demonstrated by 1984 and the high temperature combined cycle is to be demonstrated by 1981 with increased efficiency in the mid forties. These gas turbine programs will lower power costs, reduce environmental effects, and support the optimum use of all fuels. Technical development (material and design) will be required in the areas of gas turbine combusters, and the hot end of the turbo compressor. This stretched out minimum effort would delay the demonstration plant startup and would increase the total cost.

RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUMBER
0605550512835601

CATION -State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem ment of 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 ans 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

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

a. DEVELOPMENT MILESTONES *(number each consecutively)*

(Limit Title of Milestone to 60 characters and spaces)

	b. DATES				
	Start		Complete		
	FY	Q	FY	Q	
Closed Cycle Gas Turbine System					
Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	2	79	4	Th
Technical Support General support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc.	75	2	Cont.		Te
Component Test Individual testing of main components to determine specific performance of the components in an isolated situation (turbine, compressor, recuperator, precooler, etc.)	78	2	80	2	Co
Component Integration Determination of the interaction between components and the dynamic characteristics of the conversion system.	79	2	81	2	Co
Experimental Facility Demonstration Construct total 275MW(e) power system and put into operation using clean fuel.	83	1	87	1	Ex

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
0605550512835601

ampleta Q	8. DEVELOPMENT MILESTONES (continued) (Limit Title of Milestone to 60 characters and spaces)	b. DATES Start FY	Start Q	Comp FY	Comp Q
	Open Cycle Gas Turbine System				
4	Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	2	77	2
nt.	Technical Support General, blade cooling, ceramic hot end applications, catalytic combustion, etc.	75	2	Cont.	
2	Component Test Individual testing of main components to determine specific performance of the component (gas turbine, heat exchangers, control systems, etc.)	77	1	77	
2	Component Integration Determination of the interaction between components and major subsystems of the combined cycle.	77	2	79	
1	Experimental Facility Demonstration Full-scale demonstration at the 100MW(e) (prime move) level using clean fuel.	80	1	84	

(Continue on separate sheet)

2

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	(4) FY 1 Obls.	(4) C
a. OPERATING *(See p. 5 for detail)* Total Operating Requirements *(from Detail Sheet)*			24.8		22.4		26.0	
b. CONSTRUCTION *(See p. 6 for detail)* Total Construction Requirements *(from Detail Sheet)*			5.0		10.0		20.0	
c. EQUIPMENT *(See p. 7 for detail)* Total Equipment Requirements *(from Detail Sheet)*			4.2		10.6		20.0	
d. GRAND TOTAL—OBLIGATIONS			34		43		66	
e. GRAND TOTAL—OUTLAYS				34		43		

Level of Effort:

☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER:
060555051283560l

(3)	(4)		(5)		(6)		(7)		(8)		(9)	
1976	FY 1977		FY 1978		FY 1979		Subtotal FY 1975-79		Balance To Complete		Total Est FY 1974 (C	
Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	
	26.0		31.0		45.8		150		371.2		521.2	
	20.0		40		50		125		427.6		552.6	
	20.0		26		39.2		100		326.2		426.2	
	66		97		135		375		1125		1500	
43		66		97		135		375		1125		

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

c. EQUIPMENT

ITEM *(Each item not to exceed 60 characters and spaces)*		(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	FY 1 Obls.
For each major performing organization, show total equipment funds, with a separate identification of each item of equipment costing one-half million dollars or more.	TOTAL *(Carry forward to summary sheet)* ▶	—	—	24.8		22.4		23.0

(Continue on Separat

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
0605550512835601

(3) 976 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 EXCLUDI FY 1974 (Cols. 7 & Obls.	(9) TOTAL EXCLUDI FY 1974 (Cols. 7 & Outla
	26.0		31.0		45.8		150		371.2		521.2	

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(in millions of dollars)*

b. 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)* ▶	---	---	5		10		20

Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is 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 Separ

☒ MAXIMUM
☐ ONLY
☒ MINIMUM

IDENTIFICATION NO.
0605550512835601

(3) 1976 Outlays	(4) FY 1977 Obls.	Outlays	(5) FY 1978 Obls.	Outlays	(6) FY 1979 Obls.	Outlays	(7) SUBTOTAL FY 1975-79 Obls.	Outlays	(8) BALANCE TO COMPLETE Obls.	Outlays	TOTAL FY 1975- Obls.
	20		40		50		125		427.6		552.6

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

c. EQUIPMENT

ITEM *(Each item not to exceed 60 character 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
For each major performing organization, show total equipment funds, with a separate identification of each item of equipment costing one-half million dollars or more. TOTAL *(Carry forward to summary sheet)* >	—	—	4.2		10.6		20.0	

(Continue on Separate Sl

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
0605550512835601

'6	(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) SUBTOTAL FY 1975-79		(8) BALANCE TO COMPLETE		(9) TOTAL EXCLUD FY 1979 (Cols 7 &
ulays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outl
	20.0		26		39.2		100		326.2		426.2	

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

1. IDENTIFICATION NUMBER
060655051255601

2. a. PROGRAM	Energy Conversion R&D
b. SUBPROGRAM	MHD - Power Generation
3. a. PROPONENT AGENCY	Various including OCR, ARC, NBS, NASA
b. SUBUNIT	

4. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR: Various		
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:

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.

