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COO/4210-3/3

GRID CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM

Phase II, Final Stage 2 Report

Cost Benefit Analysis, Operating Costs and Computer Simulation

March 22, 1978

Work Performed Under Contract No. EC-77-C-02-4210

University of Minnesota
Physical Plant
Minneapolis, Minnesota

and

Helmick & Lutz Company
Engineers
Minneapolis, Minnesota

U. S. DEPARTMENT OF ENERGY

Division of Buildings and Community Systems

MASTER

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GRID CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM

PHASE II

FINAL STAGE 2 REPORT

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COST BENEFIT ANALYSIS,
OPERATING COSTS AND
COMPUTER SIMULATION

March 22, 1978

UNIVERSITY OF MINNESOTA PHYSICAL PLANT
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Prepared For
The U.S. Department of Energy
Under Contract No. EC-77-C-02-4210

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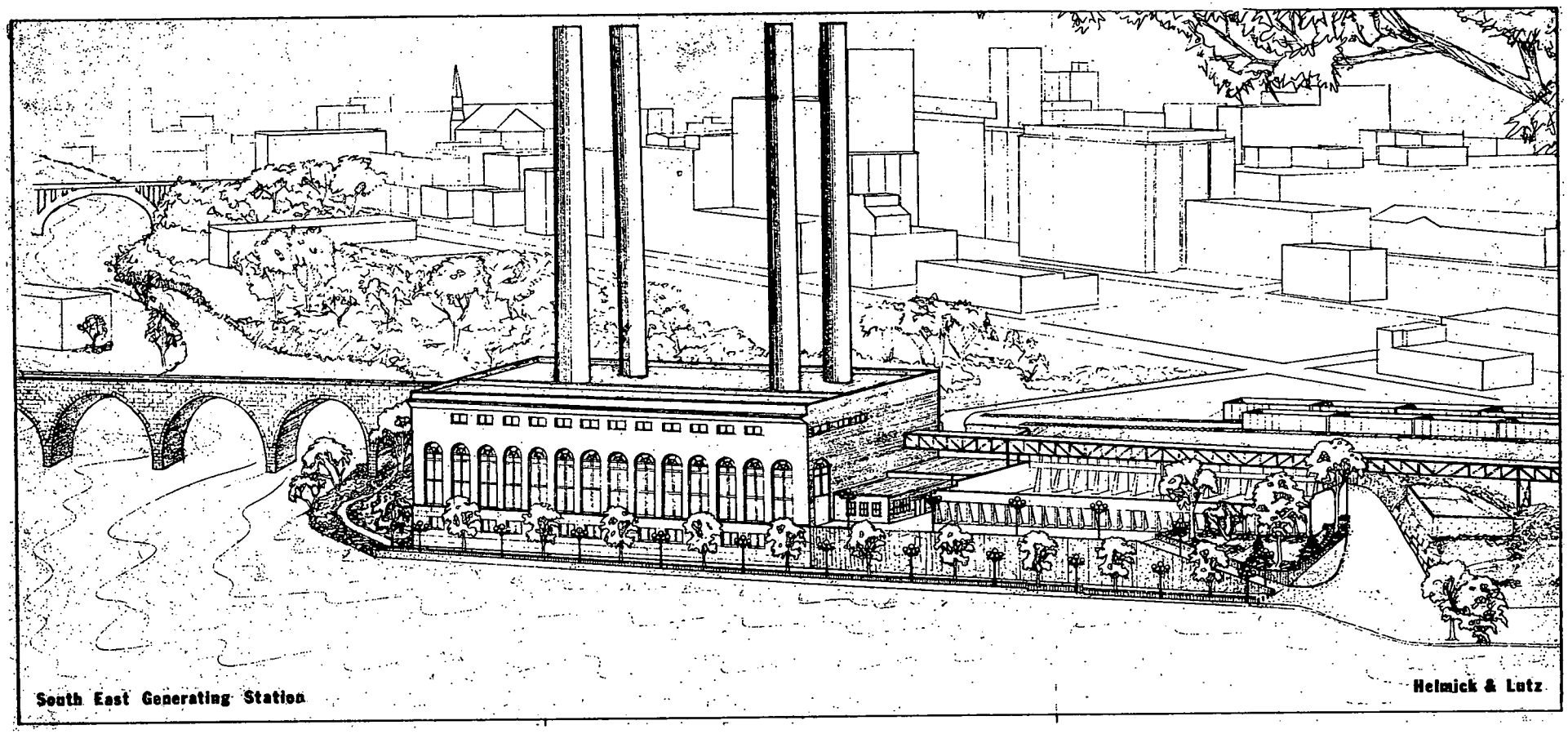
South East Generating Station
Helmick & Lutz

VOLUME 3

COST BENEFIT ANALYSIS, OPERATING COSTS AND COMPUTER SIMULATION

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3.0 COST BENEFIT SUMMARY

The following materials represent cost benefit analysis of the Basic Plan, Option I - Add-on Customers, Option II - Pyrolysis and Option III - Hot Water. All cost benefit comparisons are made relative to the University's normal plant expansion requirements into the 1980's. Capital budgets have been reallocated for the normal expansion so that true cost benefits will result when compared to the Basic Plan of ICES or any of the Options.

All loans for normal expansion or ICES were amortized at 5 3/4% effective annual rate and 15 years. Comparisons were developed to show cost benefits with or without capital cost sharing and firing the central plants on either eastern or western coal. The capital budgets were escalated from 1978 to 1979 and all operating costs to the end of 1981. Not factored into the calculations was construction cash flow debt service, but this was accounted for in the simulated computer cash flow analysis.

The steam side of normal expansion or cogeneration expansion is required to be fully cost recoverable. The turbine generator or pyrolysis are customers of the steam side of the cogeneration plant. The turbine generator is required to purchase steam based upon its annual energy production, plant heat rate, and gross owning and operating cost of the steam side. Pyrolysis receives credit from the steam side based upon a ratio of equivalent kilowatt hours of pyrolysis to that of the turbine generator. Option I add-on customers are required to pay base steam costs plus a surcharge for gross owning and operating costs of the steam grid interconnections between them and the University.

The following two pages summarize the cost benefits available with a western coal fired ICES. The outstanding result is that an eastern coal fired ICES is marginally cost effective.

Using annual escalation factors the simple cost benefit analysis was carried into a cost effectiveness analysis that used present worth arithmetic to evaluate the time effects of escalation of operating costs on cost benefits. Discounted rates of return were included in this study to make it a conservative estimate.

Generally, all the operations have definite cost effectiveness centered on the turbine generator. Pyrolysis, while not being cost effective on its own, does enhance the central plant operation. Pyrolysis is a necessary socio-economic instrument that must be installed to achieve some social benefits. It can be likened to a bridge across a rushing river. The bridge must be built to obtain the socio-economic benefits of better, shorter, more economic transporation and the tying together of a community. Pyrolysis brings together in one package the controllable collection and disposal of a hazardous waste for which there are few now available. The socio-economic benefit of pyrolysis is the overwhelming factor, not the cost benefit, and it should be installed along with the rest of the ICES program.

TABLE 1

COST BENEFIT SUMMARY - TURBINE GENERATOR

- 1981 -

	NORMAL EXPANSION	BASIC PLAN		OPTION I ADD-ON CUST.	OPTION II PYROLYSIS	OPTION III HOT WATER
Fuel Type - Coal BTU per lb.		WESTERN (8890)	EASTERN (12726)	WESTERN (8890)	WESTERN (8890)	WESTERN (8890)
Payback Period, Years	BASE	5.51	23.71	4.96	4.50	3.76
Minimum Acceptable Rate of Return, %	BASE	5.75	5.75	5.75	5.75	5.75
Rate of Return (MAR), %	BASE	16.0	BASE	21.00	19.00	19.00
Return on Investment, %	BASE	16.81	BASE	18.25	17.53	17.69
Benefit-to-Cost Ratio	BASE	2.10	1.09	2.19	2.36	2.13
Gross Production Cost, $/KWH	BASE	.02269	.02679	.02112	.01989	.02129
Gross NSP Credit, $/KWH	BASE	.028	.028	.028	.028	.028
Annual Cost Benefit, $	BASE	$216,712	$50,503	$260,528	$237,702	$242,618

TABLE 2

STEAM SIDE OF PLANTS

- 1981 -

	NORMAL EXPANSION		BASIC PLAN		OPTION I ADD-ON CUST.		OPTION II PYROLYSIS	OPTION III HOT WATER
Fuel type BTU per lb.	WESTERN (8890)	EASTERN (12726)	WESTERN (8890)	EASTERN (12726)	WESTERN (8890)	EASTERN (12726)	WESTERN (8890)	WESTERN (8890)
Gross Steam Production Charge ($ per 1000 lb.)	2.981	4.153	3.615	4.852	3.373	4.153	3.567	3.769
Community Charge ($ per 1000 lb.)								
University	2.981	4.153	3.373	4.527	3.373	4.153	3.5657	3.494
St. Mary's	BASE	N/A	N/A	N/A	*3.816 **(3.891)	*4.678 **(4.753)	*3.883 **(3.958)	-
Fairview	BASE	N/A	N/A	N/A	3.586 (3.622)	4.406 (4.442)	3.653 (3.689)	-
Augsburg	BASE	N/A	N/A	N/A	4.402 (3.651)	5.219 (4.467)	4.469 (3.718)	-

* Typical - costs for Augsburg steam distribution is totally funded by Augsburg

** Typical - costs for Augsburg steam distribution is shared by St. Mary's, Fairview and Augsburg

N/A - not applicable

3.1 CAPITAL BUDGET SUMMARY

The following outline is based upon the consultants Capital Budget for 1978. Discrepancies that exist between this budget and the consulants are primarily caused by cost takeoff and application of the 12% contingency item.

CAPITAL BUDGETS - 1978*

I. Grid ICES

A. Basic Plan (Including Engineering and Contingincies @ 12%)

1. Steam Generation

a.	Plant, Interconnections	$5,411,800
b.	S.E. Station Utilities	270,000
c.	S.E. Fuel Systems	1,863,000
d.	S.E. Plant Systems	4,448,000
e.	S.E. Remodeling	991,000
f.	S.E. Plant Instrumentations	664,000
g.	U. of M. Plant Pollution Control	2,600,000
h.	S.E. Plant Acquisition	500,000
i.	Site Survey and borings	20,000
j.	Site Demolition	150,000
	Subtotal (Steam Generation)	$16,917,800

2. Electric Generation

a.	Turbine Generator	$2,262,400
b.	Switchgear and Wiring	341,600
c.	Instrumentation	13,440
d.	Computer Interface	16,800
		$2,634,240

B. Exclusions From Grid ICES For Normal Expansion

1.	Low Pressure piping	$ 343,840
2.	Primary Electric Tie	268,800
3.	#1 and #3 Boiler	225,200
4.	Condensate Treating	99,680
5.	Makeup Water Treating	316,960
6.	Pollution Control	672,000
7.	Computer and Interface	324,800
8.	Turbine-Generation	2,634,000
	Total Exclusions	$4,885,280

II.	Normal Plant Expansion	$14,666,760
	plus Incinerator Upgrade	163,000
	Total Capital Budget	$14,829,760

III. Option I- Add-on Customers (Including Engineering & Contingencies)

1.	Tunnel Connection		$ 1,349,000
2.	Metering St. Mary's	$ 6,720	
	Fairview	6,720	
	Augsburg	6,720	
	U. of M.	10,640	
			30,800

* Capital Budgets prepared by Helmick and Lutz and the differences in the above are caused by contingency (12%) multiplication accounting.

3.	MIS	$ 16,800
4.	Augsburg Connection and Dist.	$ 431,760

Cost Sharing

Surcharge (St.Mary's,Fairview, Augsburg)	$1,359,640
D.O.E. Share	(16,800)
St. Mary's Share	(6,720)
Fairview Share	(6,720)
Augsburg Share	(6,720)
Surcharge (Augsburg)	431,760
Total Capital Loans	
Surcharge to St. Mary's,Fairview,Augsburg	1,359,640
Surcharge Add-on to Augsburg	431,760

IV. Option II- Pyrolysis

Total Capital Budget $7,700,800

V. Option III- Hot Water

Total Capital Budget $1,930,000

3.2 GENERAL SUMMARIES

The following materials summarize production, operations and depreciation costs for the various portions of the ICES. Detailed breakdowns are shown in Section 3.4 of this volume.

