APPENDIX A

Detailed Cost Estimates of Waste Energy Recovery Systems*

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

Cost Estimates for Various Solid Waste Dispesal 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
- Cradit 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 Paio Aito 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/ib.
- 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 0 90% utilization)

Capital Cost 1 \$579,370	
Annual Capital Cost (20 yrs, 0 6%) \$ 50,500	
Unit Capital Cost	\$ 0.26/ton
Unit Operating Cost ² Labor \$ 0.32/T Maintenance \$ 0.15/T	\$ 0.47/ton
.Total Unit Cost	\$ 0.73/ton
Unit Income ³	\$ 2.95/ton
Net Income	\$ 2.22/-on
<u>Notes</u>	
 Basic system including magnetic separator, combustible material removal, glass/inert screens, aluminum/metal separator delivered on site. 	2 442 422
	\$ 416,400
Installation and checkout	\$ 110,300
Contingencies @ 10%	\$ 52,670
Total Capital Cost	\$ 579,370
2. Labor (1/shift) 9 \$12,500/Y \$ 50,000/Y Payroll extras 8 25% \$ 12,500/Y	<u>, </u>
Total labor \$62,500/197,000 = \$ 0.32/T	!
Maintenance \$ 30,000/Y \$30,000/197,000 = \$ 0.15/T	<i>r</i>
3. Ferrous 0.5% of "as received" s.w. 0.\$15/ton Aluminum 0.5%" " 0.\$200/ton Glass, sand, etc, 0.15%" " 0.\$370/ton Other metals 0.25%" " 0.\$300/ton	S 1.00 S 0.45
Total Income	\$ 2.95/ton

STEAM GENERATION 600 T/D (197,000 T/Y 0 90 % utilization)

Capital Cost¹

\$12,800,000

Annual Capital Cost (20 yrs 0 6%) \$1,114,000/Y

Unit Capital Cost \$ 5.66/ton

Unit Operating Cost \$ 5.60/ton

Naintenance & Utilities \$ 2.00
Labor \$ 3.60

Total Unit Cost \$11.26/ton

Unit Income for Steam³ \$2.00/ton

Net Disposal Cost

\$ 9.26/ton

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- Chicago N.W. incinerator (1600 T/D) cost \$23,000,000 (corrected to 1/27/72). Using scale up factor of Ω.δ. then (1600/600).6 = 1.8 and (23,000,000)/1.8 = \$12,800,000.
- 2. Operating cost 3 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)1.3 = \$3.50/ton.
- 3. 1 The solid waste yields 1 to 3.5 The steam (2 The average) worth \$1/T. Therefore, 1 ton solid waste produces \$2 worth of steam. This assumes that the steam is sold. At Chicago N.M. 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.

COMBUSTICE OF WASTE AS A FOSSIL FUEL SUBSTITUTE 600 T/D1 (197,000 T/Y 0 90% utilization)

(St. Louis Demonstration Plant)

	Mu	ni	ci,	ali	ty		Utility		
Capital Cost	\$	1,	,710	,00	0 ²		\$995,000 ³		
Annual Capital Cost ⁴	\$		149	,10	0		\$167,800	_	
Unit Capital Cost				ŭ	\$	0.76/T		\$	0.89/T
Unit Operating Cost Labor Naintenance & Utilities			.75 ⁵ .43 ⁷		\$	2.18/T	\$ 0.64 ⁶ \$ 0.14 ^E	\$	0.78/ī
Transportation Cost	-				<u>\$</u>	1.12/79		<u>\$</u>	0.03
Total Cost					\$	4.06/T		\$	1.67/T
Unit Income ¹⁰					<u>\$</u>	0.92/T		· <u>\$</u>	1.67/T
· Net Disposal Cost					\$	3.14/T			0
Unit Income for Material	Ro	ĊĊ	:::::	ij	5	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.
- Solid waste processing subsystem with building \$1,320,000 Storage and transportation loading \$ 268,000 Receiving \$ 122,000 \$ 122,000 \$ 1710,000
- .3. Handling & firing capital equipment including \$ 995,000 solid waste storage & recovery, air-lock feeder valves, pneumatic transport blowers & piping, burners, and control system.
- 4. 20 years, 6% interest for municipality, 20 years, 16% for utility.
- 5. Labor 10 men (4 shifts, 7 day operation) \$ 113,000 \$ 29,500 Total labor \$ 147,500

Unit labor cost (\$147,000/Y)/(197,000/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) = \$ 6.64/TShredding equipment maintenance 0 \$1.00/T = \$ 197,000 Maintenance supplies 9 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) 8. Annual maintenance on handling & firing equipment 3 2% of capital installed cost 20,000 Utilities (100 kw 0 S0.01/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 20% loss on shredding and air classification, only 20% of the incoming waste is transported.
 Cost = (\$0.07)(.80)(20) = \$1.12/T
- 10. Solid waste fuel value estimated at \$0.45/MBtu, 3500* Btu/lb delivered to utility, 203 weight loss on shredding air classification.
 Annual value = (197,000 T/Y)(.89)(2000 1b/T)(3600 Btu/lb) (\$0.45 x 10⁻⁰/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 chamical composition that yield an exhaust gas composition different than for coal. Therefore, effective 8tu value = (4160 8tu/16)(.86) = 3600 8tu/16.

```
POWER GENERATION_FROM COMBUSTION GASES | 6GD T/D (197,000 T/Y
                                          @ 90% utilization)
(CPU-400 with water injection, 3 power modules)
Capital Cost1
                               $6,721,000
   Annual Capital Cost (20 yrs 0 6%)
                                           $586,000
     Unit Capital Cost
                                                      $ 2.98/tcn
     Unit Operating Cost<sup>2</sup>
                                                      $ 4.24/ton
          Maintenance à
          Utilities
                               $ 2.30/T
          Labor
                               $ 1.94/T
     Total Unit Cost
                                                        7.22/ton
     Unit Income for Electricity<sup>3</sup>
                                                       $ 3.89/ton
     Net Disposal Cost
                                                                  $ 3.33/tcm
     Umit Income for Material Recovery
                                                      $ 2.22/ton
     Ret Disposal Cost
                                                                  $ 1.11/tcn
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 3 10%
                                           $ 611,000
     Total
                                           $6,721,000
2.
     Labor - 24 men (4 shifts, 7 day
              operation)
                                              305,000
           Payroll extras @ 25%
                                               76,500
           Total Labor
                                              382,500
     Unit cost (SBS2,500/Y)/(197,000 T/Y)
                                                      $ 1.94/T
     Maintenance
           Gas turbine
                                               90,000
           Hot gas subsystem
                                               40,000
           S.W. subsystem 3 51.00/T
                                              197,000
           Control subsystem
                                               20,000
          Supplies
                                               26,000
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373,000

Total Maintenance

Utilities
Electricity (1000 km 0 \$0.010 km) \$ 79,000
Water (255 lb/min 3 \$0.30/1000 gai) \$ 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 0 3 mm each 9.0 mm Steam turbine generating capacity 3.15 mm 12.15 mm

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

Assume 8 mills/kwh income. Income = (10,920 kw)(24 H/D)(355 D/Y)(\$.008/kwh) = \$766,000/yr Unit income = (\$765,000/Y)/(197,000 T/Y) = \$ 3.89/ton

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POWER CENEDATION FROM CONSUSTION GASES 600 T/D (197,000 T/Y
                                           Q 90% utilization)
 (CPU-400 with sludge disposal, 3 power modules)
. Capital Cost<sup>1</sup>
                                $5,886,000
      Annual Capital Cost (20 yrs 0 6%) $ 600,000
                                                        $ 3.04/ton
      Unit Capital Cost
      Unit Operating Cost<sup>2</sup>
                                                        $ 4.26/ton
            Maintenance &
            Utilities
                                 $ 2.32
            Labor
                                 $ 1.94
       Total Unit Cost
                                                        $ 7.30/ton
      Unit Income<sup>3</sup>
                                                        $ 5.32/ten
       Net Disposal Cost
                                                                   $ 1.98/ton
       Unit Income for Material Recovery
                                                        $ 2.22/ton
       Net Disposal Cost
                                                                  -$0.24/ton
 Notes
       3 power modules 0 1,050,000 each
                                            $3,150,000
       Solid waste processing system
                                            $1,000,000
       Facility
                                            $1,000,000
                                            $ 560,000
       Steam turbine etc., -for waste heat
       Sludge pumps, tanks, etc.
       Organization & startup
                                              400,000
       Contingency @ 10%
                                               626.000
       Total
                                            CCC, 238, 32
  2.
       Labor - 24 man (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 @ S1.00/T
                                               197,000
            Control subsystem
                                                 20,000 -
            Sludge subsystem
                                                 10,000
            Supplies
                                                 26,000
```

383,000

Total Maintenance

 Utilities (1000 kw 0 \$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 0 3 mm each) 9.0 mm
Steam turbine generating capacity 3.15 mm
Total capacity 12.15 mm

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) = \$765,000/Y
Unit income for electricity = (\$766,000/Y)(197,000 T/Y) = \$ 3.89/tc

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,
(020/7)(197,000) = 5630 T/Y sewage sludge solids will be
generated at S50/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 - Gil Production 600 T/D (197,000 T/Y 3 90% utilization)

(Garrett Research - San Diego Demonstration Plant)

Capital Cost¹

\$6,800,000

Annual Capital Cost (20 yrs 0 6%) \$ 592,000

Unit Capital Cost		\$ 3.00/tcn	
Unit Operating Cost ² Haintenance & Utilities	÷ 2 72	\$ 6.74/ton	·
Labor	\$ 3.78 \$ 2. 96	_	
Total Unit Cost		\$ 9.74/ten	
Unit Income ³		\$ 3:16/ton	
Net Disposal Cost	•		\$`6.58/tc
Unit Income for Materia	1 Recovery	\$ 2.22/ton	•
Ret Disposal Cost			\$ 4.36/tc
Unit Income for Sludge	Disposal ⁴	\$ 0.29/ton	
Het Disposal Cost			\$ 4.07/20

Notes

- 2000 T/D plant estimated to cost \$14,000,000. Using scale factor of 0.6, then (2000/800). = 2.06 and \$14,000,000/2.06 = \$5,800,000 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 = \$553,000/Y labor costs including 37 total personnel. This seems reasonable since the process is quite labor intensive. Unit labor cost = \$53,000/197,000 = \$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 x 10° Btu. At S 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 500 T/D plant) or pipeline transport colli about 10.01/minored miles/Mbtu.

Therefore, transporting oil produced in the Mickest to the East Coast will cost about \$.10 to \$.15/\(\text{UStu}\) and would allow the oil to be sold at \$0.25/\(\text{VStu}\). This yields a net credit at the plant of \$0.65-\$0.15 = \$0.70/\(\text{VStu}\) 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 ion of sludge contains about (7000 Btu/lb)(2000 lb/d) = 14 x 10° Btu. With a 50 percent conversion to oil this yields about 7 %3tu/ton. At \$0.60/%5tu this is equivalent to \$4.20/ton of sewage sludge solids. 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 5530 t/y of sewage sludge solids.

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

Assume a cost for dewatering and drying the sludge to 75 percent so...ds 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/grying 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.

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MILESTONE	THRU	F	1975		ŀ	FY 19	75	AV:	¥ 77 -	- 5273	707.17.17.
	FY: 74	1::::	CPER	tor:	127	OPER	TOT	INT	FER	TOT	
THEORY ESTAULISHED	-							:	-		
ECONOMIC VIABILITY FORECASTED											
EXPERIMENT DESIGNED					•	,					
COMPONENT TESTING					-						
DENCH 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

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MILESTONES	SCI.	TECH.	ADM.	LUID ARRA	KATER	TYPE	ÇTAN.	1.05.2	Ī
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HONOMIC VIABILITY FORECASTED						·			
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COMPONENT TESTING			•	-	-		•		
BENCH MODEL						•	·		
LABORATORY EXPERIMENTATION COMPLETED								·	
ENGINEERING DEVELOPMENT	2.0			ni	ni	na		na	
PILOT PLANT				· v			-		
DEMONSTRATION PLANT	4.0		-	nī	กว๋	na		na	
FIRST COMMERCIAL APPLICATION				•					
SUBSEQUENT APPLICATION				·					

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

Development of Urban Waste-Fuel Technologies

	FY-75	FY-76	<u>FY-77</u>	FY-73	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 Corversion of Solid West a

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MILESTONE	THRU	F:	1975	7		Y 197	5	w: n	: ;	FY 0	7.7.:FY173-
	FY 74		oper.	707		SPER	 ;	::::\		707	
THEORY ISTABLISHED			·				·		٠		
ECONOMIC VIABILITY FORECASTED					٠						
EXPERIMENT DESIGNED .											
COMPONENT		-									:
MENCH MODEL COMPLETED	-				-				,		
LABORATORY EXPERIMENTATION COMPLETED				500							500
ENGINEERING DEVELOPMENT	_			300					·	677	2,300
PILOT PLANT							1500				1,560
DEMONSTRATION PLANT			-				:			2667	8,000
FIRST COMMERCIAL APPLICATION									-		
SUBSEQUENT APPLICATION											

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MILESTONES	SCI.	Tyc:.	ייייי	LUID AFFA	WATER	TYPE	द्ध्यः.	IME	Ī
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EXPERIMENT DESIGNED			_						
COMPONENT TESTING						-			
BENCH MODEL					·			2	
IABORATORY EXPERIMENTATIO COMPLETED	0.25		•	n.i.	n.i.				
ENGINEERING DEVELOPMENT	1.0			n.i.	n.i.			·	
PILOT PLATT	.1.0	•		n.i.	n.i.	Suppl:	ed by p	rccess	-
DEMONSTRATION PLANT	2.0			n.i.	n.i.	Suppl:	ed by p	rccess	
PIRST COMMERCIAL APPLICATION	Same	s čemo		n.i.	n.i.	Suppl.	ed by ;	ccess	
SUBSEQUENT APPLICATION .		·				-			·

ENVIRONMENTAL INDACT STATEMENT REQUIRED? Yes FOR WHAT YEARS? 1978

Pyrolysis Conversion of Solid Wastes

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

^{*}Private sector includes support by state and local government.