1. Open Cycle
   - Component & Materials Development
   - System Analysis & Design
   - Supporting R&D
   - Facilities Design & Construction
     - Large Scale Generator Test Facility
     - Long Endurance Materials Test Facility
   - Construction DEMO Plant (Coal Fired)
2. Liquid Metal
   - Component Development
   - Materials Studies
   - Facilities Design & Construction (1 & 5 MW)
   - Support R&D
   - Prototype Plant
3. Closed Cycle
   - Component Development
   - Feasibility Experiment
   - Support R&D
   - Prototype Plant 50 MW

6. JUSTIFICATION *(Use a seperate 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	109	125	120	91	91
	(2) Technical	125	142	138	104	104
	(3) Support	109 > 390	125 > 445	120 > 425	91 > 325	91 >
	(4) Other	47	53	47	39	39
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.)*		0.2 mill	0.4 mill	0.5 mill	0.2 mill	0.3 m
c. LAND AREA REQUIRED	(1) Govt-owned					
	(2) Govt-leased					

& DEVELOPMENT
HEET

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

1. IDENTIFICATION NUMBER
060655051285560l

Energy Conversion R&D
MHD - Power Generation
NCY Various including OCR, ABC, NBS, NASA

SITE
meters and structor; on for state; d spaces for

NAME OF CONTRACTOR: Various
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:

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and scope ion, ities acquired

1. Open Cycle
   - Component & Materials Development
   - System Analysis & Design
   - Supporting R&D
   - Facilities Design & Construction
     - Large Scale Generator Test Facility
     - Long Endurance Materials Test Facility
   - Construction DEMO Plant (Coal Fired)
2. Liquid Metal
   - Component Development
   - Materials Studies
   - Facilities Design & Construction (1 & 5 MW)
   - Support R&D
   - Prototype Plant
3. Closed Cycle
   - Component Development
   - Feasibility Experiment
   - Support R&D
   - Prototype Plant 50 MW

2

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

7. MAJOR RESOURCE REQUIREMENTS

L YEAR ▶	1975	1976	1977	1978	1979
entific	109	125	120	91	91
chnical	125	142	138	104	104
port	109 > 330	125 > 445	120 > 425	91 > 325	91 > 325
er	47	53	47	39	39
ts of tons of grams of mount of L)	0.2 mill	0.4 mill	0.5 mill	0.2 mill	0.3 mill
t-owned					
t-leased					
tely-owned	0.2 mill	0.4 "	0.5 "	—	—
er					

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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:

5. BRIEF DESCRIPTION OF PROPOSAL

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

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   - Component & Materials Development
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   - Support R&D
   - Prototype Plant
3. Closed Cycle
   - Component Development
   - Feasibility Experiment
   - Support R&D
   - Prototype Plant 50 MW

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

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	(4) Other	47	53	47	39	39
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.)		0.2 mill	0.4 mill	0.5 mill	0.2 mill	0.3 m
c. LAND AREA REQUIRED (In acres)	(1) Govt-owned					
	(2) Govt-leased					
	(3) Privately-owned	0.2 mill	0.4 "	0.5 "	—	—
	(4) Other					
d. OTHER RESOURCES NEEDED (Specify item and unit of measure below. Show quantity of each in columns at right.) (1)	(1)			3		
equipm. + test facilities		4.0 "	21.0 "	30.0 "	4.0 "	2.0 "
travel		0.4 "	0.8 "	1.0 "	0.2 "	0.2 "

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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:

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line)

nature and scope
undertaken,
lew facilities
e to be acquired

1. Open Cycle
   - Component & Materials Development
   - System Analysis & Design
   - Supporting R&D
   - Facilities Design & Construction
     - Large Scale Generator Test Facility
     - Long Endurance Materials Test Facility
   - Construction DEMO Plant (Coal Fired)
2. Liquid Metal
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   - Facilities Design & Construction (1 & 5 MW)
   - Support R&D
   - Prototype Plant
3. Closed Cycle
   - Component Development
   - Feasibility Experiment
   - Support R&D
   - Prototype Plant 50 MW

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

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3) Support	109 > 390	125 > 445	120 > 425	91 > 325	91 > 325
4) Other	47	53	47	39	39
;LS *nd units of such as tons of ', Kilograms of ıow amount of at right.)*	0.2 mill	0.4 mill	0.5 mill	0.2 mill	0.3 mill
1) Govt-owned					
2) Govt-leased					
3) Privately-owned	0.2 mill	0.4 "	0.5 "	—	—
4) Other					
IRCES NEEDED *1 unit of Show quantity as at right.)*	(1)				
ɔst facil-	4.0 "	21.0 "	30.0 "	4.0 "	2.0 "
	0.4 "	0.8 "	1.0 "	0.2 "	0.2 "

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUMBER: 0606550512855601

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.