TABLE 3

SUMMARY OF UTILITY UNIT COSTS

	1978	Escalate	1981
Coal (Per Ton)			
Western, 8,890 BTU/#	$16.78	7.4 %	$20.78
Eastern, 12,726 BTU/#	$42.31	7.4 %	$52.42
Natural Gas (MCF)			
Interruptible	$ 1.92	13 %	$ 2.77
Firm, Process	$ 2.60	13 %	$ 3.75
Fuel Oil			
No. 2 Per Gal.	.4125¢	13 %	.5951¢
Per 10^6 BTU	$ 2.946	13 %	$ 4.25
No. 6 Per 10^6 BTU	$ 2.678	13 %	$ 3.864
Ash Disposal			
Coal Ash, Per Ton	$ 6.12	6.15%	$ 7.32
Frit, Per Ton	$ 1.53	6.15%	$ 1.83
Electric Power			
Per MWH	$26.20	10 %	$34.87
Electric Power Sale			
Capacity Credit (KW)	$64		$83
Energy (MWH)	$11		$14
Water & Sewer	.535/1000 gal.	10 %	.712

TABLE 4

SUMMARY - ANNUAL DEPRECIATION EXPENSES

	Depreciation Basis 1978	Depreciation Basis End of(1) 1979	Rate %	Levelized Annual Expenses	
Basic Plan					
Existing Plant & Dist.	$20,000,000	$20,000,000	2.49	$498,000	
New Plant - Steam	12,185,000	14,602,500	2.49	363,600	
		Total Steam Gen.		$861,600	$861,600
Basic Plan					
Turbine Gen.	$ 2,352,000	$ 2,818,380	2.77	$ 78,080	$ 78,080
			Total Basic Plan		$939,680
Option I					
Main Tunnel	$ 1,204,000	$ 1,442,875	.54	$ 7,800	
Augsburg Conn.	385,500	461,985	.54	2,500	
			Total Option I		$ 10,300
Option II					
Pyrolysis, Boiler	$ 7,342,800	$ 8,799,610	2.77	$243,750	
			Total Option II		$243,750
Option III					
Buildings Retro.	$ 510,000	$ 600,400	.54	$ 3,240	
Hot Water Gen. and Dist.	1,222,000	1,464,445	2.49	36,465	
			Total Option III		$ 39,705

The above summary is based upon dispersion techniques shown in the Appendix. For the cost comparisons a sinking fund accumulation at 7% was used for the levelized depreciation amount. This amount is greater than a sinking fund with dispersion applied and would result in a conservative estimate.

1. Includes capital cost and engineering and contingencies. 1978 capital cost less engineering and contingencies escalated 7% to 1979. Engineering and contingencies are 12% of capital cost added to 1979 cost.

TABLE 5

SUMMARY ANNUAL OPERATING EXPENSES - BASIC PLAN

A. STEAM GENERATION

Plant Boiler Insurance - 1977	
University Plant	$ 5,200
Southeast Plant	5,200
ICES - 1977	$ 10,400
Plant Fire Insurance - 1977	
University Plant	$ 3,200
Southeast Plant	3,200
ICES - 1977	$ 6,400
Makeup Water and Sewer ($.28/1,000 lb)	
University Plant (30%)	$ 8,400
Southeast Plant (70%)	19,600
ICES - 1977	$ 28,000
Annual Service Contracts	
University Plant (Existing) - 1977	
Bailey Meters	$ 1,000
Hagen Meters	1,000
Hayes Meter	4,000
Southeast Plant (Estimate) - 1977	3,000
ICES TOTAL	$ 9,000
In Plant Power Costs - University Plant - 1977	$118,400
Cost per KWh - $.0268 - 1978	
Supplies and Miscellaneous Repair - 1977	
University Plant	$ 98,520
ICES (Estimates)	
University Plant	35,000
Southeast Plant	100,000
TOTAL ICES - 1977	$135,000
Custodial Costs - 1977	
University Plant (Existing)	$ 5,000
ICES Plants (Combined)	10,000
Building and Grounds - 1977	
University Plant (Existing)	$ 5,200
ICES Plants (Combined)	10,000

Coal Trucking

Coal trucking is a fuel inventory charge and charged back in fuel costs. These are few in number for ICES, so they will be neglected.

*All expenses are end of year shown.

Trucking Charges - Ash Hauling - 1977

Landfill per ton = $3.00	$ 3.00
Cost of truck per hour - $ 6.00	
Cost of driver per hour - 7.62	
Total $13.62/Hours	
Truck Capacity - 10 Tons	
Truck & Driver Charge @ 4 trips/day =	
$\frac{1}{10T} \times \frac{1}{4} \times \$13.62 \times 8 = 2.72$ per ton	$ 2.72
Total Ash Hauling - 1977	$ 5.72/Ton
- 1981	$ 6.92/Ton

Administration Expense - 1977

University Plant (Existing)	$ 75,000
ICES (Combined)	100,000

Miscellaneous Plant Labor Expense - 1977

University Plant (Carpenters, Steam Fitters, Summer Help)	$116,000
ICES (Combined)	150,000

Trackage and Locomotive Repair 1977-(ICES) (Est.) $ 20,000

Distribution Maintenance (Existing & ICES) - 1977

(Tunnels, piping, etc)	$140,000

Annual Salaries and Fringe Benefits - 1978

Existing University Plant*

1 - Sr. Chief Operating Engineer @ $12.01/Hr	$ 24,980
1 - Asst. Chief Operating Engineer @ $9.56/Hr	19,885
5 - Principal Operating Engineers @ $8.16/Hr	84,864
6 - Sr. Operating Engineers @ $7.82/Hr each	97,594
7 - Jr. Operating Engineer @ 7.20/Hr each	104,832
20 - Men Salaries	$332,155

Fringe Benefits

Average Sick Pay, $332,155 ÷ 41,600 hrs = $798	
104 hours/man/year x 20 x 7.98	$ 16,598
Insurance - .1972% of Gross Salary	
Retirement - 6.0000% of Gross Salary	
Social Sec. - 5.9727% of Gross Salary	
Unemply. Comp. - 1.1600% of Gross Salary	
Health Ins. - 6.5001% of Gross Salary	
19.8300% x $332,155	$ 65,867
Gross Annual Salaries and Fringes - 1978	$414,620

ICES*

1 - Sr. Chief Operating Engr. @ $12.01/Hr	$ 24,980
1 - Chief Operating Engr. @ $9.56/Hr	19,885
1 - Asst. Chief Operating Engr. @ $9.29/Hr	19,325
10 - Principal Operating Engr. @ $8.16/Hr	169,728
13 - Sr. Operating Engr. @ $7.82/Hr	211,452
12 - Jr. Operating Engr. @ $7.20/Hr	179,710
2 - Crane Operators @ $7.62/Hr	31,700
40 - Men Salaries	$656,780

ICES* (Continued)

Fringe Benefits

Average Sick Pay $656,780 ÷ 83,200 = $7.89	
104 hours/man/year x $7.89	$ 32,820
(19.83% ÷ 100) x $656,780	$130,240
Gross Annual Salaries and Fringes - 1978	$819,840

Fuel Costs (Experience) (ICES) - 1977

Western Coal @ 8,890 BTU/lb	
Mine Cost per Ton	$ 7.85
Tariffs per Ton	7.7747
Total Cost/Ton - 1977	$ 15.6247
Eastern Coal (Experience 1977)	$ 39.40/ton
Natural Gas - 1977	$ 1.50/MCF
No. 2 Oil - 1977	$ .36/gal

*Salaries include Vacation and Holiday pay.

B. ELECTRIC GENERATION SIDE OF CENTRAL PLANTS*

Administration Expense - 1978 (estimate)	$ 20,000	
Ash Hauling and Landfill - 1977	5.72/Ton	
Maintenance and Supplies - 1978 (estimate)	$ 30,000	
Custodial (1978) - estimate	$ 2,000	
Utilities (1978) - estimate	$ 5,000	
Insurance (1978) - estimate	$ 2,000	
Annual Salaries and Fringe Benefits (2,080 Hours) - 1978		
Southeast Steam Plant		
2 - Prin. Operating Engr. @ $8.16/Hr	$ 33,945	
1 - Journeyman Elect. @ $13.20/Hr	27,460	
Gross Salaries	$ 61,405	$61,405
Fringe Benefits - Civil Service		
Base Gross Salary = $33,945		
Sick Pay - 104 hours/man/year	1,695	
Insurance - .1972% of Gross Salary		
Retirement - 6.000% of Gross Salary		
Social Security - 5.9727% of Gross Salary		
Unemployment & Workmens Comp. - 1.16% of Gross Salary		
Health Plan - 6.5001% of Gross Salary		
Total = 19.83%	6,730	
Fringe Benefits - Union		
Base Gross Salary = $27,460		
Social Security - 5.9727% of Gross Salary	1,640	
Unemployement & Workmens Compensation - 1.16% of Gross Salary	320	
Total Annual Fringe Benefits	$ 12,502	$12,502
Gross Annual Salaries - 1978		$82,332

*All expenses are end of year shown.

TABLE 6

SUMMARY - COST ESCALATION DATA

The following data represents cost escalation data based upon actual University expenditures, Federal Register, N.S.P. projections and judgement.

Annual escalation rates of the various components making up the annual O & M costs and steam sales are shown in the following tables.

	Annual Escalation Item	% per Annum
f1	Construction	7
f2	Labor	7
f3	Sewer and water	10
f4	Purchased electricity	10
f5	Purchased supplies	7
f6	Maintenance	7
f7	Ash removal and landfill	7
f8	Insurance	3
f9	Administration	8
	Fuel	
f10	Coal (Eastern or Western)	7.399
f11	Oil (No. 2)	13
f12	Gas (Natural)	28
f13	Pool electricity credits	5.54 by rate*
f14	Service Contract	10
f15	Custodial	7
f16	Building and Grounds	7
f17	Landfill (excluding ash handling)	10
f18	Miscellaneous Labor	7
f19	Municipal waste drop charge	10
f20	HHC waste drop charge	10

*Effective annual increase in dollars is 9.23% per annum.

TABLE 7

SUMMARY OF GENERATION CREDIT STRUCTURE

The following data was supplied by Northern States Power Company.

NORTHERN STATES POWER

Projection on Pool Credits per N.S.P.

Rate Structure

	1977	1981	Total Escalation	Annual Escalation
Capacity	$64.00/KW	$83.00/KW	22.89%	5.72%
Base Load Energy Rates	$11.00/MWH	$14.00/MWH	21.43%	5.36%
		Average Annual Escalation		5.54%

Economy Rates

	1977		1981	
	On Peak	Off Peak	On Peak	Off Peak
Summer Per (MW-Hrs)	$11.20	$ 7.20	$13.56	$ 8.45
Winter Per (MW-Hrs)	$16.00	$ 8.00	$21.20	$10.17

TABLE 8

SUMMARY - COMBINED ANNUAL ESCALATION RATES

Since the life cycle study must account for inflationary trends of all expense items and for simplification it is desired to lump sum the operating expense into significant categories, it is necessary to forecast combined Escalation Rates (CER) of the lumped sum operating expenses. The calculations for determining the CER's are presented in Section 3.4.

Operating Expense Category	Annual CER, %
Purchased Utilities	10.00
Administration	8.00
Labor, Supplies, Maintenance	6.98
Western Coal	7.399
Eastern Coal	7.399
Oil (No. 2)	13.00
Natural Gas	28.00
Steam Production Charge	8.05 (coal)
Electric Production Charge	5.17 (coal)

TABLE 9

ANNUAL OPERATING EXPENSE SUMMARY

BASIC PLAN - STEAM GENERATION
ANNUAL EXPENSE ESCALATION

	Base Year (End of)	Base Year[1] OPERATING EXPENSE BASIC STM. PLANT	Base Year[1] OPERATING EXPENSE ICES PLANT	ESC.[2] FACTOR %	End of 1981 OPERATING EXPENSES BASIC STM. PLANT	End of 1981 OPERATING EXPENSES ICES PLANT
Purchased Utilities						
City Water & Sewer	1977	$ 28,000	$ 28,000	10	$ 39,200	$ 39,200
Electricity	1977	244,446	244,446	10	342,224	342,224
Total Purchased Util.		78,000	$272,446		$343,904	$381,424
Insurance						
Boiler and Fire	1977	8,400	16,800	3	9,408	20,832
Administration	1977	75,000	100,000	8	99,000	132,000
Labor, Supplies, Maint.						
Service Contracts	1977	6,000	9,000	10	8,400	12,600
Supplies & Repairs	1977	98,520	135,000	7	126,106	172,800
Custodial	1977	5,000	10,000	7	6,400	12,800
Bldg. & Grounds	1977	5,000	10,200	7	6,400	13,056
Misc. Labor	1977	116,000	150,000	7	148,480	192,000
Tracks & Loco. Maint.	1978	5,000	20,000	7	6,400	25,600
Distribution Maint.	1977	140,000	160,000	7	179,200	204,800
Plant Direct Labor	1978	414,620	819,840	7	501,690	992,006
Total Labor, Supplies		$789,870	$1,294,040		$983,076	$1,625,662
Fuel						
Eastern Coal, $/ton	1977	$ 39.40	$ 39.40	7.399	$ 52.42	$ 52.42
Western Coal, $/ton	1977	15.62	15.62	7.399	20.78	20.78
Oil, $/gal.	1977	.365	.365	13.00	.532	.532
Gas, $/MCF	1977	1.92	1.92	28.00	3.53	3.53
Ash handling and land-fill, $/ton	1977	5.72	5.72	7.00	7.32	7.32

TABLE 9 (Continued)

TURBINE - GENERATOR

Purchased Utilities	1977	-0-	$ 5,000	10	-0-	$ 7,000
Administration	1978	-0-	20,000	8	-0-	24,800
Labor, Supplies, Maint.						
Maint. & Supplies	1978	-0-	30,000	7	-0-	36,200
Custodial	1978	-0-	2,000	7	-0-	2,420
Total Labor, Supplies		-0-	32,000		-0-	38,420
Insurance	1978	-0-	2,000	3	-0-	2,180

[1]The factors and calculations used to arrive at the base year operating expense are contained in Section 3.4.