HAVE BEEN CONTRACTOR OF CLOSE SHOCKS

		•					•		••.		
MILESTONE	THRU	FY	1975			FY 19	ó	41.:	*	. FY -,	777.192175
	FY.74	1:::	OPER	707	liny	OPER	1202	INV	APER_	707	<u> </u>
THEORY ESTABLISHED			·								
ECONOMIC VIABILITY FORECASTED				20	-		50				70
EXPERIMENT DESIGNED		·	,					-	•	•	:
COMPONENT TESTING		-			•					•	P.
BENCH MODEL COMPLETED		-	-			٠	٠		•		
LABORATORY EXPERIMENTATION COMPLETED	300			480			450	•		<i>3</i> 33	1930
engineering Develophent			•			·	500		•	567	2200
PILOT PLANT	·	•			:	·	2000			2677	10,000
- DEMONSTRATION PLANT			Comments	ercial wn u	deno den p	nstra ilot	cion plant	== 25	tpd	plant	=ocule
FIRST COMMERCIAL APPLICATION						·			•		
SUBSEQUENT APPLICATION				•							

	PERSONNEL		1		FUE	LS	0.	
-MILESTONES	SCI.	7::2::.	3.75.	LAND _ATKA	WATER	TYPE	QUAN.	TYPE
THEORY ESTASLISHED					•			
ECONOMIC VIABILITY FORECASTED								
EXPERIMENT DESIGNED	·	-	-					
COMPONENT TESTING					-			
BENCH MODEL - COMPLETED		-						
LABORATORY EXPERIMENTATION COMPLETED	0.5		٠.					
ENGINEERING DEVELOPIENT	2.0							
PILOT PLANT	2.0				obtained from un- treated sewage		polied b) proce
DEMONSTRATION PLANT			S A M	AS P	ILOT	FLAS	-	
FIRST COMMERCIAL APPLICATION			S A M	E AS P	ILOT	FLAX	E	
SUBSEQUENT APPLICATION	0	0	0	n.i.	obtained from un- treated	1	plied	pi broc

ENVIRONMENTAL INPACT STATEMENT REQUIRED? Yes FOR WEAT YEARS? 1977

Biochemical Conversion of Urban Wastes

	•					· · Total
Government	FY-75 500	FY÷76 .	FY-77 8000	<u>FY-78</u> 1500	FY-79 1200	FY-75-79 14200
Private Sector*	-	-	5000	-	-	5000
Total	500	3000	13000.	1500	1200	19200

^{*}Private sector includes funding by state and local government:

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ULPLARY OF FUNDING PEQUIRENERS—Federal Covernment Only (in millions of dollars)

	(1	1)	(2	a) .	t	ņ·	(4)		
•		1974 -Add)	FY 1	975	5 71	1978	·FY	977	
Requirement	Obia.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	
OFERATING (See p. for delett)	0.2	0.5	\$. o	£.0	9.0	9,0	10.0	10.0	
Total Operating Requirements (from Detail Bheet) CONSTRUCTION (See p. for detail)	0			5.0		•			
Total Construction Requirements (from Detail Sheet) EGUIPMENT (See p. for detail)	O	0		3.3		·			
Total Equipment Requirements (from Detail Cheet) GRAND TOTAL—OBLIGATIONS	0,2		14.0		19.0		२।.०		
GRAND TOTAL—OUTLAYS		0.5	-	16.3		20.0	2	<u> २२</u>	

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1978	· FY	1977	FY	978	FY 1979		Subtr FY 19	c:a1 75-73		: 07e:	To Tob! Exc.	
Outlays	Obis.	Outlays	Obis.	Outlays	Chis.	Outlays	Obls.	Outlays	Qb!s.		Ca's.	
•	·				•	•	•		•			
.9,0	10.0	10.0	9.8	9.0	9.7	9.7	46.4	46.9	10.6	10.6	57.0	57.0
*	7											
5.0	5,0	5.0	5:0	5.0	5.0	5:0	25.0	₹5.€	10.0	10.0	35.0	3570
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10	6.0	7,0	7,0	5.0	7.0	3.7	25.0	25.0	15,0	15,0	40.c	4
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1	21.0		18.5		14.7		96.4		45,6		/ <u>3</u> 2,0	
30.0		ત્રસ.લ		19.8	•	18.4		96.4		35.6		:27.5

La. 4 of E " a 7:



			Look entre El normanion	1. HE STEICATION OF 0604010530830303					
2. c. PROGRAM	Energy Conversion		•						
* b. supphogram	Low PPU Gamification From Coal								
2 PHOPONENT AGENCY	Department of Interior, NASA, EPA, AEC								
6. SUBURIT	Office of Scal Research								
4. CONTRACTOR AND SITE (No more than 12 charocters 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:	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:						
	Congration of los	STU GGG YY	om anal that is	non nolluting era ur					

6. 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 electrower generation at high efficiency (initially over 40% and late the 50% range) and to meet industrial demand for gas, both as a as chemicla feed stocks. These accomplishments will help curb a reliance on imported oil and LNG by enabling high-sulfur coals to for power generation with due regard to environment. Two piloty 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. MA	LIOR RESOURCE REC	UIREMENTS :		
RESOURCE	FISCAL YEAR	1975	1976	1977	1978	
. MANPOWER	(1) Scientific	200	300	350	350	
(in man years)	(2) Technical	700	900	1000	1000	
	(3) Support	06	100	100	100	
	(4) Other					
coal, barrels of	and units of , such as tons of oil, Kilograms of Show amount of	600 Tons Coal/Day	700 Tons Coal/Day	1200 Tons Coal/Day	1700 Tons Coal/Day	200: Co:
C LAND AREA	[1] Govt-owned	1200	3500	5000	5000	5
REQUIRED	[2] Govt-leased			1500	1500	1
(in acres)	(3) Privately-owned	100	200	400	FOO .	
	(4) Other	•	Į	i .	i	1

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·		•	i o	•. • y	1, BU THE KAR PERMISER			
	Thmerry Conversion	*1	(1 500.05	ere and	वर्गविद्यास्त्रात्रात्रात्रात्रात्रात्रा			
GBAM	Low FOU Gasties		<u> </u>					
PROGRAM								
PONENT AGENCY	Department of In		M. P.M. A.	<u> </u>				
UniT	1055366 65 3647 E	/ T						
ACTOR AND SITE	NAME OF CONTINCTOR			· · · · · · · · · · · · · · · · · · ·				
than 42 characters and or name of contractor;	pgrlamed	State:	County:)					
or name of contractor. Maid obbicitation for state	NAME OF CONTRACTOR	`}:	3	····				
i characters and spaces fo.		State:	County:		•			
İs	NAME OF CONTRACTOR	7:						
	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	Generation of lo	w biu gas i	rom coal th	hat is	non polluting and utilizes			
TAL	all grades of co	al indigenc	us to the I	۳.S. :	This program provides an			
than 24 lines of text	alternative to natural gas and petroleum as fuels for clean electric							
more than 70 characters					lly over 40% and later into			
•	the 50% range) a	nd to meet	industrial	demand	d for gas, both as a fuel a			
outline nature and scope to be undertaken.	as chemicla feed				ents will help curb excessi			
g any rew facilities	reliance on impor				g high-sulfur coals to be us			
y have to be acquired					ironment. Two pilot/demons			
tracted.	tion plants 30 M	We to 50 MW	e are consi	tructe	d and operated in 1977-78.			
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DATION (Use a separate sheet(s). See liem 6. on instruction Sheet.)

		7. MA	JOR RESOURCE REQ	CIREMENTS :		
E	FISCAL YEAR	1975	1976	1977	1978	1979
WER	(1) Scientific	200	300	350	350	300
rears)	(2) Technical	700	900 .	1000	2000	900
;	(3) Support	05	100	100	100	. 179
elow.	IALS and units of , such as tors of oil, Kilograms of Show amount of x at right.)	600 Tons Coel/Day	700 Tons Cozl/Day	1200 Tons Coal/Day	1700 Tons Coal/Dcy	2000 Tons Coal/Day
	(1) Govt-owned	1200	3500	5000	5000	5000
בם	(2) Gayt-leased			1500	1500	1500
	(3) Privately-owned (100	200	նըն	700	₹00
	(4) Other	•				
2so	URCES NEEDED			•		
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	B. SUPPHOGRAM	phow will Gasafi				
3	. PROPONENT AGENCY	Department of	Interior, NASA	, EPA, AEC		
	6. SUNUTAT	Office of Coal	Research			
4	CONTRACTOR AND SITE	NAME OF CONTRAC	108: Various	•	····	
	(No more than 42 characters as apaces for name of contractor;	Site where work will be performed	Stato:	County:)		
	upaces for name of contractor, or a	MANE OF CONTRAC	TOR:)		
	up to 16 characters and spaces	for Site where work will be	State:	County:)		
	county.	perlo mid				
		NAME OF CONTRAC		1 5000000		
		performed	State:	County:	TOTAL U.S.	
	•	NAME OF CONTRAC	TOR:	}		
		Site where work will be	State:	County:)		
		Performed	-OP-			
		NAME OF CONTRAC		County:		
		parformed	3			· .
E	BRIEF DESCRIPTION OF	Generation of	low BIU gas ire	om coal that i	s non polluting	end uti
	PROPOSAL				This program p	
	(No more than 24 lines of text and no more than 10 character				s fuels for cle	
	end spaces for line)	FOMET PETTER			ally over 40% a	
	Briefly autline nature and scop				nd for gas, bot	
	of work to be undertaken,	. las chemicia le			ments will help	
	including any rew facilities which may have to be acquired				ng high-sulfur	
	or constructed.	ITON DONCE SCHOOL			vironment. Two	
		tion prants 30	NWe to 50 MWe	are construct	ed and operated	in 1977
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	S. JUSTIFICATION (Use a separe	to sheet(s). See Itom 6. on	instruction Sheet.)		ç-	
			Instruction Sheet.) AJOR RESOURCE REO	UIREMENTS :		
	RESOURCE SIGNAL WEAR	7. M.		UIREMENTS :	;- 1978	197
	RESOURCE FISCAL YEAR	7. M	AJOR RESOURCE REO	1977	1978	
	RESOURCE FISCAL YEA	7. M. 1975 -	1976 300	1977 350	1978 350	30
	RESOURCE FISCAL YEAR MANPOWER (11) Scientific (2) Technical	7. M. 1975 - 200 700	1976	1977 350 1000	1978 350 1000	30 90
	RESOURCE FISCAL YEA	7. M. 1975 -	1976 300	1977 350	1978 350	30
7.0	RESOURCE FISCAL YEAR MANPOWER (11 Scientific (2) Technical (3) Support (4) Other	7. M. 1975 - 200 700	1976	1977 350 1000	1978 350 1000	30 90
, 4	RESOURCE V FISCAL YEA MANPOWER (11 Scientific (In man years) (2) Technical (3) Support (4) Other RAW MATERIALS	7. M. 1975 200 700 30	1976 300 900 100	350 1000 100	1978 350 1000 100	30 90 10
, 4	RESOURCE FISCAL YEAR MANPOWER (11 Scientific (2) Technical (3) Support (4) Other	7. M. 1975 200 700 30 600 Tons	1976 300 900 100 700 Tons	1977 350 1000 100	1978 350 1000 100 	30 90 10 2000
7.0	RESOURCE V FISCAL YEA (In man years) (3) Support (4) Other RAW MATERIALS (List materials and units of measure below, such as tors of coal, barrels of oil, Kilograms of	7. M. 1975 200 700 30 600 Tons Coal/Day	1976 300 900 100	350 1000 100	1978 350 1000 100	30 90 10
, 4	RESOURCE V FISCAL YEA (In man years) (2) Technical (3) Support (4) Other RAW MATERIALS (List materials and units of measure below, such as tons of coal, barrels of oil, Kilograms curenium, etc. Show amount of	7. M. 1975 200 700 30 600 Tons Coal/Day	1976 300 900 100 700 Tons	1977 350 1000 100	1978 350 1000 100 	30 90 10 2000
, 4	RESOURCE V FISCAL YEA (In man years) (3) Support (4) Other RAW MATERIALS (List materials and units of measure below, such as tors of coal, barrels of oil, Kilograms of	7. M. 1975 200 700 30 600 Tons Coal/Day	1976 300 900 100 700 Tons	1977 350 1000 100	1978 350 1000 100 	30 90 10 2000
` d	RESOURCE V FISCAL YEA MANPOWER (In man years) (2) Technical (3) Support (4) Other RAW MATERIALS (List materials and units of measure below, such as tons of coal, barrels of oil, Kilograms of wenium, etc. Show amount of each in columns at right.)	7. M. 1975 200 700 30 600 Tons Coal/Day	1976	1977 350 1000 1000 1000 1200 Tons Coal/Day	1978 350 1000 100 100 1700 Tons Coal/Day	30 90 10 2000 Coal
` d	RESOURCE V FISCAL YEA (In man years) (3) Support (4) Other RAW MATERIALS (List materisis and units of measure below, such as tons of coal, barrels of oil, Kilograms e wenium, etc. Show amount of each in columns at right.)	7. M. 1975 200 700 30 600 Tons Coal/Day	1976 300 900 100 700 Tons	1977 350 1000 100	1978 350 1000 100 	30 90 10 2000 Coal
` d	RESOURCE V FISCAL YEA (In man years) (3) Support (4) Other RAW MATERIALS (List materials and units of measure below, such as tons of coal, barrels of oil, Kilograms of unenium, etc. Show amount of each in columns at right.) LAND AREA (1) Gavt-owned	7. M. 1975 200 700 30 600 Tons Coal/Day	1976 300 900 100 700 Tons Coal/Day	1977 350 1000 100 1200 Tons Coal/Day	1978 350 1000 100 100 1700 Tons Coal/Day	30 90 10 2000 Coal

d. OTHER RESOURCES NEEDED

(Specify item and unit of measure below. Show quantity of each in columns at right.)

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IDENTIFICATION NUMBER

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JUSTIFICATION—State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or attributed 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 [B/U], plans to minimize B/U, and basis for proceeding in face of B/U. Quantitative data should be used to the fullest extent.