There are three basic approaches to MHD electrical power generation that are various stages of development in the U.S. and abroad. They are the open cycle Plasma, closed cycle Plasma and the closed cycle Liquid Metal Systems. There exists a substantial degree of commonality in the three MHD concepts; each system however possesses unique characteristics which tend to set it apart in regard to the contribution that it can make to the Nation's energy program. The role of MHD power generation is perhaps appropriately addressed in relation to how successful development of pressing National goals which would (1) reduce air pollution and (2) reduce thermal pollution, (3) develop more economical and reliable power producing systems and (4) conserve our natural resources. All three MHD systems would contribute to the attainment of these goals.

The projected efficiencies of the MHD power systems lie in the 50-65% range. The increased efficiency would reduce the amount of heat rejected per kilowatt by greater th a factor of two. The air pollution is similarly alleviated. These systems offer unique possibilities for the control of particulates and chemical emissions and thus the prospe of considerably lower pollution then from conventional plants.

The high efficiencies that are achievable are very important to the Nation's power economy. Economic studies have shown that potential savings of MHD systems can range bet 11 to 40 Billion dollars in this century alone.

EARCH AND DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUMBER
0606550512855601

ON—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 derived from meeting the objectives or solving the problems for which the project is proposed. Outline the risks/uncertainties o 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

ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

1. IDENTIFICATION NUMBER: 0604210512850301

2. a. PROGRAM	Energy Conversion
b. SUBPROGRAM	Low BTU Gasification from coal
3. a. PROPONENT AGENCY	Department of Interior NASA, EPA, AEC
b. SUBUNIT	Office of coal Research

4. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR: Various		
Site where work will be performed ▶	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County: TOTAL U.S.
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.

Generation of low BTu gas from coal that is non polluting and utilizes all grades of coal indigenous to the U.S. This program provides an alternative to natural gas and petroleum as fuels for clean electric power generation at high efficiency (initially over 90% and later into the 50% range) and to meet industrial demand for gas. Both as a fuel and as chemical feedstocks. These accomplishments will help curb excessive relaiance on imported oil and LNG by enabling high-sulfur coals regard to environment. 1 pilot 10 emonstration plant (30mwe-50MWe) construc and operated 1978-1979.

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	60	110	150	150	150
	(2) Technical	300	450	600	600	600
	(3) Support	20	25	30	30	30
	(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.)*		400 tons cool/dry	500 tons cool/dry	500 tons cool/dry	800 tons cool/dry	800 tons cool/
c. LAND AREA REQUIRED *(In acres)*	(1) Govt owned	1200	2000	2000	2000	2000
	(2) Govt-leased					
	(3) Privately-owned	100	150	150	150	150
	(4) Other					
d. OTHER RESOURCES NEEDED *(Specify item and unit of*						

SEARCH & DEVELOPMENT
FACT SHEET

Level of Effort
☐ MAXIMUM
☐ ORDERLY
☐ MINIMUM

1. IDENTIFICATION NUMBER
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M
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ENT AGENCY
T

Energy Conversion
Low-BTU-Gasification from coal
Department of Interior NASA, EPA, AEC
Office of coal Research

OR AND SITE

NAME OF CONTRACTOR: Various

Site where work will be performed	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed	State:	County: TOTAL U.S.
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

Generation of low BTu gas from coal that is non polluting and utilizes all grades of coal indigenous to the U.S. This program provides an alternative to natural gas and petroleum as fuels for clean electric power generation at high efficiency (initially over 90% and later into the 50% range) and to meet industrial demand for gas. Both as a fuel and as chemical feedstocks. These accomplishments will help curb excessive relaiance on imported oil and LNG by enabling high-sulfur coals regard to environment. 1 pilot 10 emonstration plant (30mwe-50mwe) constructed and operated 1976-1979.

2

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

7. MAJOR RESOURCE REQUIREMENTS

FISCAL YEAR ▶	1975	1976	1977	1978	1979
R (1) Scientific	60	110	150	150	150
(2) Technical	300	450	600	600	600
(3) Support	20	25	30	30	30
(4) Other					
ERIALS	400 tons cool/dry	500 tons cool/dry	500 tons cool/dry	800 tons cool/dry	800 tons cool/day
A (1) Govt owned	1200	2000	2000	2000	2000
(2) Govt-leased					
(3) Privately-owned	100	150	150	150	150
(4) Other					
SOURCES NEEDED					

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3. a. PROPONENT AGENCY	~~Low BTU Gasification from coal~~ Department of Interior NASA, EPA, AEC
b. SUBUNIT	Office of coal Research

4. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR: Various		
Site where work will be performed ▶	State:	County:
NAME OF CONTRACTOR:		
Site where work will be performed ▶	State:	County: TOTAL U.S.
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.