[2]See Section 3.4 for escalation factors from base year to end of 1981.

[3]Existing Plant Electric Consumption (1977) = 1,866,000 kwh/year
S.E. Plant Estimated Consumption = 7,464,000 kwh/year
Total ICES Plant = 9,330,000 kwh/year

TABLE 10

BASIC PLAN PRODUCTION SUMMARY

	Eastern	Western
Total Annual Coal Consumption	109,939 tons	157,377 tons
Allocated Annual Turbine-Gen.	7,606 tons	10,888 tons
Total Annual Header Steam (1000's)	1,947,106 lbs.	
Total Annual Blowdown	58,413 lbs.	
Total Annual University Metered Steam	1,810,324 lbs.	
Total Annual University Line Loss	136,297 lbs.	
Gross Annual Generation	40,566,000 kwh	
Annual Line Losses	3,238,717 kwh	
Purchased Electricity		
S.E. Steam	7,464,000 kwh	
U. of M. Plant	1,866,000 kwh	

Purchase Price of Annual Steam for Turbine-Generator=

$$\frac{\text{Turbine Heat Rate X Annual Kwh}}{\text{Total Plant Coal X BTU/lb x 2000}} \text{ x (Gross Owning \& Operating)}$$

Average Annual Heat Rate = 4619 BTU/kwh

Eastern Coal = 12726 BTU/lb.

Western Coal = 8890 BTU/lb.

TABLE 11

OPTION I - ANNUAL INCREMENTAL PLANT USAGE - 1981

Incremental Coal Consumption	Eastern, Tons 12,726 BTU/lb	Western, Tons 8,890 BTU/lb
St. Mary's	8,637	12,364
Fairview	4,154	5,947
Augsburg	3,777	5,407
Generation	588	842
Incremental Ash	**10%, Tons**	**8%, Tons**
St. Mary's	864	990
Fairview	415	595
Augsburg	378	541
Generation	59	84
Incremental Header Steam (1,000's)		
St. Mary's	165,130 lbs	
Fairview	79,424	
Augsburg	72,165	
Incremental Blowdown Steam (1,000's)		
St. Mary's	4,954 lbs	
Fairview	2,383	
Augsburg	2,165	
Incremental Community Steam Usage (1,000's)		
St. Mary's	152,752 lbs	
Fairview	73,476	
Augsburg	66,799	
Incremental Steam Line Loss (1,000's)		
St. Mary's	11,559 lbs	
Fairview	5,560	
Augsburg	5,052	
Incremental Makeup Water @ $.364/1,000		
St. Mary's	11,559	
Fairview	5,560	
Augsburg	5,052	
Incremental Gross Generation	4,209,000 KWh	
Incremental Gross Losses	336,000 KWh	

TABLE 12

BASIC PLAN & OPTION I ADD-ON PLANT CONSUMPTION AND PRODUCTION (ANNUAL)
(End of 1981)

	BASIC PLAN			OPTION I ADD-ON					
	Univ. Comm.	Turbine	Sub-total	St. Mary's	Fairview	Augsburg	Sub-total	Elec. Gen.	Grand Total
Western Coal, Tons	146,489	10,888	157,377	12,364	5,947	5,407	23,718	842	181,937
Eastern Coal, Tons	102,333	7,600	109,939	8,637	4,154	3,777	16,568	588	127,095
Coal Cost, West	3,044,041	226,253	3,270,294	256,924	123,579	112,357	492,860	17,497	3,780,651
(end of 1981) East	5,364,067	398,689	5,762,756	452,752	217,753	197,990	868,495	30,823	6,662,074
Ash & Landfill, West.	$ 85,784	$ 6,376	$ 92,160	$ 7,247	$ 4,355	$ 3,960	$ 15,562	$ 615	$ 108,337
(end of 1981) East.	74,940	5,568	80,476	6,324	3,038	2,767	12,129	432	93,037
Steam Ge. (annual) 1000's lbs.	2,005,034	-	2,005,034	169,265	81,419	74,016	324,700	-	2,329,734
Elec. Gen. Kwh	-	40,566,000						4,209,000	44,775,000
Comm. Steam	1,810,324	-	1,810,324	152,752	73,476	66,799	293,027	-	2,103,351
Line Loss	136,297	-	136,297	11,559	5,560	5,052	22,171	-	258,468
Blowdown	58,413	-	58,413	4,954	2,383	2,165	9,502	-	67,915
Total 1000's lbs.	2,005,034	-	2,005,034	169,265	81,419	74,016	324,700	-	2,329,734
Generator Income, $									
Capacity		$ 569,463						$ 9,887	$ 579,340
Energy		567,924						58,926	626,850
Total		$ 1,137,387						$ 68,803	$1,206,190

TABLE 13

OPTION I - ANNUAL INCREMENTAL EXPENSE SUMMARY - 1981

End of 1981 Costs

Incremental Cost Item	St. Mary's	Fairview	Augsburg Main Connection	Augsburg Augsburg Distribution
Purchased Utilities	$5,563	$2,676	$2,432	$ 0
Insurance	0	0	0	0
Administration	2,085	1,003	912	830
Labor, Supplies, Miscellaneous (Distribution Add-On)	5,046	2,427	2,207	3,000

TABLE 14

ANNUAL OPERATING EXPENSE SUMMARY - OPTION II

	Cost per Ton End of 1978	PYROLYSIS Cost per Ton Base Cost	Esc. per Annum	End of 1981 Cost
Administration	.21	$ 9,702	7	$ 11,885
Labor	6.31	291,522	7	357,127
Electric Power	2.57	118,734	10.0	158,035
Fuel Oil	1.42	65,604	13.0	94,660
Insurance, Water, Gas	.85	39,270	7.5	48,785
Building & Grounds	.10	4,620	7	5,650
Service Contracts	.13	6,006	7	7,358
Slag Disposal	.28	12,936	7	15,847
Maintenance & Repair	2.03	93,786	7	114,892
	End of 1981 Operating & Maintenance			$814,239
	End of 1981 Cost/ton			$ 17.62

Steam Credit: 301,920 x 10^6 x $3.01/1000 lbs. = $908,779

Electric Credit: Incremental = $ 96,824

Drop Charge Credit: Phoenix Ind.
18,900 x $4/ton = $ 75,600
27,300 x $10/ton = $273,000

- 1981 -

Coal Consumption - Western Coal - Basic Plan
University 155,731 tons
Generation 11,340 tons

Pyrolysis Equivalent 26,144 tons

TABLE 15

OPTION II - PYROLYSIS ANNUAL PRODUCTION SUMMARY

- 1981 -

Steam (1000's lbs.)

Community Steam Usage	1,810,324 lbs.
Community Line Loss	136,297 lbs.
Community Blowdown	51,495 lbs.
Basic Plan Elec. Production	40,566,000 KWh
Option 2 Incremental Production	3,458,000 KWh
Total Production	44,024,000 KWh
Pyrolysis Steam Production	319,200,000 lbs.

TABLE 16

OPTION II - PYROLYSIS ANNUAL OPERATING COSTS PER TON

Escalation to year 1981 has been calculated according to the following schedule to show operating costs for year 1981.

Item	End of Year 1978 $/Ton Refuse	Escalation % Per Year	End of Year 1981 $/Ton Refuse
Labor	6.31	7	7.70
Fuel	1.42	13	2.05
Natural Gas	.02	10	.03
Electric Power	2.57	10	3.42
City Water and Sewer	.29	10	.38
Maintenance and Repair	2.30	7	2.82
Insurance and Miscellaneous Charges	.54	7	.66
Slag Disposal	.28	7	.34
Total - $/Ton	13.73		17.40

3.3 COST BENEFIT ANALYSIS

The following section will analyze the cost benefits of the University's normal plant expansion requirements versus the Grid ICES program for the Basic Plan plus the three options. The following cost benefit comparisons will be presented.

TABLE OF COMPARISONS

I. Basic Plan

A. Normal Plant Expansion vs. Cogeneration amortized at 5 3/4% for 15 years.

1. At Full Capital Costs

a. Eastern Coal vs. Eastern Coal (ICES)
b. Eastern Coal vs. Western Coal (ICES)
c. Western Coal vs. Western Coal (ICES)

2. At Full Capital Costs less legislative share and DOE share.

a. Eastern Coal vs. Eastern Coal (ICES)
b. Eastern Coal vs. Western Coal (ICES)
c. Western Coal vs. Western Coal (ICES)

II. Option I (Similar to Basic Plan)

A. Normal Plant Expansion vs. Cogeneration with Add-on amortized at 5 3/4% for 15 years.

*(2). At Full Capital Costs less legislative share and DOE share.

(b). Eastern Coal vs. Western Coal (ICES)

III. Option II - Pyrolysis

A. Normal Plant Expansion vs. Cogeneration with Option II add-on amortized at 5 3/4% for 15 years.

*(2). At Full capital costs less legislative share and DOE share.

(b). Eastern fuel vs. Western fuel (ICES) and solid waste (ICES)

IV. Option III

A. Normal Plant Expansion vs. Cogeneration with Option III add-on amortized at 5-3/4% for 15 years.

*(2). At Full capital costs less legislative and DOE share.

(b). Eastern fuel vs. Western fuel (ICES)

* Section numbers chosen to correspond with Basic Plan Comparisons.

3.3.1 COST BENEFITS - COMPARISON I.A.1.(a)

Eastern Coal (Both Plants), i = 5 3/4%, n = 15 years

Expense Item	Normal Plant Expansion	Cogeneration Expansion Elec. Gen.	Cogeneration Expansion Steam Gen.
Capital Budget-1978	$14,829,760	$2,634,240	$16,917,800
Escalated Budget-1979	15,867,845	2,818,635	18,102,045
Cost Sharing			
DOE	-0-	-0-	-0-
Legisl.	-0-	-0-	-0-
Total Cost Sharing	-0-	-0-	-0-
Loan (U. of M.)	$15,867,845	$2,818,635	$18,102,045
Capital Recovery	1,607,255	285,500	1,833,555
[1]Depreciation	1,001,430	78,700	1,063,810
Total Owning	$ 2,608,685	$ 364,200	$ 2,897,365
Operating Expenses (End of 1981)			
Insurance	$ 9,408	$ 2,180	$ 39,200
Purchased Utilities	343,904	7,000	381,424
Administration	99,000	24,800	132,000
Labor, Supplies, Maint.	983,076	38,720	1,625,662
[2]Fuel, Community	5,364,296	-0-	5,364,296
[3]Fuel, T-G	-0-	-0-	398,708
[4]Ash handling &landfill	74,940	-0-	80,478
[7]Turbine Steam Purch.	-0-	731,181	-0-
Total Operating Expense	$6,874,624	$803,881	$ 8,021,768
Gross Owning & Operating (End of 1981)	$9,483,309	$1,168,081	$10,919,133
Gross Production Expense			
Steam, $/1000 lbs.	4.7298	-	5.4459
Electricity, $/kwh	-0-	.0288	-
[5]Community Steam Charge	4.7298	-	5.0819
Revenue (Steam)			
a. Community Usage	$8,562,379	-	$ 9,198,594
b. Community Line Loss	644,651	-	692,550
c. Blowdown Allocation	276,279	-	296,807
d. T-G Steam	-0-	-	731,181
Total Steam Revenues	$9,483,309		$10,919,132
Revenue (Elec. Gen) (End of 1981)			
a. Capacity	-	$ 569,463	-
b. Energy	-	$ 567,924	-
Total Elec. Gen Revenue		$1,137,387	

Gross Plant Income	$9,483,309	$1,137,387	$10,919,132
* Plant Cash Flow (one year operation)	-0-	(30,694)	-0-
[6]Const. Cash Flow (Debt) (1979 through 1980)	2,957,350	525,320	3,373,741
Net Plant Cash Flow at end of 1981	(2,957,350)	(556,014)	(3,373,741)
Cash Flow Deficit at end of 1981	(2,957,350)	(556,014)	(3,373,741)
Cash Flow Deficit at end of 1983 (3 year operation for demonstration)	(6,816,368)	(614,402)	(7,776,107)
Net Cash Flow Difference	7,776,107 614,402 8,390,509 -6,816,368 1,474,141		

The cogeneration plant will lose $1,474,141 per year over the normal plant expansion.

* Parentheses indicate an amount less than zero.