NAME OF STREET

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 industrement for gas. These functions are expected to help curb excessive reliance on imported on high enabling high-sulfur coals to be used for power generation and other purposes with ollution.

wo co-funded pilot/demonstration plants are planned with initial operation estimated for the 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 gurbines. 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 gasified apable of producing sufficient low-B.t.u. gas for a 1000-megawatt powerplant, and the gasified at the 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. gasification regram contribute to the low-B.t.u. gas technology. It is possible to accelerate the democration phase of the low-B.t.u. gas program without going through a prolonged program. However, the acceleration requires a pronounced increase in the level of funding.

uis program involves research and development directed toward fluidized-bed, fixed-bed, and strained-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 Il include a gas cleanup system to remove sulfur and particulate matter. In addition deve ant is proceeding on a hot gas cleanup system, operating at gasification temperatures in or increase efficiency and improve the economy of the processes.

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

est of this program was initiated in FY 1973, thus the projects are still in an early stage evelopment. 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 expletion of design of a laboratory scale pilot plant for removal of sulfur from fuel gas be eas of a fused salt scrubber system.

FY 1974 the three types of gesifier systems (fluidized-bed, entrained-flow, and fixed-bed 11 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 will started.

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

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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 a derived from meeting the objectives or solving the problems for which the project is proposed. Quitine the risks/uncertainties a minimize B/U, and basis for proceeding in face of B/U. Quantitative data should be used to the fullest extent.



Clean Low-B.t.u. Gas

emplated that R&D for low-B.t.u. gas will be of importance (a) to provide another of for clean electric power generation at high efficiency, and (b) to meet industrial gas. These functions are expected to help curb excessive reliance on imported oil enabling high-sulfur coals to be used for power generation and other purposes without.

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 demonse 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.

I involves research and development directed toward fluidized-bed, fixed-bed, and Low 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 a gas cleanup system to remove sulfur and particulate matter. In addition developmenting on a hot gas cleanup system, operating at gasification temperatures in order efficiency and improve the economy of the processes.

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

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

ie three types of gesifier systems (fluidized-bed, entrained-flow, and fixed-bed) developed further.

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)

Ì	ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)				
	SCHEDULE (Include major facilities and major equipment. Indicate dates by Fiscal Year and Quarter). DEVELOPMENT MILESTONES (number each conneculturity)	† ſ	b. DA	TES	
3		Sta	a	Comp	
3	(Limit Title of Milestone to 60 ch-meters and spaces)	FY	0	FY	
111	Fluidized Bed Low BTU Gasification - Proposal #84 and #90	76	3	77	
MINNE	[3] Fluidized Eed (Pressure and Hydro) Pilot Plant - Proposal #90	75	2	77	
EUSHE.	(3) Entrained Bed Low BTU Combined Cycle Pilot/Demo - Proposal #108	74	1	77	
144	(-) Fluidized Bed Pressure Pilot/Demo - Proposal #109	74	1	77	
7.7.7.7.T) Suspension Bed Gasification - Proposal #111	74	2	76	
WALLEY OF	(6) 3 Stage Atmospheric Fluid Bed - Product Dev. Unit - Proposal #86	73	1	74	
3707.4	(7) Synthene Converted to Low BTU - Proposal #85	74	3	75.	3
	(5) Circular Traveling Grate (Modification) - Proposal #93	7:,	Ţŧ	76	1
	(3) Molton Salt Bath Gesifier - Proposal #113	74	4	79	
1	(13) Molton 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) Entreined Bed - Pilot - Proposals #88, #115, #116, #117	74	ı	78	
	(14) Agglomorating Bed - Demo Plant	75	2	78	
	(15) High Temp. Gas Cleanup Pilot P Dolomite - Proposal #89, #126	73	4	78	
Kings and	(15) High Temp. Gas Cleanup - Demo Plant Fused Salt - Proposal #114, #129 *				
音がはあれることというと	(17) Low BTU Retrofit of Existing Boilers - Proposal #49, #128 - Deno	75	2	78	
			-		
	-				

Level of Effort: ☐ MAXIMUM ☐ MAXIMUM IDENTIFICATION NUMBER ☐ MIN!MUM : b. DATES n. DEVELOPMENT MILESTONES (continued) b DATES Complete Com Start (Limit Tille of Milestone to 60 characters and spaces) FY Q Q FY | C i. FY (18)Exploratory Research - Low BTU Gasification -Proposal #87 (19) Engineering Evaluation - Continuing (20) General Process Support Activities 75.3



ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

	(1	i) 1974 - ¹	(2 1	5) .	(3	3)	(4)	
Par tionner	(Non-	-Add)	FY			976	FY 1	
Requirement	Obls.	Outlays	Oble	Outlays	Obls.	Outlays	Obls.	Outlays
·					1			
a. OPERATING (Sec. p. for detail)	11.84	10.4	13.37	12.0	16.96	17.5	31.07	30.0
a. OPERATING (See p. for detail) Total Operating Requirements (from Detail Sheet)						-		
	12.85	12.0	68.0	60.0	122.4	118.0	90.2	96.0
b. CONSTRUCTION (See p. for detail) Total Construction Requirements (from Detail Sheet)	<u> </u>							
c. EQUIPMENT (See p. for detail)	0.75	0.7	3.05	2,8	19.60	18.0	30.70	27.0
Total Equipment Requirements (from Detail Sheet)								
d. Grand Total-Obligations	25.44		84.42		159.0		151.9	<u>}</u>
e. GRAND TOTAL-OUTLAYS		23.1		74.8		153.5		153.00

Level of Effort:

☐ MAXIMUM

ORDERLY

☐ MINIMUM

IDENTIFICATION NUMBER 0604210512830301

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. (3	3)	. {4	1)	. (:	5)	- {1	5)	. (7		_	3}	- (5	
FY	1976	FY	‡977 [°]	FY	1978	FY	1979	Subt	otal 175 -79	Balan Con	ce To	Total E	
is.	Outlays	Obis.	Outlays	Obls.	Outlays	Obls.	Outlays	Obis.	Outlays	Obis.	Outlays	O5:2.	0
÷			-		. •		•			•			
.96	17.5	31.07	30.0	38.27	40.0	34.07	35.0	145.58	144.9	23.20	23.88	168.73	16 .75
3							• .		•	-			
45	118.0	90.2	96-0	38 .5 0	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	<u>.</u>
			•					-					
.02		151.9		90.97		62.97	٠.	574.78		40.2		614.08	
				-	•						1		•
•	153.50		153.00		98.0		82.00	-	571.7	•	43.28		É
			•.		·		• •		·			!	



ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

b. CONSTRUCTION

b. CONSTRUCTION									
			1)	(:	2)	{3	1)	(4)	į
			1974 -Add)	FY	1975	FY i	376	FY 1	٤
ITEM		Obls.	Outlays	O5Is.	Outlays	Ob!s.	Outleys	Obls.	•
	TOTAL (Carry forward to summary sheet)	5.0	4.5	20.0	18.0	25.0	24.0	15.0	•
te of project, Location (State and County) are SC (number each item consecutively). Every hondollars or more should be separately idented to support of why it is required. Title of PROJECT (Not to exceed 30 characteristics) State County Statement: Provides pilot/demonstrate operation of low ETU gas turbine and steam turgine power at 30-50 MJe size is existing utility. Title of PROJECT (Not to exceed 30 characteristics) Entrained Bei Atmosphere State County	rectors and spaces.) TEC (in millions) electric and gas electric and spaces.) TEC (in millions)	em lo.	0.1	1.5	1.2	5,0	5-1	4.0	
Statement: Provides large scale test per hour of a novel desig POU have been successful:	gn approach. ly operated.	h) 3 5	200			10.0	20.5		
Fluidized Bed Press. State County Statement: Pilot/demonstration scal of low BTU gas and gas to steam turbine electric pto 50 MWe size in an existical statement of the statement of the brutant of th	125.0 e operation urbine and over at 30-	4) 3.5	3.9	9.0	9.3	10.0	10.5	15.0	

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		•							AXIMUM	JM		Electro (app. 11)	٠.
-		•							RDERLY	060	4210513	870301	
{3	2)		4 1		-1	-		□ Mi	INIMUM				
	s) 1976		4) 1977		5) 1978		5) 1979 - (u SUB	7) TOTAL	BALA	8) NCE TO	I TOTAL E	
)bis.	Outlays	Obls.	Cutlays	Obis.	Outlays	i	Outlays	H	975-79 Outlays	COMI Obis.	Cuttays	FY 1974 (Obis	Ç. İ
-			 			00%.	Odtrays			0015.	Outrays	 	
5.0	24.0	15.0	18.0	2.0	2.5	-		62.0	62.0	-		62.0	1 2.0
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(Continue on Separate Sheet)

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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

9. DETAIL OF FUNDING REQUIREMENTS-Fedoral Government Only (in pullions of dollars)

b. CONSTRUCTION

b. CONSTRUC	MOIT	· · · · ·	•							
			(1		{:	2)	(3)	(4)	<u>.</u>
			(Non-	1974 -Add)	FY	1975	FY 1	976	FY 19	77
	ITEM		Obls.	Outlays	Obis.	Outlays	Obis	Outlays	Obls.	Di
······································		TOTAL (Carry forward	-							
		to summary sheet)	0.1		1.5		19.0		2.0	
EC) Inumber con than declars or in the control of why in TITLE OF PAG State State State Assembly Lew approx to be done	th Item consecutively). Expose should be separately it is required. DIECT (Aut to exceed 30 (Press and Hydrocounty)	identified with a brief No. (2) Characters and spaces.) (2) TEC (in millions) 15.9 ed good economics							·	
Statement: This proc	OJECT (No: to exceed 30 n Bed Gasificat: County ess produces columns and the columns are columns and the columns and the columns and the columns are columns and the columns and the columns are columns and the columns and the columns are columns and the columns are columns and the columns are columns and the columns are columns and the columns are columns and the columns are columns and the columns are columns and the columns are columns and the columns are columns and the columns are columns and the columns are columns	TEC (in millions)	0.8		5.0		6:0		1.0	
process.									·	
	DIECT (Not to exceed che ring with Clean			1	1 -	1		ĺ		
State State	County	TEC (in millions)	·-		2.5		6.5		11.0	
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Statement: Indicates	an efficient f	eed system for				}	İ			
gasifiers	with apparent in be a major en	system simpli-								
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1976		FY 1	977	FY	1978	FY	1979	SUBT FY 19	OTAL 175-79	BALAN COMF		TOTAL E	.c
Ou	tlays	Obis	Outleys	Obls.	Outlays	Obls.	Outlays	Obls.	Outloys	Obls.	Outlays	Cols.	<u>, . , ,</u>
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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

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	CTION			-	1) 1974		2)	() ())) 1976 ((4 ~ •) 977 •
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	ITEM			Obis,	Gutlays	Obls.	Outlays	Obls.	Outlays	Oble.	Outle
	,	TOTAL (Carry for					i	ļ			
e of project. L	ocation (State and Cour	•			 						
C) inumber e	ich Hem conscusively).	Svery project costing t	סרי	0.1	0.1	7.0	140	12.0	10.0	9.0	12.
ement of why	mare should be separate it is required.	•	No	}	0.1	/.0	0.0	12.0	10.0	3.0	
TITLE OF PR	EDJECT (Not to exceed ted Bed Atmosph	30 characters and space	년(1)			1	•	}	}		1
State	County	TEC (in millione	7			ļ	l		1		
		38.0	_		}	}	}		}	}	1.
Statement:			1		1	1	1		1	1	
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TITLE OF P	ROJECT (Not to exceed	30 characters and space	12/01	0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
Fused :	ROJECT (Not to exceed Salt Gasificati	lon		0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
Fused State	ROJECT (Not to exceed Salt Gasificati County	TEC (in million		0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
Fused :	Salt Gasificati County	lon		0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
State Statement: A molt	County on salt (carbon	TEC (in million 33.0		0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
State Statement: A molt carrie	on salt (carbons on submerged	TEC (in million 33.0 nate) bath combustion		0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
State Statement: A molt carries with pe	on salt (carbons on submerged ollutants and a	TEC (in million 33.0 nate) bath combustion ash dissolved		0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
State State State A molt corrie with prin sal	on salt (carbons on submerged ollutants and a twhich is rege	TEC (in million 33.0 nate) bath combustion ash dissolved		0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
State State State A molt corrie with prin sal	on salt (carbons on submerged ollutants and a	TEC (in million 33.0 nate) bath combustion ash dissolved		0.5	0.2	8.0	6.3	9.0	8.2	2.0	2
State State Statement: A molt corrie: with pein saligas the	on salt (carbons on submerged ollutants and a twhich is reger	nate) bath combustion ash dissolved encrated. Clea	ın		0.2		6.3				
State State Statement: A molt corrie: with pein saligas the	on salt (carbons on submerged ollutants and a twhich is rege	nate) bath combustion ash dissolved encrated. Clea	ın	0.5	0.2	8.0 7.0	6.3	9.0		8.0	
State State Statement: A molt corrie: with pein saligas the	on salt (carbons on submerged ollutants and a twhich is reger	TEC (in million 33.0 ante) bath combustion ash dissolved enerated. Clear and spaces.) Atmos.	un (1		0.2		6.3				
State State State State A molt corrie with poin sali gas the Title OF Fluid State	on salt (carbons on submerged ollutants and a which is regarded product.	TEC (in million 33.0 arte) bath combustion ash dissolved enerated. Clean throat characters and spaces.)	un (1		0.2		6.3				2
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Statement: A molt corrie with poin saligns the Fluid State Statement: Pilot	on salt (carbons on submerged ollutants and at which is regulated from the product. Solled Frees and a county scale operatio	TEC (in million 33.0 and e) bath combustion ash dissolved enerated. Clear Atmos. TEC (in million 38.0 and spaces.)	in (1		0.2		6.3				
Statement: A molt corrie with poin saligns the Fluid State Statement: Pilot gasifi	on salt (carbons on submerged ollutants and at which is region product. Soller (Not to exceed bed Press and a county)	TEC (in million 33.0 and e) bath combustion ash dissolved encrated. Clear Atmos. TEC (in million 38.0 and spaces.) Atmos.	in (1		0.2		6.3				
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Statement: A molt corrie: with poin saligas the fittle of Fluid State Statement: Pilot gasifi ing la	on salt (carbons on submerged ollutants and at which is region product. Soller (Not to exceed bed Press and a county)	TEC (in million 33.0 and e) bath combustion ash dissolved encrated. Clear Atmos. TEC (in million 38.0 and spaces.) Atmos.	in (1		0.2		6.3				

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Ϋ́	1976	FY	1977	FY	1978	FY	1979	SUB FY 1	70TAL 975-7 9	BALA	HCE TO	FY 1752	activity of the Care
ık.	Gutlays	Obk.	Outlays	Obls.	Outless	Obls.	Outleys	Obls.	Oetlays	0512	Outbys	Only.	•
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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

S. DETAIL OF FUNDING REQUIREMENTS-Federal Government Only (In multions of dollars)

b. CONSTRUCTION

or mannamilans		(1	3	(2	3	æ	<u> </u>	(4)	
	ł		1974	PY 1		FY 1	_	FY 19	•
ITEM		Corr	Outlays	Cok	Outins	Obls.	Outlans	Oble	- '
TOTAL (Corr. to sommery al	-								
Tate of project. Location (State and County) and Total Estim (TEC) (number each liem consecutively). Every project costs maken 62 has no more should be populately identified with a spacetry of why it is required. Title, or project (North mesered 20 characters and op light Temp Gas Clean Up State County Tec (in mills 21.5 Statement: 1802 dolonite in a reactor vessel scrubs contaminants and particular from raw hot gas stream at 18000 2000°F saving sensible heat of gas pilot scale	organa brief lam No. GC1 iona)	0.15		1.0		4.0		-	
Statement: A fused salt is used as the receipt Chemical kinetics are proven but regeneration efficiency to be investigated at pilot scale	ptor.	-		0.1		1:2		5.0	
TITLE CONTINUE TO COUNTY THE FAMORIES and specific EVALUATION State County TEC (in mile 2.3) Statement:		0.1		0.2	0.2	0.2	0.2	0.2	0.