Generation of low BTu gas from coal that is non polluting and utilizes all grades of coal indigenous to the U.S. This program provides an alternative to natural gas and petroleum as fuels for clean electric power generation at high efficiency (initially over 90% and later into the 50% range) and to meet industrial demand for gas. Both as a fuel and as chemical feedstocks. These accomplishments will help curb excessive relaiance on imported oil and LNG by enabling high-sulfur coals regard to environment. 1 pilot 10 emonstration plant (30mwe-50MWe) constructed and operated 1978-1979.

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	60	110	150	150	150
	(2) Technical	300	450	600	600	600
	(3) Support	20	25	30	30	30
	(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.)*		400 tons cool/dry	500 tons cool/dry	500 tons cool/dry	800 tons cool/dry	800 tons cool/day
c. LAND AREA REQUIRED *(In acres)*	(1) Govt-owned	1200	2000	2000	2000	2000
	(2) Govt-leased					
	(3) Privately-owned	100	150	150	150	150
	(4) Other					
d. OTHER RESOURCES NEEDED *(Specify item and unit of measure below. Show quantity of each in columns at right.)* [1]	(1)					

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUMBE
0604210512850301

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.

Clean Low-B.t.u. Gas

It is contemplated that R&D for low-B.t.u. gas will be of importance (a) to provide not alternative for clean electric power generation at high efficiency, and (b) to meet indu demand for gas. These functions are expected to help curb excessive reliance on imported and LNG by enabling high-sulfur coals to be used for power generation and other purposes pollution.

One co-funded pilot/demonstration plant is planned with initial operation estimated for FY 1978 - 79 period, thereby providing a basis for wide commercial application by the la 1980's.

A research effort for low-B.t.u. clean fuel gas from coal will integrate with research o turbines. The bulk of the research will be expanded by contract, supplemented by work in Government laboratories. The major efforts will seek to develop low-B.t.u. gasification techniques as an outgrowth of past Departmental programs. A single commercial-size gas capable of producing sufficient low-B.t.u. gas for a 1000-megawatt powerplant, and the and its associated cleanup equipment can be tailored to a conventional plant, a gas turb plant, or an advanced gas-turbine/steam-turbine plant.

Contract work began in July 1972. Individual unit processes in the high-B.t.u. gasifica program contribute to the low-B.t.u. gas technology. It is possible to accelerate the d stration phase of the low-B.t.u. gas program without going through a prolonged program. such acceleration requires a pronounced increase in the level of funding.

This program involves research and development directed toward entrained-flow gasifiers plant demonstration will be constructed to handle up to 50 tons of coal per hour. The range from 30 to 50 megawatts generating capacity. It will include a gas cleanup syste remove sulfur and particulate matter. In addition development is proceeding on a hot ga system, operating at gasification temperatures in order to increase efficiency and impro economy of the processes.

As with the high-B.t.u. gasification program, the development of reliable and feasible for plant operation requires investigation of a variety of processes, with the possibili different processes will be optimum for different coals.

Most of this program was initiated in FY 1973, thus the projects are still in an early development. However, some significant results have already been obtained, including (tion of design of a 1200-pound-per-hour fluidized-bed gasifier; (b) conceptual design of atmospheric pressure, entrained-flow gasifier for a 550 megawatt combined power system; (c) completion of design of a laboratory scale pilot plant for removal of sulfur from f means of a fused salt scrubber system.

In FY 1974 the three types of gasifier systems (fluidized-bed, entrained-flow, and fixe will all be developed further. But all except entrained flow will be sharply reduced i

ESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUMBER: 060421051285030I

TION- State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem
nt of the objective. Include reasons for selecting the recommended approach over other alternatives. Also include the benefits
be derived from meeting the objectives or solving the problems for which the project is proposed. Outline the risks/uncertainties
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Clean Low-B.t.u. Gas

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- 79 period, thereby providing a basis for wide commercial application by the late

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The bulk of the research will be expanded by contract, supplemented by work in
t laboratories. The major efforts will seek to develop low-B.t.u. gasification
s as an outgrowth of past Departmental programs. A single commercial-size gasifier is
of producing sufficient low-B.t.u. gas for a 1000-megawatt powerplant, and the gasifier
associated cleanup equipment can be tailored to a conventional plant, a gas turbine,
an advanced gas-turbine/steam-turbine plant.

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operating at gasification temperatures in order to increase efficiency and improve the
of the processes.

the high-B.t.u. gasification program, the development of reliable and feasible hardware
t operation requires investigation of a variety of processes, with the possibility that
t processes will be optimum for different coals.

this program was initiated in FY 1973, thus the projects are still in an early stage of
ent. However, some significant results have already been obtained, including (a) comple-
design of a 1200-pound-per-hour fluidized-bed gasifier; (b) conceptual design of an
ric pressure, entrained-flow gasifier for a 550 megawatt combined power system; and
letion of design of a laboratory scale pilot plant for removal of sulfur from fuel gas by
a fused salt scrubber system.