Notes (I.A.1(a))

1. Depreciation Basis: Sinking Fund - 7% return
   Average Plant Life 20 years - no dispersion

   Normal Plant Expension Basis: $35,867,845 (see Appendix)
   Levelized Annual Payment: 1,001,430

   Turbine-Generator Basis: $ 2,818,635
   Levelized Annual Payment: 78,700

   Cogeneration Expansion Basis: $38,102,045
   Levelized Annual Payment: 1,063,810

2. Coal Consumption - 1981

   Normal Plant Expansion:
   Eastern Coal: $109,939 - 10,888 \left(\frac{8890}{12726}\right) = 102,333$
   102,333 x $52.42=$5,364,296

   Grid ICES
   Eastern Coal: 109,939 Tons
   109,939 x $52.42=$5,763,002

3. Annual Turbine Steam Usage - 1981

   Equivalent Turbine Generator Steam $= \frac{7606\ (12726)\ 2000 \times .8}{(1385-220)} = 132.956(10^6)$lbs.

4. Ash Handling and Landfill - 1981

   Normal Plant Expansion
   102,333 x .10 x 7.32 = $74,940

   Grid ICES
   109,939 x .10 x 7.32 = $80,478

5. Community Steam Charge

   Normal Plant Expansion
   $$\frac{\$9,483,309}{(1,810,324 + 136,297 + 58,143)} = \$4.72975/1000 \text{ lbs.}$$

   Grid ICES
   $$\frac{\$10,919,133 - 731,181}{(1,810,324 + 136,297 + 58,413)} = \$5.081186/1000 \text{ lbs.}$$

6. i = 5 3/4% n = 2

   Present Worth of Series = 1.84
   1.84 x $1,607,255 = $2,957,350

7. Turbine Steam charge = (Gross Owning & Operating Steam Side)
   $$\times \left(\frac{\text{Turbine Heat KWh x Annual KWh}}{\text{Tons Coal x Btu/lb. x 2000}}\right)$$
   $$= (\$10,919,132)\left(\frac{4619 \times 40,566,000}{109,939 \times 12726 \times 2000}\right)$$
   = $731,181

A. SIMPLE COST BENEFIT ANALYSIS

I. Payback Period $= \dfrac{18102045 + 2818635 - 15867845}{(-30694)}$

$=$ none (0)

Obviously continuation of the simple cost benefit analysis indicates continuing losses because the generator production charge for electricity never goes below the credit for electricity from the pool.

B. COST EFFECTIVE ANALYSIS

Using the annual escalation data and/or combined escalation data (CER's), the present worth factors for various costs were determined by calculation shown in the Section 3.4. This analysis goes beyond Simple Cost Benefit because the time effects of money costs and other inflationary factors are taken into account.

Total PW of Costs = PWF X Annual Cost

Summary of Present Worth Factors [1]

Insurance	12.23
Purchased Utilities	30.97
Administration	17.78
Labor, Supplies, Maint.	16.52
Western Coal	18.23
Eastern Coal	18.23
Ash Handling and Landfill	16.52

Steam Production Operation CER

Normal Plant Expansion

$$CER = [.03\ (9408)+.1(343904)+.08(99000) + .0698(983,076)+.07399(5,364,296) + .07(74940)] \div 6,874,625$$

$$CER = 8.14\%$$

$$a = \frac{1 + .0814}{1 + .0575} = 1.023$$

$$PWF = \frac{1.0226\ (1.0226^{15}-1)}{1.0226-1} = 18.07$$

Cogeneration Plant Steam Operating CER

$$CER = [.03(39200)+.1(381,424)+.08(132,000) +.0698(1,625662)+.07399(5,763,004) +.07(80478)] \div 8,021,768$$

CER = 8.04% a = 1.0217 PWF = 17.85

Electric Production Operating CER

$$CER = [.03(2180)+.1(7000)+.08(23200) +.0698(36480)+.0804(731,181)] \div 803,881$$

CER = 7.96% a = 1.021 PWF = 29.20

[1] See Section 3.4 for calculation of Present Worth Factor at 5 3/4 %, 15 year amortization.

I. PRESENT WORTH OF 15 YEAR LONG TERM COSTS

Cost Item	PWF	Normal Exp.	Cogeneration Expansion PWF	Elec. Gen.	PWF	Steam Gen.
1979 Capital	1.0	$ 15,867,845	1.0	$ 2,818,635	1.0	$ 18,102,045
Const. Cash Flow	1.84	2,957,350	1.84	525,320	1.84	3,373,741
Depreciation	11.71	11,726,745	11.71	921,577	11.71	12,457,215
Insurance	12.23	115,060	12.73	26,661	12.23	479,416
Purchased Util.	30.97	10,650,707	30.97	216,790	30.97	11,812,701
Administration	17.78	1,760,220	17.78	440,944	17.78	2,346,960
Labor,Supplies,Maint.	16.52	16,240,416	16.52	639,654	16.52	26,855,936
Fuel-Community	18.23	97,791,116	-	-0-	18.23	97,791,116
Fuel-Turbine	18.23	-0-	-	-0-	18.23	7,268,447
Ash Hauling & Land.	16.52	1,238,009	-	-0-	16.52	1,329,497
Turbine Steam	-	-0-	17.85	13,051,581	-	-0-
PW of 15 year Owning & Operating		$158,347,468		$18,641,162		$181,817,074
PW of 15 year Revenues						
Steam	18.07	$171,363,394	-	-0-	17.85	$194,906,524
Electric	-	-0-	29.20	$33,211,700	-	-0-
Net PW of 15 years		$ 13,015,926		$14,570,538		$ 13,089,450

∴ The cogeneration plant has a cost benefit PW of 15 years of:

$13,089,450
14,570,538
$27,659,988
-13,015,926
$14,644,062

II. BENEFIT-TO-COST RATIO (LIFE CYCLE) - TOTAL COGENERATION

By definition:

$$\text{Benefit-to-Cost Ratio} = \frac{\text{Total 15 year O \& M Savings}}{\text{Incremental Capital Cost}}$$

$$\text{B/C Ratio} = \frac{\$14,644,062}{\$18,102,045 + 2,818,635 - 15,867,845}$$

B/C Ratio= 2.898

III. BENEFIT-TO-COST RATIO (LIFE CYCLE) - TURBINE-GENERATOR

$$\text{B/C Ratio} = \frac{\$14,570,538}{2,818,635}$$

B/C Ratio= 5.169

IV. PAYBACK PERIOD (TURBINE-GENERATOR)

$$\text{Payback Period} = \frac{\log\left[\frac{c}{as}(a-1) + 1\right]}{\text{Log } a}$$

In which c= incremental investment
s= annual savings
n= payback period, years

$$a = \text{discount factor} = \frac{1 + CER}{1 + i}$$

c= $2,818,635
s= -$30,694

The combined escalation rate (CER) between the two alternatives can be determined in the following manner.

$$CER = \Big[.03(39,200 - 9408)+.03(2180)+.1(381,424-343,904) +.1(7000)+.08(132,000-99,000)+.08(24,800) +.0698(1,625,662-983076)+.0698(38,720) +.07399(398,708) + .07(80,478 - 74,940) +.0804(731,181)\Big] \div \Big[8,021,768+803,881-6,874,624\Big]$$

CER=10.26 % a=1.0426 PWF=.8699

Since the present worth factor of the cogeneration plant is less than one, the indication is that something is losing money, namely the turbine generator.

$$n = \frac{\log\left[\frac{2,818,635}{(1.0426)(-30694)}(1.0426-1) + 1\right]}{\text{Log } 1.0426}$$

n= Log of a negative number

V. RETURN ON INVESTMENT

Total 15 year Savings (Future Worth) =

$$\frac{S(1+CER)\left[(1+CER)^{15}-1\right]}{CER} =$$

Since there are no savings, the Rate of Return on the Investment = 0.

CASH FLOW ANALYSIS I.A.1(a)

The following materials represent the cash flow analysis and present worth of cash flow for the foregoing cost benefit comparison. Examination of the "Net Cash Flows" indicate that the turbine-generator does not begin paying back until the 18th year, or 3 years beyond the amortization date.

However, the cumulative net cash flows indicate the the total plant has a net present worth cost benefit of:

$3,214,429 - 1,993,776 = $1,220,653 (22nd year)

(4,636,887) + (3,214,429) = ($7,851,316) (15th year)

Therefore, the turbine-generator does not begin paying off until the 18th year. Considerable cash flow problems would result if this plan was used.

COST COMPARISON 1.A.1(A) EASTERN COAL VS EASTERN COAL NO COST SHARING

ALL LOANS AMORTIZED IN 15 YEARS AT 5.75 PERCENT EFFECTIVE ANNUAL RETURN.
REVENUE REQUIREMENT BASED UPON FULL CONSTRUCTION BUDGET ESCALATED AT 7.0 PERCENT PER YR FROM JAN. 1978 TO JAN. 1981
DEPRECIATION SINKING FUND ACCUMULATED AT 7.0 PERCENT.
PRESENT WORTH CALCULATED USING 5.75 PERCENT

	NORMAL EXPANSION	TURBINE-GEN	COGEN-STEAM SIDE	TOTAL COGEN
TOTAL CAPITAL BUDGET (DOLLARS)	15867645	2818635	18102045	20920680
INTERNAL-RATE OF RETURN (PERCENT)	0	-1.00	0	-1.00

CUMULATIVE NET CASH FLOWS AND PRESENT WORTH 78/03/13

	NORMAL PLANT EXPANSION		COGENERATION PLANT: TURBINE - GENERATOR		COGENERATION PLANT: STEAM SIDE		COGENERATION PLANT: TOTAL PLANT	
YEAR	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW
1	-1607215	-1519825	-285493	-269969	-1833511	-1733817	-2119004	-2003786
2	-3214429	-2957011	-570985	-525259	-3667022	-3373360	-4238007	-3898619
3	-3214429	-2957011	-601668	-551205	-3667022	-3373360	-4268690	-3924564
4	-3214429	-2957011	-632351	-575739	-3667022	-3373360	-4299373	-3949099
5	-3214429	-2957011	-663034	-598940	-3667022	-3373360	-4330056	-3972299
6	-3214429	-2957011	-693717	-620879	-3667022	-3373360	-4360740	-3994238
7	-3214429	-2957011	-724400	-641625	-3667022	-3373360	-4391423	-4014984
8	-3214429	-2957011	-755084	-661243	-3667022	-3373360	-4422106	-4034602
9	-3214429	-2957011	-785767	-679794	-3667022	-3373360	-4452789	-4053154
10	-3214429	-2957011	-816450	-697337	-3667022	-3373360	-4483472	-4070696
11	-3214429	-2957011	-847133	-713926	-3667022	-3373360	-4514155	-4087285
12	-3214429	-2957011	-877816	-729612	-3667022	-3373360	-4544838	-4102972
13	-3214429	-2957011	-908499	-744446	-3667022	-3373360	-4575521	-4117806
14	-3214429	-2957011	-939182	-758474	-3667022	-3373360	-4606204	-4131833
15	-3214429	-2957011	-969865	-771738	-3667022	-3373360	-4636887	-4145098
16	-3214429	-2957011	-592278	-617379	-3667022	-3373360	-4259300	-3990739
17	-3214429	-2957011	-214691	-471414	-3667022	-3373360	-3881713	-3844773
18	-3214429	-2957011	162897	-333385	-3667022	-3373360	-3504126	-3706744
19	-3214429	-2957011	540484	-202861	-3667022	-3373360	-3126538	-3576220
20	-3214429	-2957011	918071	-79434	-3667022	-3373360	-2748951	-3452793
21	-3214429	-2957011	1295658	37282	-3667022	-3373360	-2371364	-3336077
22	-3214429	-2957011	1673246	147052	-3667022	-3373360	-1993776	-3225708

COMPARISON I.A.1(A) UNIVERSITY NORMAL PLANT EXPANSION EASTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PUMCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	694813	912401	1607215	0	1607215	0	0	0	0	0	0	0	0	1607
2	734765	872449	1607215	0	1607215	0	0	0	0	0	0	0	0	1607
3	777014	830200	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
4	821693	785522	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
5	868943	738275	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
6	918964	688311	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
7	971741	635474	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
8	1027616	579599	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
9	1086704	520511	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
10	1149185	458025	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
11	1215268	391947	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
12	1285146	322069	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
13	1359042	248173	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
14	1437186	170028	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
15	1519825	87390	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
16	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
17	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
18	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
19	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
20	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
21	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
22	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
SUM	15867845	8240373	24108218	20028600	44136818	188160	6878080	1980000	19661520		107285940	1498800	137492480	181629
PW	9855510	6012335	15867845	10482925	26350770	98483	3599972	1036328	10290796		56153215	784469	71963262	98314

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-1607215	-1519825
2	0	0	0	0	0	0	0	0	0	0	0	0	-1607215	-1437186
3	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		178414869		0		0	0	0	-3214429	-2957011
PW	20988608	18950392	2038216	20988608		95357021		0		0	0	0	-2957011	-2957011