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FY 1		FY			1978	FY		SUBT	OTAL 075-79	BALAS	CE TO	TOTAL T	xτ.
,	Oziays		Outlays	Obls.	Quilays	2/40	Outlays		Outlays	Obis.	Outlays	Obis.	i .
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	1 COSTAGE	4 in 9chi	rde Sheet)							•	- -	•	

ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

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b. CONSTRUCTION									
		(1	-	(2	2)	(3)	(4)	
		FY 1		FY 1	975	FY 1	976	FY 1	977
ITEM	•	Obls.	Outbys	Obis,	Outlays	Obls.	Outlays	Obls.	C=
	OTAL (Carry forward summary sheet)								
Statement: Ash generated in the proce	roject costing one ified with a brief No. No. Stere and spaces.) 14 [EC (in millione) 48.0 PSS 15 Detween			1.5	,	7.0		11.0	
THE OF PROJECT (Not to exerced 30 chain Synthene Converted to Low county	actors and spaces.) [1							
Statement: Convert the existing high pilot plant to burn air in and to disconnect	nstead of O		-						
Fixed Bed Press. Stirred	1.4	2,0	2.0	4.3	4.3	5.3	5 5.3	0.9	0.
State County	TEC (in millione) 26.9	İ			1			1	
Statement: Modification of existing gasifier to include a rab which prevents caking of gasifier bed.	ble arm								

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								Level of Effort: MAXIMUM		117	ENTIFICA	TEICATION NUMBER	
								□ m	MUMIXA				
								= -	DERLY	00	110 <u>5128</u>	30301	
(3)	{/	1)	(5)	(6	5)	_	raimum 7)	e	S)	į	9)
FY 1	976	FY	977		1978		1979		OTAL 975-79	BALA	CE TO	TOTAL E	
abs.	Outleys	.aldO	Outlays	Obls.	Outleys	Obls.	Outlays	Obis.	Outlays	Obls.	Outlays	Obis.	٠٠. ا ر
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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Cominued)

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

		{1		. (2			(3).		(4)
ITEM		FY 1	1974 Add)	FY 1	975	FY	:976	FY	197
(Each (tem not to exceed 60 characters	and spaces)	Obls.	Outlays	Obls.	Outlays	Obls.	Outleys	Obls	OL
shaw total equipment funds, with a separate a identification of each item of equipment	OTAL (Carry forward to summery sheet) .								
costing one-half million dollars or more.						1			}
Federal Laboratories		0.25	0.25	5 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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☐ MAXIMUM ORDERLY 0604210512830301 ☐ MINIMUM (4) (5) (8) (6) **{7**} (9) SUBTOTAL FY 1975-79 BALANCE TO COMPLETE TOTAL EXCLUD FY 1974 (Cols. 7 & FY 1977 FY 1978 FY 1979 Objs Outlays Outlays Obls. Obis. Outlays Dutlays Outlays Obis. Obls. Obls. Outla 4.2 4.0 4,2 4,2 4.0 4.0 73.7 72.8 2.0 2.9 75,7 . 75. 26.7 10.0 13.8 22.8 1.4 3.0

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Level of Effort:

IDENTIFICATION NUMBER :

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of

ENERGY RESERVICES A DEVELOPMENT FACT SHEET

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[3]	MAXIMUM
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1.	IDENTIF	CATION	NL

	·		☐ MINIMUM	0604210512800301			
2. s. PHOGHAM	Energy Conversion						
b. SUBPROGRAM	Low BTU Gasificati	on from C	oal	• •			
3. Y. PHOPOMENT AGENCY	Department of Into						
L SUBUNIT	Office of Coal Res	earch					
L CONTRACTOR AND SITE	NAME OF CONTRACTOR:	Various					
(No mare than 42 characters and spaces for name of contractor; use standard authorization for state; up to 16 characters and spaces for country.	Site where work will be- performed	State:	County:				
	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 end 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 prograp 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 imposoil 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. 1	MAJOR RESOURCE REC	DUIREMENTS		
RESOURCE	FISCAL YEAR	1975	1976	1977	1978	19
. MANPOWER	(1) Scientific	240	370	440	440	
	[2] Technical	800	1100	1300	1500	110
	(3) Support	80	120	150	100	<u> </u>
	(4) Other				1	
esal. borrels of	and units of , such as tons of ail. Kilograms of Show amount of	600 Tons coal/day	700 tons coal/day	1800 tons coal/day	2500 tons coal/day	4000 coai,
REQUIRED		1400	4500	8000	8000	801
	(2) Govt-leased		-	2000	2000	20
(in Geres)	(3) Privately-owned	150	300	500	500	
	(4) Other				300	

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CT SHEET

Level of Litter

MUMIXAM [3 ORDERLY

1. IDENTIFICATION NUMBER 0604210512800501

			☐ MINIMUM	0604210512800301	_		
	Energy Conversion			·	_		
189	Low BTU Casificati	on from Co	al	•	_		
AGENCY	Pepartment of Inte	rior MASA.	EPA. AEC		_		
	Office of Coal Res	earch			_		
ANDSITE	NAME OF CONTHACTOR:	Various			_		
characters and		Stata:	County:		_		
	NAME OF CONTRACTOR:				_		
re and space for	Site where work will be performed	State:	County:		_		
	NAME OF CONTRACTOR:						
	Site where work will be performed	State:	County:		_		
	NAME OF CONTRACTOR:		TOT	AL U.S.	_		
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	NAME OF CONTRACTOR:						
	Site where work will be performed	State:	County:		_		

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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 stabling high-sulfur coals to be used for power generation with the regard to environment. 4 pilot/demonstration plants plus I demonstration/commercial (300 MWe to 500 MWe) are operated prior to 1980.

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

7. MAJOR RESOURCE REQUIREMENTS								
SCAL YEAR	1975	1976	1977	1978	1979			
Scientific	240	370	440	440	370			
Technical	800	1100	1300	1300	1100			
Support	30	120	150	100	120			
Other								
units of th at tans of Kilograms of w amount of inght.)	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			
Gout-leased		-	2000	2000	2000			
Trivately-owned	150	300	500	_500	500			
Other								
CES NEEDED					1			

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PRO Shelff	Energy Conversion						
b, SUIPROGRAM	Low Bill Gasification	on from Coa	• •				
1 PROPORENT AGENCY	Department of Inter	rior NASA.					
b. SUBUNIT	Office of Coal Rese	fice of Coal Research					
1. CONTRACTOR AND SITE	NAME OF CONTRACTOR: 1	aricus					
(No more than 42 characters and spaces for name of contractor;		State:	County:				
use standard abbreviation for state	NAME OF CONTRACTOR:						
up to 16 characters and space for county.	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	Generation of low	BTU gas fr	om coal that is non polluting and				

(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 will 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 NWe to 500 NWe) are operated prior to 1980.



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

		_	7	MAJOR RESOURCE REC	DUIREMENTS		•
ı	RESOURCE	FISCAL YEAR		1976	1977	1978	1979
	MANPOWER	(1) Scientific	240	370	440	440	370
	(In man years)	(2) Technical	800	1100	1300	1300	1100
		(3) Support	80	120	150	100 .	120
		(4) Other					121
	ecal, barrels of Monium, etc. S toch in column	and units of such as tons of oil. Kilograms of Sliow amount of	600 Tons ccal/day	700 tons . coal/day	1800 tons coal/day	2500 tons coal/day	4000 tons coal/day
	LAND AREA REQUIRED	(1) Govt-owned	1400	4500	8000	8000	8000
	-	(2) Govt-leased			2000	2000	2000
•	-	(3) Privately-owned (4) Other	150	300	500	500	500
		URCES NEEDED					
	(Specify Hem a	nd unit of Show quantity	(1)			-	

ENTRGY RESEARCH AND DEVELOPMENT	FACT	SHEET	(Continued)
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(2) maximum	IDENTIFICATION WU
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6. JUSTIFICATION -State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or obtainment of the objective. Include reasons for selective the recommended approach over other alternatives. Also include the boundest especific to be derived from meeting the objectives or salving the problems for which the project is proposed. Outline the infast/uncertainness (R/U), plans to minimize xi/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 commerce demonstration plant will range from 300 MWe to 500 HWe 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 assification 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 ruel 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.



ICARCII AND DEVELOPMENT FACT SHEET (Continued)

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Clean Low-B.t.u. Gas

It is contemplated that R&D for low-3.t.u. gas will be of importance (a) to provide another alternative for clean electric power generation at high efficiency, and (b) to neet 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.

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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)

8. DEVELOPMENT MILESTONES (aumber each consecutively)		b. D.	ATES	_
(Limit Title of Milesione to 60 restricted and special) Fluidized bed low BTU gasification Proposal #84 and # 90 Fluidized bed (pressure and hydro) pilot plant proposal #90 Entrained bed low BTU combined cycle pilot/demo - proposal #108		ar.	Com	1
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Fluidized bed low Biu gasification		-		
Proposal #84 and # 90) Fluidized bed (pressure and hydro) pilot plant proposal #90	76 75	3 2	77 77	2
Entrained bed low ETU combined cycle pilot/demo - proposal #108	74	1	77	-
Fluidized bed pressure pilot/demo proposal #109	74 ·	1.	77	4
Suspension bed gasification - proposal #111	74	2	76	1
3 stage atmospheric fluid bed - product dev. unit proposal #86	73	1	74	2
Synthane converted to low BTU proposal #85	74	3	75	3
Circular traveling grate (modification) proposal #93	74	4.	76	1
Molton salt bath gasifier proposal #113	74	4	79	1
Molton iron gasification proposal #41	74	3	76	13
) Slurry firing with clean up proposal #91	74	4	79	1
Pressure bed stirred demon proposals #85,#92,#110	73	2	75	1
; Entrained bed - pilot, proposals #88,#115,#116,#117	74	1	78	į
) Agglomorating bed - demo. plant	75	2	78	
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÷			,	(15) High temp. gas clean-up pilot P Dolante proposal #89, #126	73	4	78	: 1
	3 2	77 77	2	(16) High temp ges clean-up - demo plant fused salt proposal #114, #129	74	1	78	
4	1	77 77	2	(17) Low BTU retrofit of existing boilers proposal #49, #128 - Demo	7 5	2	78	3 -
14	2	76	1	(18) Exploratory Research - low BTR gasification proposal 487	72	2	79	:
3	1	74	2	(19) Engineering evaluation - continuing				
.4	3	75	3	(20) General process support activities	72 _.	2	S 5	. :
' 4 £	4-	76	1	(21) Demonstration/commercial combine cycle plant	75	1	79	÷
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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

	j1	-	(2) ·	(3		14	
·	FY (Non-	1974 -Add)	FY 1	975	FY 1	975	FY 1	1977
Requirement	Obls	Outlays	Obis.	Outlays	Obis.	Outleys	Obts.	Outleys
a. OPERATING (See p. for delati) Total Operating Requirements (from Delat 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 Short)	12.85	12.0	92.6	82.0	212.5	200.0	170.0	185.0
c. ECUIPMENT (See p. for delea) Total Equipment Requirements (from Detail Sheet)	0.75	0.75	7.0	5.0	34.5	32.0	51.0	48.0
s. Grand Total—Deligations	25.44	125.	125.0		284.0		277.0	
e. GRAND TOTAL-OUTLAYS		23.15		110.0		267.0		287.0

Level of Elfort:

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7.0	35.0	56.0	54.0	68.0	72.4	41.0	43.C	.227.4	227.4	. •	-	227.4	5.37.4
2.5	200.0	170.0	185.0	53.5	59.5	25.5	27.6	554.11	554.1	<u>-</u>	-	554.1	<u> </u>
4.5	32.0	51.0	⁻ 48.0	19.5	24.0	6.5	9.5	118.5	118.5		-	1185	
1.0	4.	277.0		141.0		73.0		900.0	-	-	-	900.0	
•	267.0		287.0		155.9		80.1		900.0		•		٠. ٢



NERGY RESEARCH & DEVELOPMENT FACT SHEET

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1. IDENTIFICATION NUMI

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. PROGRAM	Conversion Tech	nia	ucs	•		
ь зингвослам	Gas Turbines				•	•
. PROPONENT AGERCY	AEC, NASA, DOD					·
b. SUBUNIT						
CONTRACTOR AND SITE	NAME OF CONTRACTO	۹:				
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up to 16 characters and spaces for county.	Site where work will be performed	>	State:	County:	Соп	npetitive Bidding
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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 275NW(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 industriaturbine 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, precooler, heater, valves, etc.,) will be confirmed along with the development of the control system, and the 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 turbipossible.