74 the three types of gasifier systems (fluidized-bed, entrained-flow, and fixed-bed)
be developed further. But all except entrained flow will be sharply reduced in 1975.

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

8. 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
(1) Entrained Bed Low BTU Combined Cycle Pilot/Demo - Proposal #108	74	1	77	2
(2) Suspension Bed Gasification - Proposal #111	74	2	76	1
(3) Slurry Firing with Cleanup - Proposal #91	74	4	79	1
(4) Pressure Bed Stirred Demo - Proposals #85, #92, #110	73	2	75	1
(5) Entrained Bed - Pilot, Proposals #88, #115, #116, #117	74	1	78	3
(6) High Temp Gas Cleanup Demo Plant Fused Salt - Proposal #114, #129	74	1	78	3
(7) Exploratory Research - Low BTU Gasification - Proposal #87	72	1	79	1
(8) Engineering Evaluation - Continuing				
(9) General Process Support Activities	72	2	85	2

(Continue to next column)

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
0604210512E60301

b. DATES				a. DEVELOPMENT MILESTONES *(continued)*	b. DATES			
Start		Complete		*(Limit Title of Milestone to 60 characters and spaces)*	Start		Complete	
FY	Q	FY	Q		FY	Q	FY	Q
	1	77	2					
	2	76	1					
	4	79	1					
	2	75	1					
	1	78	3					
	1	78	3					
	1	79	1					
	2	85	2					

(Continue on separate sheet)

Page of

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

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
a. OPERATING *(See p. for detail)* Total Operating Requirements *(from Detail Sheet)*	11.84	10.4	7.0	6.0	14.0	13.0	15.0	14.
b. CONSTRUCTION *(See p. for detail)* Total Construction Requirements *(from Detail Sheet)*	12.85	12.0	13.4	12.0	35.0	34.0	38.0	36.(
c. EQUIPMENT *(See p. for detail)* Total Equipment Requirements *(from Detail Sheet)*	0.75	0.75	1.0	0.8	1.6	1.4	10.0	9.0
d. GRAND TOTAL—OBLIGATIONS	25.44		21.4		50.6		63.0	
e. GRAND TOTAL—OUTLAYS		23.15		18.8		48.4		59.5

Level of Effort:

☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
0604210512850301

ays	(4) FY 1977 Obls.	FY 1977 Outlays	(5) FY 1978 Obls.	FY 1978 Outlays	(6) FY 1979 Obls.	FY 1979 Outlays	(7) Subtotal FY 1975–78 Obls.	Subtotal FY 1975–78 Outlays	(8) Balance To Complete Obls.	Balance To Complete Outlays	(9) Total Excluding FY 1974 (Col. 7 & 8) Obls.	Total Excluding FY 1974 (Col. 7 & 8) Outlays
.0	15.0	14.5	16.0	17.0	15.0	16.0	67.0	66.5	40.0	40.5	107.0	107.0
0	38.0	36.0	39.0	40.0	20.0	21.0	145.4	143.0	55.0	57.4	200.4	200.4
4	10.0	9.0	10.0	9.5	15.0	16.0	37.6	36.9	10.0	10.7	47.6	47.6
	63.0		65.0		50.0		250.0		105.0		355.0	
4		59.5		66.5		53.0		246.4		108.6		355.0

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

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

a. DEVELOPMENT MILESTONES *(number each consecutively)* *(Limit Title of Milestone to 50 characters and spaces)*	b. DATES Start FY	Start Q	Complete FY	Complete Q
Open Cycle				
1. Long Endurance Materials Test Facility Operational	75		80	
2. Large Scale Generator Test Facility Operational with Clean Fuels	75		80	
3. Channel, Magnet & Other Parts Completed for US-USSR Exchange	75		77	
4. Generator Enthalpy Extraction Tests Complete	75		80	
5. Test Facility Modification for Coal	77		80	
6. Coal Fired Tests Complete	79		80	
7. Component Lifetime Tests Completed	77		80	
8. Component Performance Verified	77		80	
9. Evaluation of 50 MW Demo Plant Completed	75		80	
10. Design of 50 MW Demo Plant Completed	77		80	
Liquid Metal				
1. Component Design Established	75	>	80	
2. Simulated 1 MW Power System Completed	75	>	80	
3. Hi-Temp. Test Facility Completed	75	>	80	
4. Component Testing Completed	75	>	80	
5. System Performance Demonstrated	77	>	80	
6. 20 MW Prototype Plant Design Complete	78	>	80	

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Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER: 0606550512855601

b. DATES Start FY	b. DATES Start Q	b. DATES Complete FY	b. DATES Complete Q	a. DEVELOPMENT MILESTONES (continued) (Limit Title of Milestone to 60 characters and spaces)	b. DATES Start FY	b. DATES Start Q	b. DATES Complete FY	b. DATES Complete Q
				Closed Cycle				
		80		1. Component Construction Complete	75		80	
				2. Feasibility Experiment Complete	77		> 80	
		80		3. Design of 50 MW Plant Complete	77		> 80	
		77		4. Proof of Concept	76		> 80	
		80		5. Design of Prototype Plant	77		> 80	
		80						
		80						
		80						
		80						
		80						
		80						
		80						
		80						
		80						
		80						
		80						
		80						