COMPARISON I.A.1(A) TURBINE-GENERATOR SIDE OF COGENERATION PLANT EASTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	123421	162072	285493	0	285493	0	0	0	0	0	0	0	0	285
2	130518	154975	285493	0	285493	0	0	0	0	0	0	0	0	285
3	138022	147470	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
4	145959	139534	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
5	154351	131141	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
6	163227	122266	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
7	172612	112880	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
8	182537	102955	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
9	193033	92459	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
10	204133	81360	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
11	215870	69622	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
12	228283	57210	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
13	241409	44083	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
14	255290	30202	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
15	269969	15523	285493	78700	364193	2180	7000	24800	38720	0	0	0	803878	1168
16	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	803878	1168
17	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
18	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
19	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
20	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
21	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
22	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
SUM	2818635	1463753	4282368	1574000	5856388	43600	140000	496000	774400		0	0	15218107	21074
PW	1750653	1067982	2818635	823828	3642463	22820	73276	259605	405319		0	0	8116003	11758

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-285493	-269969
2	0	0	0	0	0	0	0	0	0	0	0	0	-285493	-255290
3	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-25945
4	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-24535
5	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-23200
6	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-21939
7	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-20746
8	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-19618
9	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-18551
10	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-17543
11	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-16589
12	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-15687
13	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-14834
14	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-14027
15	0	0	0	0	0	0	40566	731178	.0288	567924	569463	1137387	-30683	-13265
16	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	154359
17	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	145966
18	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	138029
19	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	130524
20	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	123427
21	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	116716
22	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	110370
SUM	0	0	0	0		0		13764107		11358480	11389260	22747740	1673246	147652
PW	0	0	0	0		0		7354982		5945003	5961114	11906117	147652	147652

COMPARISON I.A.1(A) STEAM SIDE OF COGENERATION PLANT EASTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	792643	1040868	1833511	0	1833511	0	0	0	0	0	0	0	0	1833
2	838220	995291	1833511	0	1833511	0	0	0	0	0	0	0	0	1833
3	886418	947093	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
4	937387	896124	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
5	991287	842224	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
6	1048286	785225	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
7	1108562	724949	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
8	1172355	661206	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
9	1239712	593799	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
10	1310996	522515	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
11	1386378	447133	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
12	1466095	367416	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
13	1550395	283116	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
14	1639543	193968	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
15	1733817	99694	1833511	1063810	2897321	39200	381424	132000	1625662	109939	5763004	80478	6021768	10919
16	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	6021768	9085
17	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	6021768	9085
18	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	6021768	9085
19	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	6021768	9085
20	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	6021768	9085
21	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	6021768	9085
22	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	6021768	9085
SUM	18102045	9400421	27502666	21276200	48778866	784000	7628480	2640000	32513240		115260080	1609560	160435360	209214
PW	11243170	6858875	18102045	11135916	29237961	410344	3992730	1381770	17017358		60326873	842440	83971515	113209

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-1833511	-1733817
2	0	0	0	0	0	0	0	0	0	0	0	0	-1833511	-1639543
3	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	5.081	10919089	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		205547204		0		0	0	0	-3667022	-3373360
PW	20988608	18950392	2038216	20988608		109836117		0		0	0	0	-3373360	-3373360

COMPARISON I.A.1(A) TOTAL COGENERATION PLANT EASTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PUMCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	916065	1202939	2119004	0	2119004	0	0	0	0	0	0	0	0	2119
2	968738	1150265	2119004	0	2119004	0	0	0	0	0	0	0	0	2119
3	1024441	1094563	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
4	1083346	1035658	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
5	1145638	973365	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
6	1211513	907491	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
7	1281175	837829	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
8	1354842	764161	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
9	1432746	686258	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
10	1515128	603875	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
11	1602248	516755	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
12	1694378	424626	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
13	1791804	327199	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
14	1894833	224171	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
15	2003786	115218	2119004	1142510	3261514	41380	388424	156800	1664382	109939	5763004	80478	8825646	12087
16	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
17	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
18	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
19	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
20	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
21	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
22	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
SUM	20920680	10864374	31785054	22850200	54635254	827600	7766480	3136000	33287640		115260080	1609560	175653467	230288
PW	12993823	7926857	20920680	11959745	32880425	433164	4066005	1641376	17422678		60326873	842440	92087518	124967

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-2119004	-2003786
2	0	0	0	0	0	0	0	0	0	0	0	0	-2119004	-1894833
3	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-25945
4	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-24535
5	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-23200
6	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-21939
7	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-20746
8	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-19618
9	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-18551
10	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-17543
11	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-16589
12	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-15687
13	2005034	1810324	194710	2005034	5.061	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-14834
14	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-14027
15	2005034	1810324	194710	2005034	5.081	10919089	40566	731178	.0288	567924	569463	1137387	-30683	-13265
16	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	154359
17	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	145966
18	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	138029
19	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	130524
20	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	123427
21	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	116716
22	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	110370
SUM	40100680	36206480	3894200	40100680		205547204		13764107		11358480	11389260	22747740	-1993776	-3225708
PW	20988608	18950392	2038216	20988608		109836117		7354982		5945003	5961114	11906117	-3225708	-3225708

3.3.2

COST BENEFITS - COMPARISON I.A.1(b)

Eastern Coal vs. Western Coal, i=5 3/4 % n=15 yrs

Expense Item	Normal Plant Expansion	Cogeneration Expansion: Elec. Gen.	Cogeneration Expansion: Steam Gen.
Capital Budget-1978	$14,829,760	$2,634,240	$16,917,800
Escalated Budget-1979	15,867,845	2,818,635	18,102,045
Cost Sharing			
DOE	-0-	-0-	-0-
Legisl.	-0-	-0-	-0-
Total Cost Sharing	-0-	-0-	-0-
Loan (U. of M.)	$15,867,845	$2,818,635	$18,102,045
Capital Recovery	$ 1,607,255	$ 285,500	$ 1,833,555
Depreciation	1,001,430	78,700	1,063,810
Total Owning	$ 2,608,685	$ 364,200	$ 2,897,365
Operating Expenses-1981			
Insurance	$ 9,408	$ 2,180	$ 39,200
Purchased Utilities	343,904	7,000	381,424
Administration	99,000	24,800	132,000
Labor, Supplies, Maint.	983,076	38,720	1,625,662
Fuel Community	5,364,296	-0-	3,044,041
Fuel Turbine-Gen.	-0-	-0-	226,253
Ash Handling & Landfill	74,940	-0-	92,160
[1]Turbine Steam Purch.	-0-	562,101	-0-
Total Operating Expense	$6,874,624	$634,801	$5,496,794
Gross Owning & Operating	$9,483,309	$999,001	$8,394,159
Gross Production Expense			
Steam, $/1000 lbs.	4.7297	-	4.1865
Electricity, $/kwh	-	.02463	-
[2]Community Steam Charge	4.7297	-	3.9062
Revenue (Steam)			
a. Community Usage	$8,562,379	-	$7,071,482
b. Community Line Loss	644,651	-	532,403
c. Blowdown Allocation	276,279	-	228,173
d. T-G Steam	-0-	-	562,101
Total Steam Revenues	$9,483,309		$8,394,159
Revenue (Elec. Gen)			
a. Capacity	-	$569,463	-
b. Energy	-	567,924	-
Total Elec. Gen. Revenue	-	$1,137,387	-

Gross Plant Income	$9,483,309	$1,137,387	$8,394,159
Plant Cash Flow (one year operation)	-0-	$ 138,386	-0-
Const. Cash Flow(Debt) (1979 through 1980)	$2,957,350	$ 525,320	$3,373,741
*Net Plant Cash Flow at end of 1981	(2,957,350)	(386,934)	(3,373,741)

* Parentheses indicate an amount whose value is less than zero.

Notes I.A.1(b)

1. Turbine Steam Charge $= \frac{4619 \times 40,566,000}{157,377 \times 2000 \times 8890}$ ($8,394,159)

$= 562,100$

2. Community Steam Charge

Normal Plant Expansion: $\frac{\$9,483,309}{2,005,034} = \$4.7297/1000$ lbs.

ICES: $\frac{\$8,394,159 - 562,101}{2,005,034} = \$3.9062/1000$ lbs.

A. SIMPLE COST BENEFIT ANALYSIS

I. Payback Period - Total Cogeneration Plant

If the cash flow for construction is neglected the cost benefit for a Cogeneration Plant accrues at $343,644 per year.

$$\text{Payback Period (Including Cash Flow Deficit for Construction)} = \frac{\text{Incremental Investment Flow}}{\text{Annual Cost Benefit}}$$

$$= \frac{(18{,}102{,}045 + 2{,}818{,}635 - 15{,}867{,}845)+}{138{,}386}$$

Payback Period = 36.5 years

II. Payback Period on Turbine-Generator

$$\text{Payback Period} = \frac{\text{Total Investment}}{\text{Annual Cost Benefit}}$$

$$= \frac{2{,}818{,}635}{138{,}386}$$

Payback Period = 20.4 years.

III. Minimum Acceptable Rate of Return (MAR)

This method will compare the larger investment against the smaller to ascertain if the incremental investment does earn the minimum acceptable rate, in this case 5 3/4 EAR. If the calculated MAR exceeds the minimum acceptable rate of return, then the incremental investment is justified.

Minimum Acceptable Rate = 5 3/4%, 15 years
CRF = Capital recovery factor

$$(18{,}102{,}045+2{,}818{,}635)CRF\Big|_{15}^{i}+(5{,}496{,}794=634{,}801)-(8{,}394{,}159+1{,}137{,}387)$$

$$=(15{,}867{,}845)CRF\Big|_{15}^{i}$$

$$+ 6{,}874{,}624 - 9{,}483{,}309$$

$$CRF\Big|_{15}^{i} = \frac{\$\ 791{,}261}{\$\ 5{,}052{,}835} = .156597$$

From Annuity tables for $CRF = \frac{i\ (1+i)^n}{(1+i)^n-1}$, n=15

$$CRF\Big|_{15}^{12\%} = .14682$$

$$CRF\Big|_{15}^{15} = .17102$$

Therefore MAR $\cong$ 13.5%

and the larger investment in Cogeneration facilities is justified.

IV. Return-on-Investment (ROI) - Turbine Generator

$$ROI = \frac{\text{Cost Benefit}}{\text{First Cost}} \times 100$$

$$= \frac{\$138,386}{\$2,818,635} \times 100$$

ROI = 4.91 %

V. Return-On-Investment (ROI) - Cogeneration Plant

$$ROI = \frac{\text{Total Cost Benefit}}{\text{Incremental Investment}} \times 100$$

$$= \frac{138,386}{(18,102,045+2,818,635)-15,867,845} \times 100$$

ROI = 2.74 %

VI. Benefit-to-Cost Ratio (B/C)-Total Cogeneration Plant

$$\text{B/C Ratio} = \frac{\text{Total P.W. of 15 year Operative Savings}}{\text{Incremental Investment}}$$

$$PWF = \frac{[(1+i)^n-1]}{i(1+i)^n}$$

$$PWF = \frac{(1+.0575)-1}{.0575(1+.0575)^{15}} = 9.87289$$

Normal Plant Expansion PW of 15 year Costs

PW of 15 year Operating Expenses	(67,872,407)
PW of 15 year Steam Income	93,627,667
PW of 15 year	$ 25,755,260

Cogeneration Expansion PW of 15 year Costs

PW of 15 year Operating Expense	(54,269,243)
PW of 15 year Total Steam Income	82,874,608
PW of 15 year Generator Income	11,229,297
PW of 15 year T-G Operating Expenses	(6,267,320)
PW of 15 years	33,567,342

$$\text{B/C Ratio} = \frac{33,567,342 - 25,755,268}{(18,102,045+2,818,635)-15,867,845}$$

B/C Ratio = 1.55

VII. Benefit-to-Cost Ratio (Turbine-Generator)

$$\text{B/C Ratio} = \frac{11,229,297-6,267,320}{2,818,635}$$

B/C Ratio = 1.76

B. COST EFFECTIVENESS ANALYSIS

Using the annual escalation data and combined escalation data (CER's), the Present Worth Factors for various costs were determined by calculation shown in Section 5.4. This analysis goes beyond the depth of Section A - Cost Benefit Analysis because it analyzes the effect of the time-cost of money and other inflationary factors.

Total PW of Costs = Present Worth Factor X Annual Cost

Summary of Present Worth Factors[1]

	15 years @ 5 3/4 %
Insurance	12.23
Purchased Utilities	30.97
Administration	17.78
Labor, Supplies, Maint	16.52
Western Coal	18.23
Eastern Coal	18.23
Ash Handling & Landfill	16.52

The Present Worth Factors for steam production expense and electric production expense must be calculated.

Steam Production Operation CER=(f_x)

Referring to the Cost Benefit Comparison I.A.1.(b).