6. JUSTIFICATION (Use a reparate sheetls). See Item 5. on Instruction Sheet.)

		7. K	AJOR RESOURCE RE	QUIREMENTS		
RESOURCE Y	FISCAL YEAR		1976	1977	1978	19:
. MANPOWER	(1) Scientific	166	352	387	 	
(in mon years)	(2) Technical	104	235	482	194 678	125
	(3) Support	104	293	579	581	374
	(4) Other	41	293	482	484	312
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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.



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

	7. M	AJOR RESOURCE RE	QUIREMENTS		
FISCAL YEAR	1975	1976	1977	1978	1979
) Scientific	166	352	387	194	125
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(No more than 24 lines of text and no more than 70 characters and speces per line)

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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 turbin possible.

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

		7.	MAJOR RESOURCE A	REQUIREMENTS		
RESOURCE Y	FISCAL YEAR	1975	1976	1977	1978	197
. MANFOWER	(1) Scientific	166	352	387	194	125
(in mon years)	(2) Technical	104	235	482	678	437
	(3) Support	104	293	579	581	. 374
	(4) Other	41	293	482	484	312
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	(4) Other	•				
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	7. M	AJOR RESOURCE	REQUIREMENTS		•
SCAL YEAR	1975	1976	1977	1976	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
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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continue	CNERGY	RESEARCH	AND DEVEL	OPMENT FACT	SHEET /Continue
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6. JUSTIFICATION-State the specific energy problem or objective, and specify how the project contribute to the solution of the problem or attainment of the objective. Include reasons for selecting the recommended approach over other attendance. 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 fact 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 turbine exhausting into a heat exchanger which in turn produces steam for a steam turbine. I nuclear gas turbine (1500°F-Helium cooled) is to be pilot demonstrated by 1979 and the high temperature combined cycle is to be demonstrated by 1977 with increased efficient in the mid forties. These gas turbine programs will lower power costs, reduce environ 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.

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

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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Closed Cycle Gas Turbine System Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system. Technical Support General support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc. Component Test Individual testing of main components to determine specific	75 76	2	FY 79	4
Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system. Technical Support General support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc. Component Test	75	2	79	4
Confirmation of all design aspects of the components. Performance determination of the complete power generating system. Technical Support General support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc. Component Test	75	2		
Confirmation of all design aspects of the components. Performance determination of the complete power generating system. Technical Support General support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc. Component Test	75	2		
Performance determination of the complete power generating system. Technical Support General support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc. Component Test			Con	ļ.
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valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc. Component Test	76			
	76	1	B .	
Individual testing of main components to determine specific		2	79	2
performance of the components in an isolated situation				
(turbine, compressor, recuperator, precooler, etc.)				
Component Integration	78	2	78	: 3
Determination of the interaction between components and the dynamic characteristics of the conversion system.				
Experimental Facility Demonstration	79	2	83	, 4
Construct total 275MW(e) power system and put into operation using clean fuel.				
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MAXIMUM ORDERLY MINIMUM

IDENTIFICATION NUMBER 0605550512835601

'	b. D.	ATES	1	DEVELOPMENT MILESTONES (continued)		ls (ates .	
St	ant	Com	olete		Sta	1	Cone	
=Y	a	FY	c	(Limit Title of Milestone to 60 characters and spaces)	FY	a i	FY	
5	1	79	. 4	Open Cycle Gas Turbine System Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	1	76	
75	2	Cont	۸	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	93	:4	Experimental Facility Demonstration Full-scale demonstration at the 100MW(e) (prime move) level using clean fuel.	76	2	SO	
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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

2 SUMMARY OF FUNDING REQUIREMENTS—Federal Government Only (to millione of dollars)

	_	1)	ŧ	2) ·	(:	3) ·	
<u> </u>		1974 -Add)		1975	· .	1976	F
Requirement	Obls.	Outlays	Obla	Outlays	Obls.	Outleys	Obls.
		•					
e. OPERATING (See p. for detail) Total Operating Requirements (from Detail Sheet)			50		102	·	154
b. CONSTRUCTION (See p. for de:::0)			15		30		65
Total Construction Requirements (from Detail Sheet)			·				·
C. EQUIPMENT (See p. for detail) Total Equipment Requirements (from Detail Sheet)			18		88 -		112
C. GRAND TOTAL-OBLIGATIONS			83		220		331
e. Grand Total—Outlays				83		220	·

Level of Effort:

MAXIMUM

ORDERLY

☐ MINIMUM

IDENTIFICATION NUMBER 0605550512835601

(3). (7) (8) [4] (6) **{6}** . 19) Subtotal Balance To Total Exclud 1976 FY 1978 FY 1977 FY 1979 FY 1975-79 FY 1974 (C.I.) Complete Outlays Oble. Outlays Obls. Outlays Outlays Obis. Out Obls. **Outlays** Outlays Obls. 154 77 27 410 . 0 410 200 190 500 <u>.</u>0 . 500 65 112 55 . 17 290 0 290 332 234 1200 0 1200 331 332 220 1200 331 1.20

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

a. OPERATING	•	1)	t:	2}	(:	3)
		1974 -∧dd)	FY	1975	FY	1976
ITEM	Obls.	Outlays	Obls.	Outlays	Obis.	Outlays
TOTAL (Carry forward to summary sheet)	_	-	50		102	
() Name of Performing Organization:						
MANPOWER MATERIALS MAJOR PROCUREMENTS ALL OTHER TOTAL FOR THIS PERFORMING ORGANIZATION						
i) Name of Performing Organization:						
MANPOWER MATERIALS MAJOR PROCUREMENTS ALL OTHER TOTAL FOR THIS PERFORMING ORGANIZATION					٠.	
() Name of Performing Organization:	 	 	-	<u> </u>		
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() Name of Performing Organization:						
Manpower Materials Major Procurements All Other Total for this performing organization						

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Other	

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									INIMUM	L			<u> </u>
(3)	((4)		(5)		(G)		(7)	(6)		ti	3)
FY	1976	FY	1977	FY 1978		_	1979				NCE TO PLETE	(9) ILTOTAL EXCLU	
بواران	Outlays		Outlays	Obls.	Outlays	I	l		SUBTOTAL FY 1975-79		1	FY 1974	Cuis
	-	00.3.	Cuttays	Cois,	Outrays	Obls.	Outlays	Obis.	Outlays	Obis.	Outlays	Otals.	<u> </u>
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9. DETAIL OF FUNDING REQUIREMENTS-Federal Government Only (in millions of delices)

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. CONSTRUC	CTION			•						
				[1 	l) 1974 . _l		2)	(:		
				(Non-	Add	FY	1975	FY	1976	FY :
	ITEM		:	Obis.	Outlays	Obis.	Outlays	Obls.	Outlays	Obls.
		TOTAL (Carry foru to summary sheet)	ward			15		30		65
C) (number ea- ion dollars or i ement of why	Ocation (State and Count ich liem consecutively). E more should be separately it is required. OJECT (Not to exceed 30 County	y) and Total Estimated (Every project costing only identified with a brief	Cost tem No.	(•			
TITLE OF PR	ROJECT (Not to exceed 3	O characters and spaces,						`		
Statemore										
	RNECT (Not to exceed a	-								
State	_ County	TEC (in millions)				1	1	1	ļ	
Statement:										

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(:	3)	(4	4)	(9	5)	(G)	(INIMUM 7)		8)		91	
ΞY ·	1976	FY	1977	FY	1978	FY 1979		SUBT	TOTAL 975-79	BALA	NCE TO PLETE	TOTAL E	NCLUD: Con 7.5	
als.	Outlays	Obls	Outlays	Obis.	Outlays	Obls.	Outlays	1 8	Outlays	Ob!s.	Outlays	Obls.	Outh	
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- 9. DETAIL OF FUNDING REQUIREMENTS-Federal Government Only (In millions of culture)
 - c. EQUIPMENT

	(1 EV 1)	(2			(3)	(4) FY 1977		
ITEM (Each Item not to exceed 60 characters and spaces)	FY 1 (Non- Obla	Add) Outlays		00tlays	FY Obla	1976 Outlays	Obls.	1977 Out	
For each major performing organization, TOTAL (Corry forward show total aquipment funds, with a separate to summary sheet)	3		18	Cuttays	88	Cutays	112		
identification of each item of equipment costing one-balf million dollars or more,						·			

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						Level of Effort: MAXIMUM ORDERLY MINIMUM			5550512	NTION NUM 835601	BER	
′3}		(4)	(!	5)	(6) (7) (6)			(8) (9)				
176		1977		1978	FY	1979	SUBT	OTAL 975-79	BALA	NCE TO	TOTAL EXCLUDING FY 1974 (Cols. 7 & St	
Outlays	Obls.	Outlays	Obis.	Outlays	Obls.	Outlays	Obis,	Outlays	Obis.	Outlays	Obis.	Outlays
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5. DETAIL OF FUNDING REQUIREMENTS-Federal Government Only (In millions of dullers)

a. OPERATING		(3)		(2)		(3)		
		' 1974 n-Add)	FY	1975	l FY	1976	l F	
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TOTAL (Carry forward to summary sheet)			28.8		34		80	
1 Name of Performing Organization:								
MANPOWER		1.	l					
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MAJOR PROCUREMENTS	1		l					
ALL OTHER	1		1				l	
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ALL OTHER	· .		i	1	i	1		
TOTAL FOR THIS PERFORMING ORGANIZATION	l]	}	ļ		
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Hame of Performing Gryonization:								
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MAJOR PROCUREMENTS	1	}	1	ł	!	1		
ALL OTHER	}		l	1	i	1	Ì	
TOTAL FOR THIS FERFORMING ORGANIZATION								
1 Name of Performing Organization:						-	-	
MANPOWER				İ	•	1	1	
MATERIALS	1			1	1	1		
MAJOR PROCUREMENTS	1		1	l	1			
ALL OTHER	1		1	1	1	1	1	
TOTAL FOR THIS PERFORMING ORGANIZATION	-		1	1		1	1	
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75	FY	1976	FY	1977	FY	1978		1979		OTAL 75-79			TOTAL EX	:·
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	ACT SHEET	F. String(A)		□ MAXIMUN □ CRDERLY	s 1. IDENTIFE	CATION NUME
2, m. PROGRAM				☐ MINIMUM	06055505128	35601
t, #, PROGRAM b. SURPROGE		Conversion To	chniques			
R. PROPONE		Cas Turbine S NASA/AEC/DOD	ystems			
b. SUBUNIT	T PIGEIRG !	NASA/AEC/DOD				
CONTRACTO	R ANDSITE	NAME OF CONTRACT	OR-	· · · · · · · · · · · · · · · · · · ·		
(No more than	42 characters and	Site where work will be	State:	County:		
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	breviation for state:	NAME OF CONTRACT				
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		NAME OF CONTRACT	DR:		!	TITUO LIIE
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of work to be a Including any n which may have or constructed.	ew facilities e to be acquired	All design aspecomponents (reconfirmed along turbine compression the 2500°F of blades, cata	turbine of 10 fuels in a comments of the clauperator, pressor performant gas turbine rulytic combust lout to produce.	OffW(e) capace bined cycle gooder, heat elopment of the will be done and appropriate to the control of the cont	as turbine and a er, valves, etc. the control syste	power sou ssociated) will be em, and th
	The Cole is repartite in				20	
RESOURCE		7. MA.	OR RESOURCE REC	UIREMENTS		
A LESCONCE	FISCAL YEAR▶	1975	1976	1977	1978	1979
MANPOWER	(1) Scientific	02	110			
(in man years)		83 51	112	188	124	75
	(3) Support	51	<u>75</u> 93	234	433	263
	(4) Other	20	93	292	371	226
RAWMATERI		20	73	234	309	188
(List materials of measure below, cool, barrels of wantum, etc. S	and units of such as tons of oil, Kilograms of lhow smount of				3.74 x 10 ⁵	7.48 x
esch in column						

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c. LAND AREA (1) Govt-owned REQUIRED (2) Govt-leased

d. OTHER RESOURCES NEEDED (Specify Item and unit of

(in ocres)

(2) Govt-leased

(3) Privately-owned (4) Other

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FACT	SHEET		•	MAXIMUM	. • INCUTIFIC	ATION NUMBER
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	ition for states and spaces for	Site where work will be	State:	County:		
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any new fa		All design aspe components (rec confirmed along turbine compres For the 2500°F of blades, cata	cts of the clauperator, prediction with the development of the companies of the combustion out to product to p	bined cycle co osed cycle gas cooler, heater elopment of th ce will be det esearch and de ion, and appli	turbine and as , valves, etc.) e control syste	sociated will be m, and the ter cooling ic materials
SATION (E	íse a seporale s	hcet(s). See Item 6. on In	itruction Sheet.) OR RESOURCE REC	UIREMENTS	z	
E FIS	CAL YEAR	1975	1976	1977	1978	1979
ER [1] S		83	112	188	124	75
ears) (2) 1	echnical	51	75	234	433	263
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(2) Govt-leased
(3) Privately-owned
(4) Other
ESOURCES NEEDED

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STREET STREET STREET Site where work will be (No more than 42 characters and State: County: performed spaces for name of contractor: NAME OF CONTRACTOR: use slandard abbreviation for state. up to 16 characters and spaces for Site where work will be State: County: county. performed Competitive bidding NAME OF CONTRACTOR: Site where work will be State: • County: performed NAME OF CONTRACTOR: Site where work will be State: _ . County: performed NAME OF CONTRACTOR: Site where work will be County: State: berformed 5. BRIEF DESCRIPTION OF The double thrust of this program is the investigation, design, PROPOSAL construct, and test operate by 1981 a 1500°F Helium closed gas tu (No more than 24 lines of text system at the 275MW(e) capacity using a fossile fired heater for and no more than 70 characters and spaces per line) joining to a high temperature gas reactor in a direct cycle and t Briefly outline nature and scope investigate; design; construct, and test by 1979 a 2500°F open cy of work to be undertaken, industrial gas turbine of 100MW(e) capacity as the prime power so including any new facilities burning clean fuels in a combined cycle configuration. which may have to be acquired or constructed. 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 cooli of blades, catalytic combustion, and application of ceramic mater: will be carried out to produce the most reliable and advanced gas turbine 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 (1) Scientific 83 112 188 124 75_ (In man years) (2) Technical 234 433 263 荭 93 282 226 (3) Support 371 20 93 234 (4) Other 309 188 b. RAW MATERIALS (List materials and units of 10⁵ 3.74 x measure below, such as tons of 7.48 X

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bbl oil

. bbl oi

coal, barrels of oil, Kilograms of uraplum, etc. Show amount of

each in columns at right.)