(Continue on separate sheet)

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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 1977 Obls.	(4) FY 1977 Outlays
a. OPERATING *(See p. for detail)* Total Operating Requirements *(from Detail Sheet)*				16.2		19.0		18.5
b. CONSTRUCTION *(See p. for detail)* Total Construction Requirements *(from Detail Sheet)*				3.2		17.1		24.4
c. EQUIPMENT *(See p. for detail)* Total Equipment Requirements *(from Detail Sheet)*				1.0		4.3		6.1
d. GRAND TOTAL—OBLIGATIONS								
e. GRAND TOTAL—OUTLAYS				20.4		40.4		49.0

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

ew. Show quantity

Level of Effort:

- ☐ MAXIMUM
- ☐ ORDERLY
- ☒ MINIMUM

IDENTIFICATION NUMBER

06065505128556O1

(4) FY 1977		(5) FY 1978		(6) FY 1979		(7) Subtotal FY 1975-79		(8) Balance To Complete		(9) Total Excluding FY 1974 (Col. 7 & 8)	
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays
	18.5		13.4		13.5		80.6				
	24.4		3.2		1.6		49.5				
	6.1		0.8		0.4		12.6				
	49.0		17.4		15.5		142.7				

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

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

9. 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	FY Obls.
TOTAL *(Carry forward to summary sheet)* ▶							
[ ] Name of Performing Organization: Various							
MANPOWER				12.0		16.0	
MATERIALS				0.2		0.3	
MAJOR PROCUREMENTS				--		--	
ALL OTHER				0.6		0.6	
TOTAL FOR THIS PERFORMING ORGANIZATION				12.8		16.9	
Open Cycle							
[ ] Name of Performing Organization: Various							
MANPOWER				3.0		1.7	
MATERIALS				0.1		0.1	
MAJOR PROCUREMENTS				--		--	
ALL OTHER				0.3		0.3	
TOTAL FOR THIS PERFORMING ORGANIZATION				3.4		2.1	
Liquid Metal & Closed Cycle							
[ ] 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							

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Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER:
0606550512855601

(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 EXCLUDING FY 1974 (Cols. 7 & 8) Obls.	(9) TOTAL EXCLUDING FY 1974 (Cols. 7 & 8) Outlays
16.0		15.7		9.3		8.4		61.4				
0.3		0.3		0.2		--		1.0				
--		--		--		--		--				
0.6		0.9		0.5		0.4		3.0				
16.9		16.9		10.0		8.8		65.4				
1.7		1.4		3.0		4.1		13.2				
0.1		0.1		0.2		0.3		0.8				
--		--		--		--		--				
0.3		0.1		0.2		0.3		1.2				
2.1		1.6		3.4		4.7		15.2				

(Continue on Separate Sheet)

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS–Federal Government Only *(In millions of dollars)*

b. 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	FY Obls.
TOTAL *(Carry forward to summary sheet)* ▶							
Title of project, Location *(State and County)* and Total Estimated Cost (TEC) *(number each item consecutively)*. Every project costing one million dollars or more should be separately identified with a brief statement of why it is required. Item No. ( )							
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* ( )							
State / County / TEC *(in millions)*							
Statement: This work will be performed under contract or work statement authorized by the lead organization - Open Cycle				2.5		15.1	
TITLE OF PROJECT *(Not to exceed 30 characters and spaces.)* ( )							
State / County / TEC *(In millions)*							
Statement: This work will be performed under contract or work statement authorized by the lead organization - Liquid Metal & Closed Cycle				0.7		2.0	
TITLE OF PROJECT *(Not to exceed characters and spaces.)* ( )							
State / County / TEC *(In millions)*							
Statement:							

(Continue on Separate

Level of Effort:

☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER

0606550512855601

97? 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 EXCLUDING FY 1974 (Cols. 7 & 8) Obls.	(9) TOTAL EXCLUDING FY 1974 (Cols. 7 & 8) Outlays
15.1		22.4		2.4		0.9		43.3				
2.0		2.0		0.8		0.7		6.2				

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

c. EQUIPMENT

ITEM *(Each item not to exceed 60 characters and spaces)*	(1) FY 1974 (Non-Add) Obls.	(1) FY 1974 (Non-Add) Outlays	(2) FY 1975 Obls.	(2) FY 1975 Outlays	(3) FY 1976 Obls.	(3) FY 1976 Outlays	(4) FY 197 Obls.	(4) O
For each major performing organization, show total equipment funds, with a separate identification of each item of equipment costing one-half million dollars or more. TOTAL *(Carry forward to summary sheet)* ▶								
Various - Open Cycle				0.7		4.0		
Various - Liquid + Closed Cycle				0.3		0.3		