Normal Plant Expansion

$$CER = [.03(9408)+.1(343,904)+.08(99,000)+.0698(983,076) + .07399(5,364,296)+.07(74940)] \div 6,874,624$$

CER= 8.14 %

Then $a=\frac{1+.0814}{1+.0575} = 1.023$ PWF = 18.07

Cogeneration Plant Expansion Steam Operating CER

$$CER = [.03(39,200)+.1(381,424)+.08(132,000) +.0698(1,625,662)+.07399(3,226,348) +.07(92,160)] \div 5,496,794$$

CER =7.94 a = 1.021 PWF = 17.78

Electric Production Operation CER

$$CER = [.03(2180)+.1(7000)+.08(23200) +.0698(36,480)+.0794(562,101)] \div 634,801$$

CER = 7.84 % a = 1.02 PWF = 17.64

I. PRESENT WORTH OF 15 YEAR LONG TERM COSTS

Cost Item	PWF	Normal Plant Exp.	Cogeneration Plant PWF	Elec. Gen.	PWF	Steam Gen.
1979 Capital	1.0	$ 15,867,845	1.0	$ 2,818,635	1.0	$ 18,102,045
Const. Cash Flow	1.84	2,957,350	1.84	525,320	1.84	3,373,741
Depreciation	11.71	11,726,745	11.71	921,577	11.71	12,457,215
Insurance	12.23	115,060	12.23	26,661	12.23	479,416
Purch. Utility	30.97	10,650,707	30.97	216,790	30.97	11,812,701
Administration	17.78	1,760,220	17.78	440,944	17.78	2,346,960
Labor, Sup., Maint.	16.52	16,240,416	16.52	639,654	16.52	26,855,936
Fuel	18.23	97,791,116	-	-0-	18.23	53,299,269
Ash Hand. & Landfill	16.52	1,235,531	-	-0-	16.52	1,522,483
Turbine Steam	-	-	17.78	9,994,156	-	-
PW of 15 year Owning & Operating		$158,344,990		$15,583,737		$130,249,766
PW of 15 year Revenues						
Steam	18.07	$171,363,394	-	-	17.78	$149,248,147
Electric	-	-0-	17.64	$20,063,507	-	-0-
PW of 15 year Revenues		$171,363,394		$20,063,507		$149,248,147
Net PW of 15 years		$ 13,018,404		$ 4,479,770		$ 18,998,381

∴ The cogeneration plant has PW of 15 year operations of $10,459,747 in excess of the normal plant expansion.

II. BENEFIT - TO - COST RATIO (LIFE CYCLE) - TOTAL COGENERATION

By definition:

$$\text{Benefit to Cost Ratio} = \frac{\text{Total 15 years O \& M Savings}}{\text{Incremental Capital Cost}}$$

$$\text{Benefit to Cost Ratio (Cogeneration Plant)} = \frac{\$10,459,747}{5,052,835}$$

$$B/C = 2.07$$

III. BENEFIT TO COST RATIO - TURBINE GENERATION

$$B/C = \frac{20063507 - 15,583,737}{2,818,635} = 1.58$$

III. PAYBACK PERIOD (TURBINE GENERATOR)

$$\text{Payback Period, } n = \frac{\log \left[\frac{C}{as} (a-1) + 1 \right]}{\log a}$$

in which C = incremental investment
S = Annual Savings
n = Payback period, years

$$a = \text{discount factor} = \frac{1 + CER}{1 + i}$$

C = $2,818,635
S = $ 138,836

The combined escalation rate (CER) between the two alternatives can be determined in the following manner.

$$CER = \left[.03\,(39,200 - 9408) + .03(2180) + (.1)\,(381,424 - 343,904) + .1(7000) + .08(132,000 - 99,000) + .08(24800) + .0698(1,625,662 - 983,076) + .0698(38720) + .07399(-3,226,348 + 5364296) + .07(92160 - 74940) + .0794(562,101) \right] \div \left[-6,131,595 + 6874624 \right]$$

$$CER = .3769$$

$$a = \frac{1 + .3769}{1 + .0575} = 1.302$$

$$\text{Payback Period, } n = \frac{\log \left[\frac{2,818,635}{1.302 \times 138,386} (1.302-1) + 1 \right]}{\log 1.302}$$

$$n = \frac{\log 5.724363}{\log 1.302}$$

$$n = 6.61 \text{ years}$$

IV. RETURN ON INVESTMENT

Total 15 year savings (Future Worth) =

$$\frac{S\,(1 + CER)\left[(1 + CER)^{15} - 1\right]}{CER}$$

$$\text{Rate of Return, } R = \left(\frac{\text{Total 15 year saving}}{\text{Incremental Investment}}\right)^{1/n} - 1$$

$$\text{Total 15 year Savings} = \frac{(138{,}356)\,(1.3769)\left[1.3769^{15} - 1\right]}{.3769}$$

$$= \$60{,}772{,}422$$

$$\text{Rate of Return, } R = \left(\frac{60{,}772{,}422}{2{,}818{,}635}\right)^{1/15} - 1$$

$$R = .2272 = 22.72\%$$

CASH FLOW ANALYSIS I.A.1(b)

This plan is a considerable improvement above I.A.1(a) since Western coal is used for cogeneration. Sufficient positive cash flows accumulate to pay off the turbine-generator between the 6th and 7th years.

COST COMPARISON 1.A.1(B) EASTERN COAL VS WESTERN COAL NO COST SHARING

ALL LOANS AMORTIZED IN 15 YEARS AT 5.75 PERCENT EFFECTIVE ANNUAL RETURN.
REVENUE REQUIREMENT BASED UPON FULL CONSTRUCTION BUDGET ESCALATED AT 7.0 PERCENT PER YR FROM JAN. 1978 TO JAN. 1981
DEPRECIATION SINKING FUND ACCUMULATED AT 7.0 PERCENT.
PRESENT WORTH CALCULATED USING 5.75 PERCENT

	NORMAL EXPANSION	TURBINE-GEN	COGEN-STEAM SIDE	TOTAL COGEN
TOTAL CAPITAL BUDGET (DOLLARS)	15867845	2818635	18102045	20920680
INTERNAL RATE OF RETURN (PERCENT)	0	3.34	0	-1.00

CUMULATIVE NET CASH FLOWS AND PRESENT WORTH 78/03/13

			COGENERATION PLANT					
	NORMAL PLANT EXPANSION		TURBINE - GENERATOR		STEAM SIDE		TOTAL PLANT	
YEAR	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW
1	-1607215	-1519825	-285493	-269969	-1833511	-1733817	-2119004	-2003786
2	-3214429	-2957011	-570985	-525259	-3667022	-3373360	-4238007	-3898619
3	-3214429	-2957011	-435531	-410721	-3667022	-3373360	-4102554	-3784081
4	-3214429	-2957011	-300078	-302411	-3667022	-3373360	-3967100	-3675771
5	-3214429	-2957011	-164624	-199990	-3667022	-3373360	-3831646	-3573350
6	-3214429	-2957011	-29170	-103138	-3667022	-3373360	-3696192	-3476498
7	-3214429	-2957011	106283	-11552	-3667022	-3373360	-3560739	-3384912
8	-3214429	-2957011	241737	75054	-3667022	-3373360	-3425285	-3298306
9	-3214429	-2957011	377191	156951	-3667022	-3373360	-3289831	-3216409
10	-3214429	-2957011	512645	234394	-3667022	-3373360	-3154378	-3138965
11	-3214429	-2957011	648098	307627	-3667022	-3373360	-3018924	-3065732
12	-3214429	-2957011	783552	376878	-3667022	-3373360	-2883470	-2996481
13	-3214429	-2957011	919006	442364	-3667022	-3373360	-2748016	-29 0995
14	-3214429	-2957011	1054459	504289	-3667022	-3373360	-2612563	-2869070
15	-3214429	-2957011	1189913	562847	-3667022	-3373360	-2477109	-2810513
16	-3214429	-2957011	1733637	785123	-3667022	-3373360	-1933385	-2588237
17	-3214429	-2957011	2277362	995313	-3667022	-3373360	-1389661	-2378046
18	-3214429	-2957011	2821086	1194074	-3667022	-3373360	-845936	-2179285
19	-3214429	-2957011	3364810	1382028	-3667022	-3373360	-302212	-1991331
20	-3214429	-2957011	3908534	1559763	-3667022	-3373360	241512	-1813597
21	-3214429	-2957011	4452259	1727833	-3667022	-3373360	785236	-1645527
22	-3214429	-2957011	4995983	1886765	-3667022	-3373360	1328961	-1486595

COMPARISON I.A.1(B) UNIVERSITY NORMAL PLANT EXPANSION EASTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PUNCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	694813	912401	1607215	0	1607215	0	0	0	0	0	0	0	0	1607
2	734765	872449	1607215	0	1607215	0	0	0	0	0	0	0	0	1607
3	777014	830200	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
4	821693	785522	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
5	868940	738275	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
6	918904	688311	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
7	971741	635474	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
8	1027616	579599	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
9	1086704	520511	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
10	1149186	458025	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
11	1215268	391947	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
12	1285146	322069	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
13	1359042	248173	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
14	1437186	170028	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
15	1519825	87390	1607215	1001430	2608645	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
16	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	9483
17	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
18	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
19	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
20	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
21	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
22	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
SUM	15867845	8240373	24108218	20028600	44136818	188160	6878080	1980000	19661520		107285920	1498800	137492480	181629
PW	9855510	6012335	15867845	10482925	26350770	98483	3599972	1036328	10290796		56153215	784469	71963262	98314

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-1607215	-1519825
2	0	0	0	0	0	0	0	0	0	0	0	0	-1607215	-1437186
3	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	4.730	9483269	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		178414869		0		0	0	0	-3214429	-2957011
PW	20988608	18950392	2038216	20988608		95357021		0		0	0	0	-2957011	-2957011

COMPARISON I.A.1(B) TURBINE-GENERATOR SIDE OF COGENERATION PLANT WESTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	123421	162072	285493	0	285493	0	0	0	0	0	0	0	0	285
2	130518	154975	285493	0	285493	0	0	0	0	0	0	0	0	285
3	138022	147470	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
4	145959	139534	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
5	154351	131141	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
6	163227	122266	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
7	172612	112880	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
8	182537	102955	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
9	193033	92459	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
10	204133	81360	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
11	215870	69622	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
12	228283	57210	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
13	241409	44083	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
14	255290	30202	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
15	269969	15523	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
16	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
17	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
18	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
19	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
20	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
21	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
22	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
SUM	2818635	1463753	4282388	1574000	5856388	43600	140000	496000	774400		0	0	11895369	17751
PW	1750653	1067982	2818635	823828	3642463	22820	73276	259605	405319		0	0	6376889	10019

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-285493	-269969
2	0	0	0	0	0	0	0	0	0	0	0	0	-285493	-255290
3	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	114538
4	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	108310
5	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	102421
6	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	96852
7	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	91586
8	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	86606
9	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	81897
10	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	77444
11	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	73233
12	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	69251
13	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	65486
14	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	61925
15	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	58558
16	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	222276
17	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	210190
18	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	198761
19	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	187954
20	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	177734
21	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	168070
22	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	158932
SUM	0	0	0	0		0		7294026		11358480	11389260	22747740	4995983	1886765
PW	0	0	0	0		0		3923077		5945003	5961114	11906117	1886765	1886765

COMPARISON I.A.1(B) STEAM SIDE OF COGENERATION PLANT WESTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	792643	1040868	1833511	0	1833511	0	0	0	0	0	0	0	0	1833
2	838220	995291	1833511	0	1833511	0	0	0	0	0	0	0	0	1833
3	886418	947093	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
4	937367	896124	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
5	991287	842224	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
6	1048286	785225	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
7	1108562	724949	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
8	1172305	661206	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
9	1239712	593799	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
10	1310996	522515	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
11	1386378	447133	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
12	1466095	367416	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
13	1550395	283116	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
14	1639543	193968	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
15	1733817	99694	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
16	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
17	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
18	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
19	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
20	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
21	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
22	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
SUM	18102045	9400621	27502666	21276200	48778866	784000	7628480	2640000	32513240		65405880	1843200	110814800	159593
PW	11243170	6858875	18102045	11135916	29237961	410344	3992730	1381770	17017358		34233294	964727	58000223	87238

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-1833511	-1733817
2	0	0	0	0	0	0	0	0	0	0	0	0	-1833511	-1639543
3	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		155926644		0		0	0	0	-3667022	-3373360
PW	20988608	18950392	2038216	20988608		83864825		0		0	0	0	-3373360	-3373360