REQUIRED

(in acres)

(13

c. LANDAREA (1) Govt-owned

d. OTHER RESOURCES NEEDED (Specify Item and unit of measure below. Show quantity of each in columns at right.)

(2) Govt-leased

(3) Privately-owned (4) Other

(1)

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)	Level of Effort:	
	☐ MAXIMUM ☐ ORDERLY ☐ MINIMUM	1DENTIFICATION 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.

3. SCHEDULE (Include major facilities and major equipment, Indicate dates by Fixed Year and Quarter). a. DEVELOPMENT MILESTONES (number cach consecutively)		b. D	ATES		
(Limit Title of Micstone to 80 characters and spaces)	St	ır	Com	olete	
	FY	C.	FY	a	
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	•	<u>Te</u>
Component Test Individual testing of main components to determine specific performance of the components in an isolated situation	77	2	79	2	Co
Component Integration Determination of the interaction between components and the	78	2	79	1	Co
Experimental Facility Demonstration Construct total 275MW(e, power system and put into operation using clean fuel.	82	2	85	4	Ex
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Level of Effort:

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IDENTIFICATION NUMBER 0605550512835601

			MINIMUM DOUGGEOOD	1312833601						
),	ATES		a. DEVELOPMENT MILESTONES (continued)		b DATES					
]	Com	plete	(Limit Title of Mücstone to 60 characters and spaces)	Sta	rt	Comp	15te			
]	FY	Q	spinie tire of massace to be empleted and spaces	FY	0	FY	0			
	79	4	Open Cycle Gas Turbine System Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	1	76	1			
	Cont	•	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		82	4			
			'Continue on separate sheet)	Page	۵	f				

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

	(1		(2	e) ·	(3)		(4) I	
		1974 -Add)	FY 1			976		1977
Requirement	Oble.	Outlays	Obis.	Outlays	Obls	Outlays	Obb.	Outleys
_								
. 2. OPERATING (See 3.5 for detail)			28.8		34		80	<u> </u>
Total Operating Requirements (from Detail Sheet)								
·		·					35	
b. CONSTRUCTION (See p. 6 for detail) Total Construction Requirements (from Detail Sheet)	-		5.0		15		35	 -
•								
a POUNDIPAY May 7 de desti			7.2		21 .		46	
c. EQUIPMENT (See p.7 for detail) Total Equipment Requirements (from Detail Sheet)								
d. GRAND TOTAL-OBLIGATIONS		4	41	-	70	-	161	4
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e grand total-outlays				41	}	70		161
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HATE. If America according to proposed, indicate the amount by yea

☐ MAXIMUM IDENTIFICATION NUMBER **公 ORDERLY** 0605550512835601 ☐ MINIMUM 3) -(4) (5) (6) (7) (8) (9) Subtota! Total Excluding Balance To 1976 FY 1977 FY 1978 FY 1979 FY 1974 (Col. 7 & S) FY 1975-79 Complete Outlays Outlays Obls. Obis. Outlays Outlays Obis. Obls. Obis. Outlays Outlays * Obls. | Outlays 80 49 38.2 230 101.2 331.2 70.0 250 187.6 437.6 35 125 46 38 32.8 145 86.2 231.2 141 625 161 212 375 · 1000 70 141 212 .625 161 375 1000

Level of Effort:

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



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

	•	(:	2}	(3	:)	(4)
		FY	1975	FY	1976	FY	11.
Obls.	Outlays	Obls.	Outlays	Obls.	Outlays	Obls.	9
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9. DETAIL OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

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- 9. DETAIL OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)
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Construct, and test operate by 1984 a 1500°F helium closed cycle gas turbine and appearance per line; gas turbine system at the 27500°F helium closed cycle gas turbine nature and scope products to be undertaken, including any new facilities which may have to be acquired precipitationed. All design aspacts 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 turbine compressor performance will be determined. For the 2500°F gas turbine, research and development on water cool of blades, catalytic combustion, and application of ceramic mater will be carried out to produce the most reliable and advanced gas turbine possible.	•		State:	County:	
IUSTIFICATION (Use a separate sheet(s). See Item 6. on Instruction Sheet.)	ROPOSAL (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	construct, and test gas turbine system heater for future cycle and to invest 2500°F open cycle prime power source. All design aspacts components (recupe confirmed along with turbine compressor for the 2500°F gas of blades, catalys will be carried or	st operate at the 27 joining to stigate, de industrial burning confiderator, preside the deverger performants turbine, sie combust	by 1984 a 5MW(e) ca a high the sign, corner fuel cosed cycle cooler, helppment ce will be research ion, and	a 1500°F helium closed cycle apacity using a fossile fired temperature gas reactor in a astruct, and test by 1981 a sine of 100MW(e) capacity as as in a combined cycle configuration and associated neater, valves, etc.,) will be of the control system, and so determined. and development on water con application of ceramic mater
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	(3) Support	42	57	116	170	216
	(4) Other	18	57	96	142	180
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FNERGY RES	EARCH AND DEVELOPMENT	FACT SHEET	(Continued)	Level of Effort:	
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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 remains for objective, 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 follest extent.

MINIMUM (A

Several advantages can be realized by combining the closed cycle gas turbine with the high temperature gas-cooled reactor (NTCR), 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-Melium 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.

Level of Effort:	
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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. Instade reasons for selecting the recommended approach over other alternatives. Also include the benefits 1 to be derived from meeting the objectives or solving the problems for which the project is proposed. Outline the risks/uncertainties igns to minimize R/U, and basis for proceeding in face of R/U. Quantitative data_hould be used to the follest extent.

ral 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 me exhausting into a heat exchanger which in turn produces steam for a steam me. The nuclear gas turbine (1500°F-Helium cooled) is to be pilot demonstrated 84 and the high temperature combined cycle is to be demonstrated by 1981 with cased efficiency in the mid forties. These gas turbine programs will lower power, reduce environmental effects, and support the optimum use of all fuels. It is development (material and design) will be required in the areas of gas ne combusters, and the hot end of the turbo compressor. This stretched out num effort would delay the demonstration plant startup and would increase the cost.



SCHEDULE (Include major facilities and major rautpment, Indicate dates by Flocal Year and Quarter). 8. DEVELOPMENT MILESTONES (number each consecutively)		b. D	ATES	1	•
. (Limit Title of Milestone to 60 chemations and spaces)	St	ar t	Com	piete	
	FY	0	FY	0	
Clased Cycle Gas Turbine System	l				
Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	2	79	4	Th
Canaral Support Canaral support, He technology, turbine blades, aerodynamics, valving, ductings, vibration analysis, bearings, seals, heat transfer in heat exchangers, pressure drops studies, etc.	75	2	Con		<u>Te</u> Co
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
Determination of the interaction between components and the dynamic characteristics of the conversion system.	79	2.	81	2	Ex
Construct total 275MW(e) power system and put into operation using clean fuel.	83	1	S7	1	

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		ORDERLY			UMBER	
		e. DEVELOPMENT MILESTONES (continued)	2533		DATES	
am	plete	(Limit Title of Milatione to 60 characters and spaces)	MAXIMUM OGDERLY OTHER OGDERLY OGDERLY OTHER			
		Open Cycle Cas Turbing System		<u>. u</u>		<u> </u>
	4	Theory Design Confirmation of all design aspects of the components. Performance determination of the complete power generating system.	75	2	77	2
ובני	•	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.	68	1	84	:
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9. SUMMARY OF FUNDING REQUIREMENTS-Federal Government Only (in millione c.' dollars)

	•	i) ::974	(3	e) ·	(:	3).	(4)
		-Add)	FY	1975	FY	1976	FY	ı
Requirement a. OPERATING (See p. 5 for detail) Total Operating Requirements (from Detail Sheet) b. CONSTRUCTION (See p. 6 for detail) Total Construction Requirements (from Detail Sheet) c. EQUIPMENT (See p. 7 for detail) Total Equipment Requirements (from Detail Sheet) d. GRAND TOTAL—OBLIGATIONS e. GRAND TOTAL—OBLIGATIONS	Oble	Outlays	Obis.	Cutleys	Obls.	Outlays	0 6!s.	Š
		•			·			
DERATING (See p. 5 for detail) Total Operating Requirements (from Detail Sheet) D. CONSTRUCTION (See p. 6 for detail) Total Construction Requirements (from Detail Sheet) C. EQUIPMENT (See p. 7 for detail) Total Equipment Requirements (from Detail Sheet) d. GRAND TOTAL—OBLIGATIONS			24.8		22.4		26.0	
b. CONSTRUCTION (See p. 6 for detail)			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	, n
			34		43		65	The same of the sa
e. Grand Total-Outlays				34		43		

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* ,	1976	FY	1977	FY ·	1978	FY	1979	Subt FY 19	otal · 375-79		ice To	Total E.	
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-	٠	20.0		26	٠	39.2	·	100		326.2		426.2	
	43	66	66	97 <u>.</u>	97	135	135	375	375	1125	1125	1500	• • • • • • • • • • • • • • • • • • • •

Level of Effort:

- 9. DETAIL OF FUNDING REQUIREMENTS-Federal Government Only (in millions of dollars)
 - c. EQUIPMENT

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Each liem not to exceed 60 charact	ers and spaces)	(Non- Obls.	Add) Outlays		Outlays	Obls.	Outlays	Obis.	!
or each major performing organization, how total equipment funds, with a separate contilication of each item of equipment	TOTAL (Carry forward to summary sheet)			24.8		22.4		25.0	ļ
osting one-half million dollars or more.	•								١
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Level of Effort:

IDENTIFICATION NUMBER

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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

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				1974 -Add)	FY 1	975	FY	1976	₹.
	ITEM		Obis.	Outlays	Obls.	Outlays	Obls.	Outlays	Opt
		TOTAL (Carry forward to summary sheet)			5		10		20
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Statement:	County	TEC (In millions)							

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	1978		1977		1978		1979	SUBT	TOTAL 975-79	BALANCE TO COMPLETE		107AL E	
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ENERGY RESEARCH & DEVELOPMENT FACT SMEET (Continued)

- 9. DETAIL OF FUNDING REQUIREMENTS-Federal Government Only (In millions of dollars)
 - C EQUIPMENT

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For community performing organization,	TOTAL (Corry formers to its separate to summer sheet)				·	10.6		20.0	Our
control of each field of equipment	•								
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	20.0		26		39.2		100		326.2	٠,	426.2	
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LNERGY RESEARCH & DEVE FACT SHEET	EOPMENT		-	Level of Effort: D ORDERLY MINIMUM	1. IDENTIFICATION NUMB 0606550512955601
2. a. PHOGHAM	Energy Convers	ion	R&D		
b. SURPROGRAM	MID - Power Go		ation		•
3. P. PROPONENT AGENCY b. SUBURIT	Various includ	ieą	OCR, AD	C. NBS. NASA	
4. CONTRACTOR AND SITE	NAME OF CONTRACTO	it:	Varicus		
(No more than 42 characters and	Site where work will be performed	٨	State:	County:	<u> </u>
use standard o'decrution for state. up to 16 characters and apores for county.			Stare:	County:	
	NAME OF CONTRACTO	R:		-	
	Site where work will be performed	>	State:	County:	
ì	NAME OF CONTRACTO	R:		· · · · · · · · · · · · · · · · · · ·	
	Site where work will be performed	Þ	State:	County:	
	NAME OF CONTRACTO Site where work will be	R:	State:	County:	
5. BRIEF DESCRIPTION OF PROPOSAL (No more than 24 lines of text and no more than 70 characters and speces per line) Briefly outline nature and scopt of work to be undertaken, including any new facilities which may have to be acquired or constructed.	. System An . Supportin . Facilitie - Large S - Long En . Construct 2. Liquid Neta . Component . Materials	alyge State of Colors of C	sis & De &D esign & e Genera ance Mat DEMO Pl velopmen udies esign & ent evelopmen Experime	Construction tor Test Facility erials Test Facil ant (Coal Fired) t Construction (1 &	ity

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		7. MA.	OR RESOURCE REC	UIREMENTS	•	
RESOURCE	FISCAL YEAR	1975	1976	1977	1978	1979
. MANPOWER	(11 Sciemific	109	125、	120-	91 \	91~
(in mon years)	(2) Technical	125/	142 /	128	204	104)
	(3) Support	108 \ 320	125 > 445	120 > 425	91 / 325	91 >
	(4) Other	47)	53./	47.	39 4	39/
L RAWMATER	IALS	·				
cool, berrels of	such as tons of oil, Kilograms or Show amount of	0.2 mill	0.4 mill	0.5 mill	0.2 mill	0.3 и
F. LAND AREA REQUIRED	(1) Govt-owned				_	
	[2] Govidessed					
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	ELOPMENT		Level of Effort:		
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	Energy Convi		· · · · · · · · · · · · · · · · · · ·		
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f tert recters d scope), es quired	System Support Facilit Facilit Inge Onstru Constru Compone Materia Facilit Support Prototy Compone Feasibi Support	ent & Materials Analysis & Des ring R&D ries Design & C e Scale Generat Endurance Mate extion DEMO Pla etal ent Development als Studies ries Design & C e R&D rpe Plant role ent Development lity Experiment	ign onstruction or Test Facili rials Test Faci nt (Coal Fired onstruction (1	ility)	
seperate i	thees(s). See Item 6. CR	. Instruction Sheet.) AJOR RESOURCE REC	QUIREMENTS		•
L YEAR	1975	1976	1977	- 1978	1979
ntific	109-	125 \	120	91	915

	7. MA	JOR RESOURCE REQ	JIREMENTS	•	•
N_ YEAR	1975	1976	1977	- 1978	1979
entific	109	125、	120	91	91~
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Site where work will be performed	•	State:	County:	

6. BRIEF DESCRIPTION OF PROPOSAL

(No more than 24 lines of text end 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.