(Continue on Separate

Level of Effort:
☐ MAXIMUM
☐ ORDERLY
☒ MINIMUM

IDENTIFICATION NUMBER
0606550512855601

ays	(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 EXCLUDING FY 1974 (Cols. 7 & 8) Obls.	(9) TOTAL EXCLUDING FY 1974 (Cols. 7 & 8) Outlays
.0		5.7		0.6		0.3		11.3				
.3		0.4		0.2		0.1		1.3				

(Continue on Separate Sheet)

Page of

2

ENERGY RESEARCH & DEVELOPMENT
FACT SHEET

Level of Effort:
☐ MAXIMUM
☑ ORDERLY
☐ MINIMUM

1. IDENTIFICATION NO
0606550512S55601

2. a. PROGRAM	Energy Conversion R&D
b. SUBPROGRAM	MHD - Power Generation
3. a. PROPONENT AGENCY	Various including ECR, AEC, NBS, NASA
b. SUBUNIT	

4. CONTRACTOR AND SITE

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

NAME OF CONTRACTOR: Various		
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:

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.

1. Open Cycle
   - Component & Materials Development
   - System Analysis & Design
   - Supporting R&D
   - Facilities Design & Construction
     - Large Scale Generator Test Facility
     - Long Endurance Materials Test Facility
   - Construction DEMO Plant (Coal Fired)
2. Liquid Metal
   - Component Development
   - Materials Studies
   - Facilities Design & Construction (1 & 5 MW)
   - Support R&D
   - Prototype Plant
3. Closed Cycle
   - Component Development
   - Feasibility Experiment
   - Support R&D
   - Prototype Plant 50 MW

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	(1) Scientific	154	182	171	120	116
(In man years)	(2) Technical	176	208	195	138	133
	(3) Support	154 (550)	182 (650)	171 (610)	120 (430)	116
	(4) Other	66	78	73	52	50
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.)*		0.3 mill	0.7 mill	0.4. mill	0.4 mill	0.2
c. LAND AREA	(1) Govt-owned					

:ARCH & DEVELOPMENT
ACT SHEET

Level of Effort:
☐ MAXIMUM
☒ ORDERLY
☐ MINIMUM

MHD

1. IDENTIFICATION NUMBER
0606550512855601

AM	Energy Conversion R&D
	MHD - Power Generation
T AGENCY	Various including CCR, ABC, NBS, NASA

AND SITE			
42 characters and of contractor; reviation for state; ters and spaces for	NAME OF CONTRACTOR: Various		
	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:

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24 lines of text 70 characters line)

nature and scope ndertaken, w facilities to be acquired

1. Open Cycle
   - Component & Materials Development
   - System Analysis & Design
   - Supporting R&D
   - Facilities Design & Construction
     - Large Scale Generator Test Facility
     - Long Endurance Materials Test Facility
   - Construction DEMO Plant (Coal Fired)
2. Liquid Metal
   - Component Development
   - Materials Studies
   - Facilities Design & Construction (1 & 5 MW)
   - Support R&D
   - Prototype Plant
3. Closed Cycle
   - Component Development
   - Feasibility Experiment
   - Support R&D
   - Prototype Plant 50 MW

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

7. MAJOR RESOURCE REQUIREMENTS

FISCAL YEAR ▶	1975	1976	1977	1978	1979
1) Scientific	154	182	171	120	116
2) Technical	176	208	195	138	133
3) Support	154 ~~550~~	182 ~~650~~	171 ~~630~~	120 ~~430~~	116 ~~415~~
4) Other	66	78	73	52	50
LS					
d units of uch as tons of B. Kilograms of ow amount of t right.)	0.3 mill	0.7 mill	0.4. mill	0.4 mill	0.2 mill
) Govt-owned					
) Govt-leased					
Privately-owned	0.4	0.8	0.4	0.4	0.2
Other					

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Use standard abbreviation for state; up to 16 characters and spaces for 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:

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.

1. Open Cycle
   - Component & Materials Development
   - System Analysis & Design
   - Supporting R&D
   - Facilities Design & Construction
     - Large Scale Generator Test Facility
     - Long Endurance Materials Test Facility
   - Construction DEMO Plant (Coal Fired)
2. Liquid Metal
   - Component Development
   - Materials Studies
   - Facilities Design & Construction (1 & 5 MW)
   - Support R&D
   - Prototype Plant
3. Closed Cycle
   - Component Development
   - Feasibility Experiment
   - Support R&D
   - Prototype Plant 50 MW

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 (In man years)	(1) Scientific	154	182	171	120	116
	(2) Technical	176	208	195	138	13
	(3) Support	154 (550)	182 (650)	171 (610)	120 (430)	116
	(4) Other	66	78	73	52	50
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.)		0.3 mill	0.7 mill	0.4. mill	0.4 mill	0.
c. LAND AREA REQUIRED (In acres)	(1) Govt-owned					
	(2) Govt-leased					
	(3) Privately-owned	0.4	0.8	0.4	0.4	0.
	(4) Other					
d. OTHER RESOURCES NEEDED (Specify item and unit of measure below. Show quantity of each in columns at right.)						
(1).	(1)					
equipm. + test facilities		4.5 mill	26.0 "	39.0 "	17.5 "	5.
travel, etc.		0.8 mill	1.0 "	0.9 "	0.7 "	0.