COMPARISON I.A.1(B) TOTAL COGENERATION PLANT WESTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	916065	1202939	2119004	0	2119004	0	0	0	0	0	0	0	0	2119
2	968738	1150265	2119004	0	2119004	0	0	0	0	0	0	0	0	2119
3	1024441	1094563	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
4	1083346	1035658	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
5	1145638	973365	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
6	1211513	907491	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
7	1281175	837829	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
8	1354842	764161	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
9	1432746	686258	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
10	1515128	603875	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
11	1602248	516755	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
12	1694378	424626	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
13	1791804	327199	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
14	1894833	224171	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
15	2003786	115218	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
16	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
17	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
18	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
19	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
20	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
21	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
22	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
SUM	20920680	10864374	31785054	22850200	54635254	827600	7760480	3136000	33287640		65405880	1843200	122710169	177345
PW	12993823	7926857	20920680	11959745	32880425	433164	4066005	1641376	17422678		34233294	964727	64377113	97257

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-2119004	-2003786
2	0	0	0	0	0	0	0	0	0	0	0	0	-2119004	-1894833
3	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	114538
4	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	108310
5	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	102421
6	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	96852
7	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	91586
8	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	86606
9	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	81897
10	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	77444
11	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	73233
12	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	69251
13	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	65486
14	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	61925
15	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	58558
16	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	222276
17	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	210190
18	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	198761
19	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	187954
20	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	177734
21	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	168070
22	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	158932
SUM	40100680	36206480	3894200	40100680		155926644		7294026		11358480	11389260	22747740	1328961	-1486595
PW	20988608	18950392	2038216	20988608		83864825		3923077		5945003	5961114	11906117	-1486595	-1486595

3.3.3

COST BENEFITS - COMPARISON I.A.1(c)

Western Coal vs. Western Coal, i = 5 3/4%, n = 15 years

Expense Item	Normal Combined Plant Expansion	Cogeneration Expansion	
		Elec. Gen.	Steam Gen.
Capital Budget - 1978	$14,829,760	$2,634,240	$16,917,800
Escalated Budget - 1979	15,867,845	2,818,635	18,102,045
Cost Sharing			
DOE	-0-	-0-	-0-
Legisl.	-0-	-0-	-0-
Total Cost Sharing	-0-	-0-	-0-
Loan (U of M)	$15,867,845	$2,818,635	$18,102,045
Capital Recovery	$ 1,607,255	$ 285,500	$ 1,833,555
Depreciation	1,001,430	78,700	1,063,810
Total Owning	$ 2,608,685	$ 364,200	$ 2,897,365
Operating Expenses (end of 1981)			
Insurance	$ 9,408	$ 2,180	$ 39,200
Purchased Utilities	343,904	7,000	381,424
Administration	99,000	24,800	132,000
Labor, Supplies, Maint.	983,076	38,720	1,625,662
[1]Fuel-Community	3,044,041	-0-	3,044,041
[2]Fuel-Turbine	-0-	-0-	226,252
[3]Ash Handling & Landfill	85,784	-0-	92,160
[4]Turbine Steam Purch.	-0-	565,044	-0-
Total Operating Expense	$ 4,565,213	$ 637,744	$ 5,540,739
Gross Owning & Operating	$ 7,173,898	$1,001,944	$ 8,438,104
Gross Production Expense			
Steam, $/1000 lbs.	3.5779	-0-	4.20846
Electricity, $/KWh	-0-	.0247	-0-
[5]Community Steam Charge	3.5779	-	3.92664
Revenue (Steam)			
a. Community Usage	$ 6,477,237	-	$ 7,108,503
b. Community Line Loss	487,663	-	535,190
c. Blowdown Allocation	208,998	-	229,367
d. T-G Steam	-0-	-	565,044
Total Steam Revenue	$ 7,173,898		$ 8,438,104
Revenue (Elec. Gen.)			
a. Capacity	-	$ 569,463	-
b. Energy	-	567,924	-
Total Elec. Gen. Revenue		$1,137,387	

Expense Item	Normal Combined Plant Expansion	Cogeneration Expansion	
		Elec. Gen.	Steam. Gen.
Gross Plant Income	$ 7,173,898	$1,137,387	$ 8,438,104
Plant Cash Flow (one year operation)	-0-	$ 135,443	-0-
Const. Cash Flow (Debt) (1979 through 1980)	$ 2,957,350	$ 525,320	$ 3,373,741
Net Plant Cash Flow at end of 1981	($ 2,957,350)	($ 389,877)	($ 3,373,741)
Cash Flow Deficit at end of 1981	($ 2,957,350)	($ 389,877)	($ 3,373,741)

NOTES (I.A.1(c))

1. 146,489 tons x $20.78 = $3,044,041

2. 146,489 x .08 x 7.32 = $ 85,784

3. 10,888 x 20.78 = $ 226,252

4. $\left(\frac{4,619 \times 40,566,000}{157,377 \times 2,000 \times 8,890}\right)$ ($8,438,104) = $565,044

5. $\frac{\$7,173,898}{2,005,034}$ = $3.5779 per 1000 lbs.

$\frac{\$8,438,104 - 565,044}{2,005,034}$ = $3.92664 per 1000 lbs.

A. SIMPLE COST BENEFIT ANALYSIS

I. Payback Period (Total Plant) $= \dfrac{18,102,045 + 2,818,635 - 15,867,455}{135,443}$

$= 37.3$ years

II. Payback Period (Turbine-Gen.) $= \dfrac{2,818,635}{135,443}$

$= 20.8$ years

III. Minimum Acceptable Rate of Return (MAR)

$$(\$18,102,045 + 2,818,635)CRF\Big|_{15} + (5,540,739 + 637,744) - (8,438,104 + 1,137,387)$$

$$= (15,867,845)CRF\Big|_{15}^{i} + 4,565,213 - 7,173,898$$

$$CRF\Big|_{15}^{i} = \frac{788,323}{5,052,835} = .15602$$

$$MAR = 13.5\%$$

IV. Return on Investment (ROI) - Turbine-Generation

$$ROI = \frac{\$135,443}{\$2,818,635} \times 100$$

$$ROI = 4.81\%$$

V. Return on Investment (ROI) - Total Cogeneration

$$ROI = \frac{\$135,443}{18,102,045 + 2,818,635 - 15,867,845} \times 100$$

$$ROI = 2.68\%$$

VI. Benefit-to-Cost Ratio (B/C) - (Total Cogeneration)

PWF = 9.87289

Normal Plant Expansion PW of 15 Year Costs

PW of 15 Year Operating Expenses	($45,071,846)
PW of 15 Year Steam Revenues	70,827,106
PW of 15 Years	$25,755,260

Cogeneration Expansion PW of 15 Year Costs

PW of 15 Year Steam Operating Expenses	($54,703,107)
PW of 15 Year Steam Revenues	83,308,473
PW of 15 Year Generator Income	11,229,297
PW of 15 Year Gen. Operating Expenses	6,296,376
PW of 15 Years	$33,538,287

$$\text{B/C Ratio} = \frac{33,538,287 - 25,755,268}{(18,102,045 + 2,818,635 - 15,867,845)}$$

$$= \frac{7,783,019}{5,052,835}$$

B/C Ratio = 1.54

VII. Benefit-to-Cost Ratio (B/C) - (Turbine-Generator)

$$\text{B/C Ratio} = \frac{11,229,297 - 6,296,376}{2,818,635}$$

B/C Ratio = 1.75

B. COST EFFECTIVENESS ANALYSIS

Normal Plant Expansion Steam Operation
Combined Escalation Rate:

$$CER = [.03(9,408) + .1(343,904) + .08(99,000) + .0698(983,076) + .07399(3,044,041) + .07(85,784)] \div 4,565,213$$

$$= 8.075\%$$

$$a = \frac{1 + .0875}{1 + .0575} = 1.02199$$

$$PWF = \frac{1.02199(1.02199^{15} - 1)}{1.02199 - 1} = 17.93$$

Cogeneration Expansion Steam Operation CER

$$CER = [.03(39,200) + .1(381,424) + .08(132,000) + .0698(162,662) + .07399(3,270,293) + .07(92,160)] \div 5,540,739$$

$$CER = 7.9399\%$$

$$a = \frac{1.079399}{1.0575} = 1.02071$$

$$PWF = \frac{1.02071(1.02071^{15} - 1)}{1.02071 - 1} = 17.74$$

Electric Production Operation CER

$$CER = [.03(2,180) + .1(7,000) + .08(24,800) + .0698(38,720) + .079399(565,044)] \div 637,744$$

$$CER = 7.89\%$$

$$a = 1.0202$$

$$PWF = 17.71$$

I. PRESENT WORTH OF 15 YEAR LONG TERM COSTS

Cost Item	PWF	Normal Plant Expansion	Cogeneration Plant PWF	Elec. Gen.	PWF	Steam Gen.
Sub-total through Labor, Supplies Maint. of Comp. I.A.1(b)	-	$ 59,318,343	-	$ 5,589,581	-	$ 75,428,014
Fuel-Community	18.23	55,492,867	-	-0-	18.23	55,492,867
Fuel-Turbine	18.23	-0-	-	-0-	18.23	4,124,574
Ash Hand.& Landfill	16.52	1,417,152	-	-0-	16.52	1,522,483
Turbine Steam	-	-0-	17.74	10,023,881	-	-0-
PW of 15 year Owning & Operating		$114,811,210		$15,613,462		$136,567,938
PW of 15 year Revenue						
Steam	17.93	$128,627,991	-	-0-	17.74	$149,691,965
Elec. Gen.	-	-0-	17.71	$20,143,123	-	-0-
Less PW of 15 year Owning & Operating		($114,811,210)		($15,613,462)		($136,567,938)
Net PW of 15 years		$ 13,816,781		$ 4,529,661		$ 13,124,027

Total PW of Cogeneration	$17,653,688
Totwl PW of Normal Exp.	13,816,781
Cost Benefit PW of Cogeneration	$ 3,836,907

∴ The cogeneration plant has a better economic outlook, but not significant.

II. BENEFIT-TO-COST RATIO (B/C) - LIFE CYCLE (TURBINE-GENERATOR)

$$\text{B/C Ratio} = \frac{\$3,836,907}{2,818,635}$$

$$= 1.36$$

III. PAYBACK PERIOD (TURBINE-GENERATOR)

CER between alternatives

$$\begin{aligned}\text{CER} = \Big[&.03(39,200 - 9,408) + .03(2,180) + .1(381,424 - 343,904) \\ &+ .1(7,000) + .08(132,000 - 99,000) + .08(24,800) \\ &+ .0698(1,625,662 - 983,076) + .0698(38,720) \\ &+ .07399(3,270,293 - 3,044,041) + .07(92,160 - 85,784) \\ &+ .0794(565,044)\Big] \\ &\div \Big[5,540,793 - 4,565,213\Big]\end{aligned}$$

$$\text{CER} = .1246 \qquad a = 1.06345$$

$$\text{Payback Period, } n = \frac{\log\left[\frac{2,818,635}{(1.06345)(135,443)}(1.06345 - 1) + 1\right]}{\log 1.06345}$$

$$n = 13.12 \text{ years}$$

IV. RETURN ON INVESTMENT (LIFE CYCLE)

$$\text{Total 15 year savings} = \frac{(135,443)(1.1246)\left[1.1246^{15} - 1\right]}{.1246}$$

$$= \$5,893,073$$

$$\text{Rate of Return, } R = \left(\frac{5,893,073}{2,818,635}\right)^{1/15} - 1$$

$$= 5.04\%$$

CASH FLOW ANALYSIS I.A.1(c)

This is the same plan as I.A.1(b) except western coal is used for both normal expansion and the cogeneration plant. The turbine-generator is paid off in the seventh year.