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 DEWO Plant (Coal Fired)
- 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

		7. MA	JOR RESOURCE REC	UIREMENTS	-	
RESOURCE	FISC^L YEAR▶	1975	1976	1977	1978	·197
. MANPOWER	(1) Scientific	109~	125、	120	91 \	91~
(in mon years)	(2) Technical	125/	142 /	138 /	104)	104 /
	(3) Support	109 7 390	125 7 445	120 > 425	91 > 325	91 >
	(4) Other	475	53 ノ	47.	39 /	39./
. RAW MATERI	ALS	•				
coal, barrels of	such as lons of oil, Kilograms of Show amount of	0.2 mill	0.4 mill	0.5 mill	0.2 mill	0.3 n
LAND AREA	(1) Govt-owned		-			
REQUIRED	(2) Govt-leased					
(in acres)	(3) Privately-owned	0.2 mill	0.4 "	0.5 "		******
	(4) Other					
. Other reso	URCES NEEDED		1			
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	Site where work will be performed	State:	County:	
IPTION OF 24 lines of text an TO characters tiline) nature and scope Indertaken, her facilities to be acquired	- Iong End . Constructi 2. Liquid Metal . Component . Materials	lysis & Desi R&D : Design & Co ale Gererato urance Mater on DEMO Plan Development Studies : Design & Co D Plant : Development y Experiment D	nstruction r Test Facility ials Test Facility t (Coal Fired) nstruction (1 & 5 MW)	

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	7. M.	JOR RESOURCE REC	UIREMENTS		·
FISCAL YEAR≯	1975	1976	1977	1978	1979
1) Scientific	109	125	120~	91	91~
2) Technical	125/	142 /	138	104	104 /
3) Support	390 ر 109	125 7 445	120 > 425	91 > 325	91 > 325
4) Other	47)	53.	47 J	39	39/
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1) Govt-owned					
2) Covt-leased					
3) Privately-owned	0.2 mill	0.4 "	0.5 "	design	-
4) Other					
IRCES NEEDED					
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VEHGY	RESEARCH	AND	DEVELOPMENT	FACT	SHEET	(Continued)
AFIRGA	RESEARCH	VMD	PEAFFORMENT	FACI	SHLET	(Continu

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IDENTIFICATION NUMBER

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JUSTIFICATION—State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem or attainment of the objective. Include reasons for selecting the recommended approach over other afternatives. 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 the 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 prosper 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.

FARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Lifert	
□ MAXIMUM	IDENTIFICATION NUMBER
ORDERLY MINIMUM	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 a 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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nigh efficiencies that are achievable are very important to the Nation's power Economic studies have shown that potential savings of MHD systems can range between Billion dollars in this century alone.



ENERGY RESEARCH & DEVELOPMENT FACT SHEET

Level of Effort:

MAXIMUM

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1. IDENTIFIC TION NUMBER

			DOMINIMUM!	<u> 0604210532850301 </u>						
2. a. PROGRAM	Energy Conversion	3								
b. SURFROCHAM	Low NTU Casifica		al	† 						
3. a. PHOPONENT AGENCY		Department of Interior NASA, EPA, AFC								
b. SUBUNIT	Office of coa	Research								
4. CONTRACTOR AND SITE	NAME OF CONTRACTOR:	<u> Various</u>								
(No more than 42 characters and spaces for name of contractor;	Site where work will be performed	State:	County:							
	use slandard abbreviation for state! NAME OF CONTRACTOR:									
up to 16 characters and spaces for county.	Site where work will be performed	State:	County: TOTAL	II. S						
	NAME OF CONTRACTOR:									
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	NAME OF CONTRACTOR:									
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5. BRIEF DESCRIPTION OF PROPOSAL

(No more than 24 lines of lext 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) construct and operated 1978-1979.



			7. MA	JOR RESOURCE REQ	UIREMENTS	•	
ı	RESOURCE	FISCAL YEAR	1975	1976	1977	1978	1979 :
a.	MANPOWER	[1] Scientific	60	i10	150	150	150
	(in men years)	(2) Technical	300	450	600	600	600
		(3) Support	20	25	30	30 ·	30
		(4) Other					
b.	b. RAWMATERIALS (List materials and units of measure below, such as torz of eoal, barrels of oil, Kilograms of wantum, 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 tor
C.	LAND AREA		1200	2000	2000	2000	2000
	(in acres)	(3) Privately-owned (4) Other	100	150	150	150	150
d.	OTHER NESC	OURCES NEEDED					

SEARCH	7.	DEVELOPMENT
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D NAXIMUM

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1. IDENTIFICATION NUMBER 060km 0510550700

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GHAM		Lou-BTU-Gasification from coal							
IENT AGENCY				CASA FPA AEC					
7	Office of								
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un 42 cherocies and me of explorator:	Site where work will be purformed	>	State:	County: .					
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ion 24 lines of text ; Itian 70 characters per line) ne nature and scope to undertaken, ty new facilities lave to be acquired led. 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 relainance on imported oil and LNG by enabling high-sulfur coals regard to renvironment. I pilot 10 emonstration plant (30mme-500Me) constructed and operated 1976-1979.

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TION (Lie a separate sheet(s). See Hom 6. on Instruction Sheet.)

	,	7. M/	JOR RESOURCE REQ	UIREMENTS		
	FISCAL YEAR	1975	1976	1977	1978	1979
R	(1) Scientific	60	110	150	150	150
rs)	(2) Technical	300	450	600	600	600
	(3) Support	20	25	30	30 ·	30
	(4) Other					
or. of : S	and units of such as love of oil, Kilogram of Show emount of set right.)	400 tons cool/dry	500 tons cool/dry	500 tons cool/dry	800 tons cool/dry	800 tons coel/day
	(1) Gov: owned	1200	2000	2000	2000	2000
)	(2) Covidensed					
	(3) Privately-owned	100	150	150	150	150
	(4) Other					
SO	URCES NEEDED	,				
	nd unit of Show quantity					

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3. a. PROFONER	NT AGENCY		of Interior NA			
b. SUBUNIT		Office of	coal Research			
4. CONTRACTO	R AND SITE	NAME OF CONTRACT	various			
•	42 characters and	Site where work will be performed	Slate:	County:		•
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county.		performed		TO	TAL U.S.	
	•	NAME OF CONTRACT Site where work will be	~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	16		
		performed	State:	County:		
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5. BRIEF DESCR	RIPTION OF					- · ,
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and speces per					d petroleum as	
Briefly outline	nature and scope				gh efficiency	
of work to be	undertoken,				d to meet indus	
including any o	new facilities to be acquired				emical feedsto	
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6. JUSTIFICATI	ON (Use a separate s	skeet(s). See Item 6. on l	Instruction Sheet.)			
··········		7. MA	JOR RESOURCE REC	UIREMENTS	•	
RESOURCE	EIGONI WEARL	1			4070	4070
▼	FISCAL YEAR	1975	1976	1977	1978	1979
a. MANPOWER	(1) Scientific	60	110	150	150	150
	(2) Technical	300	450	600	600	600
	(3) Support	20	25	30	30	30
	(4) Other					
b. RAWMATER	IALS					
(List materiels	and units of	400 tons	500 tons	500 tons	800 tons	800 tons
measure below	, such as tons of	cool/dry	cool/dry	cool/dry	cool/dry	cool/day
	oil, Kilograms of		,,	,	· · · - • · · · - •	· /
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c. LAND AREA	(1) Govt owned	1200	2000	2000	2000	2000
REQUIRED	(2) Gavt-leased					•
(in acres)	(3) Privately-owned	00.	150	150	150	150
	(4) Other					
d. OTHER RESC	URCES NEEDED					
(Specify ilrm o						
messure below	. Show quantity]				
of each in colu		(19)				
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ENERGY RESEARCH AND DEVE	LOPMENT FACT	SHEET	(Continued)
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0	ORDERLY
13	MINIMUM

IDENTIFICATION NUCLEE

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6. JUSTIFICATION State the specific energy problem or objective, and specify how the proposit will contribute to the solution of the problem or attanuagent of the objective. Include reasons for selecting the recommended approach over other attenuatives. Also include the banelits expected to be derived from meeting the objectives or solving the problems for valuels the project is proposed. Outline the risks/uncorrelatives (B/U), plans to minimize H/U, and take for proceeding in Loca of R/U. Quantitative data about the fullest extent.

Clean Low-B.t.u. Gas

It is contemplated that RED 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 indudemand for gas. These functions are expected to help curb excessive reliance on imported and LEG 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 goal will integrate with research of 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 system remove sulfur and particulate matter. In addition development is proceeding on a hot gas system, operating at gasification temperatures in order to increase efficiency and impresentation 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 possibilidifferent 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 gazifier; (b) conceptual design of atmospheric pressure, entrained-flow gazifier 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 1071 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 in

SEARCH AND DEVELOPMENT FACT SHEET (Continued)

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ITION—State the specific energy problem or objective, and specify how the proposal will contribute to the solution of the problem mt of the objective. Include remains for selecting the recommended approach over other alternatives. Also include the Lanelits be derived from meeting the objectives or solving the problems for which the project is proposed. Outline the insistancertainties is to minimum 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

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mded pilot/demonstration plant is planned with initial operation estimated for the - 79 period, thereby providing a basis for wide commercial application by the late

the effort for low-B.t.u. clean fuel gas from goal will integrate with research on gas
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
as 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.

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

ram involves research and development directed toward entrained-flow gasifiers. Pilot nonstration will be constructed to handle up to 50 tons of coal per hour. The plant will om 30 to 50 megawatts generating capacity. It will include a gas cleanup system to alfur and particulate matter. In addition development is proceeding on a hot gas cleanup operating at gasification temperatures in order to increase efficiency and improve the of the processes.

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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) completesign 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.



ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Comminued)

8. SCHEDULE (Include major facilities and major equipment. Indicate dates by Fiscal Year and Quarter). a. DEVELOPMENT MILESTONES (number each consecutively)	ĺ	ь. D	ATES	
(Limit Tifle of Milestone to 60 characters and spaces)	Su	arı	Com	dete
(Links and of American	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	ħ	79	ì
(4) Pressure Bed Stirred Dezo - Proposels #85, #92, #110	73	2	75	1
(5) Estrained Bed - Pilot, Proposals #88, #115, #116, #117	74	1	78	3
(6) High Temp Gas Cleanup Demo Plant Fused Salt - Proposal #114, #129	74	ì	78	3
(7) Exploratory Research - Low ETU Gasification - Proposal #87	72	1	79	1
(ô) Engineering Evaluation - Continuing				
(9) General Process Support Activities	72	2	85	2
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				Level of Effort:	IDENTIF	::	Carer			
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	ь n	ATES	1	a. DEVELOPMENT MILESTONES (continued)	06042105	1200) 1				
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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

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

	(1		(3	9	{3	ŋ·	(4) _.
		1974 -Add)	FY	1975	FY 1	1976	FY 1	1977
Requirement	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	Obls.	Outla
a. OPERATING (See p. for delail)	11.84	10.4	7.0	6.0	14.0	13.0	15.0	14.
Total Operating Requirements (from Detail Sheet)								,
	12.89	12.0	13.4	12.0	35.0	34.0	38.0	36.0
b. CONSTRUCTION (See p. for detail) Total Construction Requirements (from Detail Sheet)								
EQUIDATENT (December 40)	0.75	0.75	1.0	0.8	1.6	1.4	10.0	9.0
c. EQUIPMENT (See p. for detail) Total Equipment Requirements (from Detail Sheet)		 						
G. GRAND TOTAL-OBLIGATIONS	25.44		21.4		50.6	1	63.0	
e. GRAND TOTAL—OUTLAYS		23.15		18.8		48.4		59.5

Level of Effort:

☐ MAXIMUM IDENTIFICATION NUMBER
☐ ORDERLY
☐ MINIMUM 0604210512850301

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	FY	1977	FY	1973	FY	1979	Subtotal FY 1975-79		-	ice To	Total E	xaluding Col. 7 & El	
ays	Obis.	Guttays	Cb!s.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	Outlays	!/	Outlavs	
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-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	
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0	35.0	36.0	39.0	40.0	20.0	21.0	145.4	143.0	55.0	57.4	200.4	200.4	
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1;		59-5		66.5		53.0		246.4		108.6		355 D	
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nding. A brief description of the Cooperative programs and the rationale for the division of funding

ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

SCHEDULE (Include major facilities and major equipment, Indicate dates by Fiscal Year and Quarter). 5. DEVELOPMENT MILESTONES (number each consecutively)	L	b. D/	ATES	1	Ì	
(Limit Title of Milestone to 50 characters and spaces)	<u> </u>	art	Com			
1. Long Endurance Materials Test Facility Operational 2. Large Scale Generator Test Facility Operational with Clean Puels 3. Channel, Magnet & Other Parts Completed for US-USSR Exchange 4. Generator Enthalpy Extraction Tests Complete 5. Test Facility Modification for Coal 6. Coal Fired Tests Complete 7. Component Lifetime Tests Completed	75 75 75 77 79 77	a	80 77 80 80 80 80	a	1. 2. 3. 4.	C F I
3. Component Performance Verified 9. Evaluation of 50 MV Domo Plant Completed 10. Design of 50 MV Domo Plant Completed Liquid Metal 1. Component Design Established	77 75 77	>				
2. Simulated 1 MV Power System Completed 3. Hi-Tum. Test Facility Completed 4. Component Testing Completed 5. System Performance Demonstrated 6. 20 MW Prototype Plant Design Complete	75 75 75 77 78	7 > > >	1			

Complete Climit Title of Milestone to 60 characters and spaces) South		b. D/	ATES		Level of Effort: MAXIMUM ORDERLY MINIMUM B. DEVELOPMENT MILESTONES (continued)	IDENTII 060655		855		· - <u>-</u>
Closed Cycle 1. Camponent Construction Camplete 2. Feasibility Experiment Camplete 3. Design of 50 Mr Plant Camplete 77 80 80 80 80 80 80 80 80 80 80 80 80 80	ta	T.	Com	plete	All to describe to a best of the second of t		3101	,	Comp	ic-s
Closed Cycle 1. Component Construction Complete 2. Feasibility Experiment Complete 33. Design of 50 Mw Plant Complete 77 77 4. Proof of Concept 5. Design of Prototype Plant 77 80 80 80 80 80 80 80 80 80 80 80 80 80	Т	Q	FY	Q	(Limit Tille of Milestone to 60 characters and spaces)		FY	0	FY	C.
(Continue on separate sheet) Page of		V V V	80 77 80 80 80 80 80 80 80 80 80 80 80	Q	Closed Cycle 1. Component Construction Complete 2. Feasibility Experiment Complete 3. Design of 50 MW Plant Complete 4. Proof of Concept		75 77 77 76	C	80 > 80 > 80 > 30	C
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9. SUMMARY OF FUNDING REQUIREMENTS—Federal Government Only (in millions of dollars)