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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:	

1. Open Cycle
   - Component & Materials Development
   - System Analysis & Design
   - Supporting R&D
   - Facilities Design & Construction
     - Large Scale Generator Test Facility
     - Long Endurance Materials Test Facility
   - Construction DEMO Plant (Coal Fired)
2. Liquid Metal
   - Component Development
   - Materials Studies
   - Facilities Design & Construction (1 & 5 MW)
   - Support R&D
   - Prototype Plant
3. Closed Cycle
   - Component Development
   - Feasibility Experiment
   - Support R&D
   - Prototype Plant 50 MW

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

7. MAJOR RESOURCE REQUIREMENTS

YEAR ▶	1975	1976	1977	1978	1979
fic	154	182	171	120	116
cal	176	208	195	138	133
t	154 (550)	182 (650)	171 (610)	120 (430)	116 (415)
	66	78	73	52	50
f ns of ms of nt of	0.3 mill	0.7 mill	0.4. mill	0.4 mill	0.2 mill
wned					
eased					
y-owned	0.4	0.8	0.4	0.4	0.2
EEDED antity it.)					
(1)					
cili-	4.5 mill	26.0 "	39.0 "	17.5 "	5.0 "
	0.8 mill	1.0 "	0.9 "	0.7 "	0.6 "

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort:

- ☐ MAXIMUM
- ☒ ORDERLY
- ☐ MINIMUM

IDENTIFICATION NUMBE

0606550512855601

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.

There are three basic approaches to MHD electrical power generation that are various stages of development in the U.S. and abroad. They are the open cycle Plasma, closed cycle Plasma and the closed cycle Liquid Metal Systems. There exists a substantial degree of commonality in the three MHD concepts; each system however possesses unique characteristics which tend to set it apart in regard to the contribution that it can make to the Nation's energy program. The role of MHD power generation is perhaps appropriately addressed in relation to how successful development of pressing National goals which would (1) reduce air pollution and (2) reduce thermal pollution, (3) develo more economical and reliable power producing systems and (4) conserve our natural resources. All three MHD systems would contribute to the attainment of these goals.

The projected efficiencies of the MHD power systems lie in the 50-65% range. The increased efficiency would reduce the amount of heat rejected per kilowatt by greater than a factor of two. The air pollution is similarly alleviated. These systems offer unique possibilities for the control of particulates and chemical emissions and thus the prospect of considerably lower pollution than from conventional plants.

The high efficiencies that are achievable are very important to the Nation's power economy. Economic studies have shown that potential savings of MHD systems can range between 11 to 40 Billion dollars in this century alone.

AND DEVELOPMENT FACT SHEET (Continued)

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

IDENTIFICATION NUMBER
0606550512855601

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

e three basic approaches to MHD electrical power generation that are of development in the U.S. and abroad. They are the open cycle Plasma, lasma and the closed cycle Liquid Metal Systems. There exists a sub- e of commonality in the three MHD concepts; each system however possesses eristics which tend to set it apart in regard to the contribution that it e Nation's energy program. The role of MHD power generation is perhaps ddressed in relation to how successful development of pressing National uld (1) reduce air pollution and (2) reduce thermal pollution, (3) develop l and reliable power producing systems and (4) conserve our natural . three MHD systems would contribute to the attainment of these goals.

cted efficiencies of the MHD power systems lie in the 50-65% range. The ciency would reduce the amount of heat rejected per kilowatt by greater of two. The air pollution is similarly alleviated. These systems offer ities for the control of particulates and chemical emissions and thus considerably lower pollution than from conventional plants.

efficiencies that are achievable are very important to the Nation's Economic studies have shown that potential savings of MHD systems can l to 40 Billion dollars in this century alone.

2

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

8. 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
(1.) Open Cycle				
1. Long Endurance Materials Test Facility Operational	75		77	
2. Large Scale Generator Test Facility Operational With Clean Fuels	75		77	
3. Channel, Magnet & Other Parts Completed for US-USSR Exchange	75		77	
4. Generator Enthalpy Extraction Tests Complete	75		78	
5. Test Facility Modification for Coal	76		78	
6. Coal Fired Tests Complete	78		79	
7. Component Lifetime Tests Complete	76		79	
8. Component Performance Verified	76		80	
9. Evaluation of System Performance	75		80	
10. Design of 50 MW Demo Plant Complete	75		80	
Liquid Metal				
1. Compound Design Established	75		76	
2. Simulated 1 MW Power System Completed	75		78	
3. Hi-Temp. Test Facility Completed	75		79	
4. Component Testing Completed	75		80	
5. System Performance Demonstrated	76		80	
6. 20 MW Prototype Plant Design Complete	75		80	