;	(1)			23 '	C	30 -		0
		1974 -Add)	FY	1975		1976		1977
Requirement	Obls	Outlays	Obls.	Outlays	Obk.	Outlays	Obla.	Outleys
a. OPERATING (See p. for detail) Total Operating Requirements (from Detail Sheet)		-		16.2		19.0		18.5
								.,
b. CONSTRUCTION (See p. for detail)				3.2		17.1		24.4
Total Construction Requirements (from Detail Sheet)								
c. EQUIPMENT (See p. for detail)				1.0		4.3		5.1
Total Equipment Requirements (from Detail Sheet)								
		,						
d. GRAND TOTAL-OBLIGATIONS					-			1 1
•			; 					'
€ GRAND TOTAL-OUTLAYS				20.4	1	40.4	1	49.0
	ļ		ļ		1	70.4	١.	43.0

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

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	1977	J <i>-</i>	1	1		Subtotal !			ce To				
	Outlays		FY 1978		1979		75-7 9		olete	FY 1974 (Cai. 7 & 21		
Oble.	Outlays	Obis	Cutteys	Obis.	Outlays	Obis.	Outlays	Obis	Cettays	Obis.	Quilays		
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	43.0		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)

OPERATING .		1)	(2}	(3)	
		1974 -Add)	FY	1975	FY	1976	FY
ITEM	Obls	Outleys	Obls.	Outlays	Obls.		Obla.
TOTAL (Corry forward to summary sheet)	>						
() Name of Performing Organization: Various							·
MARFOWER	1			12.0		16.0	
MATERIALS	j	1		0.2			
MAJOR PROCUREMENTS	1	l				1	
. ALL OTHER		}		0.6		0.6	}
, TOTAL FOR THIS PERFORMING ORGANIZATION	1			12.8			
Open Cycle							
1) Name of Performing Organization: Various	-						
MANPOWE R		Į		3.0	1	1.7	1
MATERIALS		1	•	0.1	Ì		
MAJOR PROCUREMENTS	j	Ì	•		}	1	}
ALL OTHER		1 .	}	0.3	1	0.3	1
TOTAL FOR THIS PERFORMING ORGANIZATION		1	İ	3.4		2.1	
Liquid Metal & Closed Cycle .							
() Name of Performing Organization:							
MANPOWER			ļ		Ī		
MATERIALS			l		l	i	1
MAJOR PROCUREMENTS		1	į	1	!	.	•
ALL OTHER	. 1]	1	1	1	i
TOTAL FOR THIS PERFORMING ORGANIZATION		·	}			1	
i) Name of Performing Organization:	_	1			 	1 :	1-
MANPOWER		1	1				Į.
MATERIALS	1		1	1	1	1	}
MAJOR PROCUREMENTS			1	1	1	1	1
ALL OTHER	1	}	}	i	1	1	1
TOTAL FOR THIS PERFORMING ORGANIZATION		1	l	1		1	1
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4	1976	FY	1977	FY	1978	FY	1979	SUBT FY 19	OTAL 75-79	BALAN	CE TO	TOTAL EX	Cots, 7 & C)	
	Outlays	Obis.	Outlays	Obls.	Outlays	Obis.	Outlays	3 1		Obis.	Gutlays	Obls.	Outlays	
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_	16.9		16.9		10.0		8.8		• 65.4		!		į	
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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

b. CONSTRUCTION

	OCTION	•		{1	3	(:	2)	(3	3)		
*			1	FY (Non-	1974 -Add)	FY	1975	FY	1976	FY	
	ITEM		Į	Obls.	Outlays	Obis.	Outlays	Obis.	Outlays	Obis.	
		TOTAL (Corry forwar to summary sheet)	ط •	-							
(TEC) (numbers of milion dollars of statement of who Statement: Statement: This wo contract	Location (State and County) rach Item consecutively). Ever more should be separately in y it is required. ROJECT (Not to exceed 30 cl County ork will be perfor et or work stateme lead organization	ry project costing one gentified with a brief paracters and spaces.] TEC (in millions) med under nt authorized	tem				2.5		15.1		
State Statement: This wo contract by the	County Ork will be perforet or work statemed lead organization of Closed Cycle	TEC (In r-mions) med under ent authorized)		-		0.7		2.0		
	ROJECT (Not to exceed enai	TEC (in millions))								†
State	County			}				} .	}		
Statement:											

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970		., 1977		" 1978		" 197 9 	1 SUBT	OTAL 975-79	BALA	B) NCE TO PLETE	TOTAL E	9) XCLUDING Cols. 7 & 2)
Outleys	Obis.	Outlays	Obis,	Outlays		Outlays	Obis.	Outlays	Obis.	Outlays	FY 1974 (Cols. 7 & El Cuttays
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Level at Eilort:

IDENTIFICATION NUMBER .

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ENERGY RESEARCH & DEVELOPMENT FACT SHEET (Continued)

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

c. EQUIPMENT

		1)		2!	(3)		(4)	
ITEM	(Non	1974 -Add)	i	1975		1976	FY	•
(Each item not to exceed 60 characters and spaces)	Obls.	Outlays	Obls.	Outleys	Obls.	Outlays	Obis.	O
intermedication of each item of equipment	-				-			-
costing one-half million dollars or more.								
Various - Open Cycle		'		0.7		4.0		1
Various - Liquid + Closed Cycle				0.3		0.3		
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вуз	(4) 1977 Outlays	FY Obis,	:278	FY 1	(6) 1979 Outlays	Level of MAX ORD MIN SUBT FY 19 Obls.	IMUM ER LY IMUM	06	0655051	12855601 12855601 1507AL E: FY 1974 (1	
.0	S.7 0.4		0.6		0.3 0.1		11.3			e e	
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ENERGY RESEARCH & DEVELOPMENT Level of Effort: FACT SHEET □ MAXIMUM ORDERLY 1. IDENTIFICATION NU 0606550512855601 MINIMUM 2. a. PROGRAM Energy Conversion FAD b. SUBPROGRAM MID - Power Generation 3. . PROPONENT AGENCY Various including CCR, AEC, NBS, NASA b. SUBUNIT 4. CONTRACTOR AND SITE NAME OF CONTRACTOR: Various Site where work will be (No more than 42 charecters and State: County: performed spaces for name of confractor; we standard abbreviation for state. NAME OF CONTRACTOR up to 16 characters and spices for Site where work will be State: County: county. performed NAME OF CONTRACTOR: Site where work will be State: County: performed NAME OF CONTRACTOR: Site where work will be County: performed NAME OF CONTRACTOR: State: Site where work will be County: performed 5. BRIEF DESCRIPTION OF Open Cycle PROPOSAL . Component & Materials Development (No more than 24 lines of text . System Analysis & Design and no more than 70 characters . Supporting R&D and spaces per line) . Facilities Design & Construction Briefly outline nature and scope of work to be undertaken. - Large Scale Generator Test Facility including any new facilities - Long Endurance Materials Test Facility which may have to be acquired or constructed. . Construction DE-10 Plant (Coal Fired) Liquid Metal

3. Closed Cycle

. Component Development

Component Development
 Materials Studies

. Facilities Design & Construction (1 & 5 MW)

- . Feasibility Experiment
- . Support R&D

Support R&DProtetype Plant

Prototype Plant 50 MW

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

		7. MAJ	OR RESOURCE REQUI	REMENTS		
RESOURCE Y	FISCAL YEAR	1975	1976	1977	1978	197
. MANPOWER	(1) Scientific	154	182	1715	120	716
(in mon years)	(2) Technical	176 /	208	195	138	133
	(3) Support	154 (200	182 7 650	171 7 610	120 / 430	116
	(4) Other	66	78	73/	52	<u> 5</u> C
€cel, barrels of	and units of , such == tons of oil, Kilograms of Show amount of	0.3 mill	0.7 mill	C.4. mill	0.4 mill	0.2
C LAND AREA	(1) Govt-owned	-1		·		

ACT SHEET				1. IDENTIF	MID ICATION NUMBER 12855601
	Energy Conver	sion RAD	MUNINUM	1 000000	
AM	MID - Power (
TAGENCY	Various inclu	ding CCR, ADC	, NES, NASA		
ANDSITE	NAME OF CONTRACT	on: Various	•	•	
42 characters and * of contractor;	Site where work will be performed	State:	County:	-	
	NAME OF CONTRACT		·		**************************************
ters and spices for	Site willere work will be performed	State:	County:		
	NAME OF CONTRACT	CR:			
	Site where vierk will be performed	State:	County:		•
	NAME OF CONTRACT	OR:			
_	Site where work will be performed	State:	County:		
•	NAME OF CONTRACTO	OR:			•
	Site where work will be performed	State:	County:	•	
3PTION OF 24 lines of text as 70 characters dune) nature and scope ndertaken, aw facilities to be acquired	System A Support: Faciliti I arge Iong I Construct Liquid Meta Componer Material Faciliti Support Prototy Closed Cycl Componer Feasibil Support	nt & Materials Analysis & Des Ing R&D ier Design & Co Scale Generate Andurance Materich DEMO Plan il is Studies Les Design & Co R&D ier Plant le it Development le ity Experiment R&D ier Plant 50 MW	ign onstruction or Test Facili riais Test Fac nt (Coal Fire onstruction (1	:ility l) .	2
there a schmitte it				- .	
		DR RESOURCE REQU	UNEMENTS		· · · · · · · · · · · · · · · · · · ·
FISCAL YEAR	1975	1976	1977	1978	1979
1) Scientific	154	182	171	120	116
2) Technical	176 /	208 /	195 / 610	138	133 /
3) Support	1,34	202	171 / 020	120 \ 430	116 /
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LS Id units of uch as tons of Il. Kilograms of Ow amount of ut right.)	0.3 mill	0.7 mill	0.4. mill	0.4 mill	0.2 mill

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Other

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ese standary abbreviation for state	NAME OF CONTRACTOR	t:		· ·				
up to 16 characters and spuces (or county.	Site where work will be performed	>	State:	County:				
•	NAME OF CONTRACTOR:							
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	Site where work will be performed	>	State:	County:				
ARISE DESCRIPTION OF	1 Ones Ocala			•				

PROPOSAL

(No more than 24 lines of text end 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.

Open Cycle

- . Component & Materials Development
- . System Analysis & Design
- . Supporting R&D
- . Facilities Design & Construction
 - Large Scale Generator Test Facility
 - Tong Endurance Materials Test Facility
- . Construction DEWO Plant (Coal Fired)

Liquid Metal 2.

- . 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

		7. MAJ(OR RESOURCE REQUI	REMENTS	• •	
RESCURCE	FISCAL YEAR	1975	1976	1977	1978	19:
. MANPOWER	(1) Scientific	154	182	171	120	116
(in man years)	(2) Technical	176 (208	195	138 /	133
	(3) Support	154 7550	182 > 650	171 7 610	120 / 430	116
-	(4) Other	66	78/	73/	52/	5C
cool, barrels af	end units of , such as tons of oil, Kilograms of Show amount of	0.3 mill	0.7 mill	0.4. mill	0.4 mill	0.
C. LAND AREA	(1) Gavt-owned					
REQUIRED	(2) Govt-leased					
(in ocres)	(3) Privately-owned	0.4	-0.8	0.4	0.4	0.2
4 0	(4) Other					
(Spec'ly liem o	. Show quantity	f1)		3		
equipm. + +	test facili-	4.5 mill	26.0 "	39.0 "	17.5 *	. 5 .
travel, etc	:. Í	0.8 mill	1.0 "	0.9 "	0.7 "	0.1

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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: .				
	1. Open Cycle		•	, 3			
_	. Component 8	Materials	Development				
zt :	. System Anal						
iera:	Supporting	•					
cope	Facilities Design & Construction						
	- Large Sca	le Generato	r Test-Facility				
. 1	- Long Endu	rance Mater	ials Test Facility				
red			t (Coal Fired)				
•	2. Liquid Metal						
	. Component I	eveloament	•				
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j			nstruction (1 & 5 MV)				
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	7. MAJ	R RESOURCE REQUI	REMENTS		
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s of ms of nt of	0.3 mill	0.7 mill	0.4. mill	0.4 mill	0.2 mill
ined					
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ili-	(1) 4.5 mill	26.0 "	39.0 "	17.5 "	5.0 "
	0.8 mill	1.0 "	0.9 "	0.7 "	0.6 "
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ENERGY RESEARCH AND DEVELOPMENT FACT SHEET (Continued)

Level of Effort:	
MAXIMUM	IDENTIFICATION NUMB
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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) development 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)

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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).
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a. DEVELOPMENT MILESTONES (number each consecutively) b. DATES				
(Limit Title of Milestone to 60 characters and spaces)	Start		Complete	
(I.) Open Cycle	FY	α	FY	<u>a</u>
1. Long Endurance Materials Test Facility Operational 2. Large Scale Generator Test Facility Operational With Clean Fuels 3. Channel, Magnet & Other Parts Completed for US-USSR Exchange 4. Cenerator Enthalpy Extraction Tests Complete 5. Test Facility Modification for Coal 6. Coal Fired Tests Complete 7. Component Lifetime Tests Complete 8. Component Performance Verifiel 9. Evaluation of System Performance 10. Design of 50 MW Demo Plant Complete Liquid Metal 1. Compound Design Established 2. Simulated 1 MW Power System Completed 3. Mi-Temp. Test Facility Completed 4. Component Testing Completed 5. System Performance Demonstrated 6. 20 MW Prototype Plant Design Complete	75 75 75 76 76 76 75 75 75 75 75 75 75 75 75 75 75 75 75		77 77 78 79 80 80 80 80 80	