COST COMPARISON I.A.1(C) WESTERN COAL VS WESTERN COAL NO COST SHARING

ALL LOANS AMORTIZED IN 15 YEARS AT 5.75 PERCENT EFFECTIVE ANNUAL RETURN.
REVENUE REQUIREMENT BASED UPON FULL CONSTRUCTION BUDGET ESCALATED AT 7.0 PERCENT PER YR FROM JAN. 1978 TO JAN. 1981
DEPRECIATION SINKING FUND ACCUMULATED AT 7.0 PERCENT.
PRESENT WORTH CALCULATED USING 5.75 PERCENT

	NORMAL EXPANSION	TURBINE-GEN	COGEN-STEAM SIDE	TOTAL COGEN
TOTAL CAPITAL BUDGET (DOLLARS)	15867845	2816635	18102045	20920680
INTERNAL RATE OF RETURN (PERCENT)	0	3.34	0	-1.00

CUMULATIVE NET CASH FLOWS AND PRESENT WORTH 78/03/13

	NORMAL PLANT EXPANSION		COGENERATION PLANT: TURBINE - GENERATOR		COGENERATION PLANT: STEAM SIDE		COGENERATION PLANT: TOTAL PLANT	
YEAR	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW
1	-1607215	-1519825	-285493	-269969	-1833511	-1733817	-2119004	-2003786
2	-3214429	-2957011	-570985	-525259	-3667022	-3373360	-4238007	-3898619
3	-3214429	-2957011	-435531	-410721	-3667022	-3373360	-4102554	-3784081
4	-3214429	-2957011	-300078	-302411	-3667022	-3373360	-3967100	-3675771
5	-3214429	-2957011	-164624	-199990	-3667022	-3373360	-3831646	-3573350
6	-3214429	-2957011	-29170	-103138	-3667022	-3373360	-3696192	-3476498
7	-3214429	-2957011	106283	-11552	-3667022	-3373360	-3560739	-3384912
8	-3214429	-2957011	241737	75054	-3667022	-3373360	-3425285	-3298306
9	-3214429	-2957011	377191	156951	-3667022	-3373360	-3289831	-3216409
10	-3214429	-2957011	512645	234394	-3667022	-3373360	-3154378	-3138965
11	-3214429	-2957011	648098	307627	-3667022	-3373360	-3018924	-3065732
12	-3214429	-2957011	783552	376878	-3667022	-3373360	-2883470	-2996481
13	-3214429	-2957011	919006	442364	-3667022	-3373360	-2748016	-2930995
14	-3214429	-2957011	1054459	504289	-3667022	-3373360	-2612563	-2869070
15	-3214429	-2957011	1189913	562847	-3667022	-3373360	-2477109	-2810513
16	-3214429	-2957011	1733637	785123	-3667022	-3373360	-1933385	-2588237
17	-3214429	-2957011	2277362	995313	-3667022	-3373360	-1389661	-2378046
18	-3214429	-2957011	2821086	1194074	-3667022	-3373360	-845936	-2179285
19	-3214429	-2957011	3364810	1382028	-3667022	-3373360	-302212	-1991331
20	-3214429	-2957011	3908534	1559763	-3667022	-3373360	241512	-1813597
21	-3214429	-2957011	4452259	1727833	-3667022	-3373360	785236	-1645527
22	-3214429	-2957011	4995983	1886765	-3667022	-3373360	1328961	-1486595

COMPARISON I.A.1(C) UNIVERSITY NORMAL PLANT EXPANSION WESTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PUMCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	694813	912401	1607215	0	1607215	0	0	0	0	0	0	0	0	1607
2	734765	872449	1607215	0	1607215	0	0	0	0	0	0	0	0	1607
3	777014	830200	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
4	821693	785522	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
5	868940	738275	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
6	918904	688311	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
7	971741	635474	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
8	1027616	579599	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
9	1086704	520511	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
10	1149189	458025	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
11	1215268	391947	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
12	1285146	322069	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
13	1359042	248173	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
14	1437186	170028	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
15	1519825	87390	1607215	1001430	2608645	9408	343904	99000	983076	146489	3044041	85784	4565213	7173
16	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
17	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
18	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
19	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
20	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
21	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
22	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
SUM	15867845	8240373	24108218	20028600	44136818	188160	6878080	1980000	19661520		60880820	1715680	91304260	135441
PW	9855510	6012335	15867845	10482925	26350770	98483	3599972	1036328	10290796		31864888	897983	47788449	74139

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-1607215	-1519825
2	0	0	0	0	0	0	0	0	0	0	0	0	-1607215	-1437186
3	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	3.578	7173858	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		132226649		0		0	0	0	-3214429	-2957011
PW	20988608	18950392	2038216	20988608		71182209		0		0	0	0	-2957011	-2957011

COMPARISON I.A.1(C) TURBINE-GENERATOR SIDE OF COGENERATION PLANT WESTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	123421	162072	285493	0	285493	0	0	0	0	0	0	0	0	285
2	130518	154975	285493	0	285493	0	0	0	0	0	0	0	0	285
3	138022	147470	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
4	145959	139534	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
5	154351	131141	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
6	163227	122266	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
7	172612	112880	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
8	182537	102955	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
9	193033	92459	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
10	204133	81360	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
11	215870	69622	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
12	228283	57210	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
13	241409	44083	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
14	255290	30202	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
15	269969	15523	285493	78700	364193	2180	7000	24800	38720	0	0	0	637741	1001
16	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
17	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
18	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
19	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
20	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
21	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
22	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
SUM	2818635	1463753	4282388	1574000	5856388	43600	140000	496000	774400		0	0	11895369	17751
PW	1750653	1067982	2818635	823828	3642463	22820	73276	259605	405319		0	0	6376889	10019

YR	STEAM GEN. BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-285493	-269969
2	0	0	0	0	0	0	0	0	0	0	0	0	-285493	-255290
3	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	114538
4	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	108310
5	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	102421
6	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	96852
7	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	91586
8	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	86606
9	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	81897
10	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	77444
11	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	73233
12	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	69251
13	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	65486
14	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	61925
15	0	0	0	0	0	0	40566	394720	.0247	567924	569463	1137387	135454	58558
16	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	222276
17	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	210190
18	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	198761
19	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	187954
20	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	177734
21	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	168070
22	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	158932
SUM	0	0	0	0		0		7294026		11358480	11389260	22747740	4995983	1886765
PW	0	0	0	0		0		3923077		5945003	5961114	11906117	1886765	1886765

COMPARISON I.A.1(C) STEAM SIDE OF COGENERATION PLANT WESTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	792643	1040868	1833511	0	1833511	0	0	0	0	0	0	0	0	1833
2	838220	995291	1833511	0	1833511	0	0	0	0	0	0	0	0	1833
3	886418	947093	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
4	937387	896124	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
5	991287	842224	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
6	1048286	785225	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
7	1108562	724949	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
8	1172365	661206	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
9	1239712	593799	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
10	1310996	522515	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
11	1386378	447133	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
12	1466095	367416	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
13	1550395	283116	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
14	1639543	193968	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
15	1733817	99694	1833511	1063810	2897321	39200	381424	132000	1625662	157377	3270294	92160	5540740	8438
16	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
17	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
18	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
19	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
20	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
21	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
22	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
SUM	18102045	9400621	27502666	21276200	48778866	784000	7628480	2640000	32513240		65405880	1843200	110814800	159593
PW	11243170	6856875	18102045	11135916	29237961	410344	3992730	1381770	17017358		34233294	964727	58000223	87238

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-1833511	-1733817
2	0	0	0	0	0	0	0	0	0	0	0	0	-1833511	-1639543
3	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	4.012	8438061	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		155926044		0		0	0	0	-3667022	-3373360
PW	20988608	18950392	2038216	20988608		83864825		0		0	0	0	-3373360	-3373360

COMPARISON I.A.1(C) TOTAL COGENERATION PLANT WESTERN COAL NO COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	916065	1202939	2119004	0	2119004	0	0	0	0	0	0	0	0	2119
2	968738	1150265	2119004	0	2119004	0	0	0	0	0	0	0	0	2119
3	1024441	1094563	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
4	1083346	1035658	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
5	1145638	973365	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
6	1211513	907491	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
7	1281175	837829	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
8	1354842	764161	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
9	1432746	686258	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
10	1515128	603875	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
11	1602248	516755	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
12	1694378	424626	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
13	1791804	327199	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
14	1894833	224171	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
15	2003786	115218	2119004	1142510	3261514	41380	388424	156800	1664382	157377	3270294	92160	6178481	9439
16	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
17	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
18	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
19	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
20	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
21	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
22	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
SUM	20920680	10864374	31785054	22850200	54635254	827600	7768480	3136000	33287640		65405880	1843200	122710169	177345
PW	12993823	7926857	20920680	11959745	32880425	433164	4066005	1641376	17422678		34233294	964727	64377113	97257

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDIT$)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-2119004	-2003786
2	0	0	0	0	0	0	0	0	0	0	0	0	-2119004	-1894833
3	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	114538
4	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	108310
5	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	102421
6	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	96852
7	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	91586
8	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	86606
9	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	81897
10	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	77444
11	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	73233
12	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	69251
13	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	65486
14	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	61925
15	2005034	1810324	194710	2005034	4.012	8438061	40566	394720	.0247	567924	569463	1137387	135454	58558
16	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	222276
17	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	210190
18	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	198761
19	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	187954
20	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	177734
21	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	168070
22	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	158932
SUM	40100680	36206480	3894200	40100680		155926644		7294026		11358480	11389260	22747740	1328961	-1486595
PW	20988608	18950392	2038216	20988608		83864825		3923077		5945003	5961114	11906117	-1486595	-1486595

3.3.4

COST BENEFITS - COMPARISON I.A.2(a)

Eastern Coal Vs. Eastern Coal, 5 3/4%, n = 15 years

Expense Item	Normal Plant Expansion	Cogeneration Expansion	
		Elec. Gen.	Steam Gen.
Capital Budget - 1978	$14,829,760	$2,634,240	$16,917,800
Escalated Budget - 1979	15,867,845	2,818,635	18,102,045
Cost Sharing			
[1]DOE (MIS)	-0-	15,000	324,800
Legisl.	11,422,190	-0-	11,422,190
Total Cost Sharing	$11,422,190	$ 15,000	$11,746,990
Loan (U of M)	$ 4,445,655	$2,803,635	$ 6,355,055
Capital Recovery	$ 450,300	$ 283,980	$ 643,704
Depreciation	1,001,430	78,700	1,063,810
Total Owning	$ 1,451,730	$ 362,680	$ 1,707,514
Operating Expenses (end of 1981)			
Insurance	$ 9,408	$ 2,180	$ 39,200
Purchased Utilities	343,904	7,000	381,424
Administration	99,000	24,800	132,000
Labor, Supplies, Maint.	983,076	38,720	1,625,662
[2]Fuel-Community	5,364,296	-0-	5,364,296
Fuel-Generator	-0-	-0-	398,708
[3]Ash Handling and Landfill	74,908	-0-	80,475
[4]Turbine Steam Purch.	-0-	651,504	-0-
Total Operating Expense	$ 6,874,592	$ 724,204	$ 8,021,765
Gross Owning & Operating	$ 8,326,322	$1,086,884	$ 9,729,279
Gross Production Expense			
Steam, $/1000 lbs.	$ 4.15271	-	$ 4.8524
Electricity, $/KWh	-	$ .02679	-0-
[5]Community Steam Charge	$ 4.15271	-	$ 4.52749
Revenue (Steam)			
a. Community Usage	$ 7,517,748	-0-	$ 8,196,227
b. Community Line Loss	566,002	-0-	617,084
c. Blowdown Allocation	242,572	-0-	264,464
d. T-G Steam	-0-	-0-	651,504
Total Steam Revenue	$ 8,326,322	-0-	$ 9,729,279
Revenue (Elec. Gen.)			
a. Capacity	-	$ 569,463	-
b. Energy	-	567,924	-
Total Elec. Gen. Revenue		$1,137,387	

Expense Item	Normal Plant Expansion	Cogeneration Expansion	
		Elec. Gen.	Steam Gen.
Gross Plant Income	$ 8,326,322	$1,137,387	$ 9,729,279
Plant Cash Flow (one year operation)	-0-	$ 50,503	-0-
Const. Cash Flow (Debt) (1979 through 1980)	$ 828,552	$ 522,523	$ 1,184,415
Net Plant Cash Flow at end of 1981	($ 828,552)	($ 472,020)	($ 1,184,415)
Cash Flow Deficit at end of 1981	($ 828,552)	($ 472,020)	($ 1,184,415)

NOTES (I.A.2(a))

	Total	DOE
1. Computer Interface Steam Gen.	$ 65,000	$ 65,000
Computer MIS	225,000	225,000
		$2,901,000
Computer Interface - Turbine	15,000	15,000

2. Fuel - 109,939 - 10,888 $\left(\frac{8,890}{12,726}\right)$ = 102,333

   Community Charge = 102,333 x 52.42

   = 5,364,295

3. Ash Handling = 102,333 x .1 x 7.32

   = $74,908

4. $\frac{4,619 \times 40,566,000}{109,939 \times 2,000 \times 12,726}$ ($9,729,279) = $651,504

5. $\frac{9,729,279 - 651,504}{2,005,034}$ = $4.52749 per 1,000 lbs.

A. SIMPLE COST BENEFIT ANALYSIS

I. Payback Period - Total Cogeneration

$$\underset{\text{(Total Plant)}}{\text{Payback Period}} = \frac{\$6,355,055 + \$2,803,635 - \$4,445,655}{\$50,503}$$

$$= 93.32 \text{ years}$$

II. Payback Period - Turbine-Generator

$$\underset{\text{(Turbine-Gen.)}}{\text{Payback Period}} = \frac{\$2,803,635}{\$50,503}$$

$$= 55.51 \text{ years}$$

III. Minimum Acceptable Rate of Return (MAR)

$$(\$6,355,055 + 2,803,635)CRF\Big|_{15}^{i} + (8,021,765 + 724,204)$$

$$-(9,729,279 + 1,137,387) = (4,445,655)CRF\Big|_{15}^{i}$$

$$+ 6,874,592 - 8,326,322$$

$$CRF\Big|_{15}^{i} = \frac{668,967}{\$4,713,035}$$

$$= .14194$$

$$MAR \cong 11.5\%$$

IV. Return-on-Investment (ROI) - Total Cogeneration

$$ROI = \frac{\$50,503}{6,355,055 + 2,803,635 - 4,445,655} \times 100$$

$$ROI = 1.07\%$$

V. Return-on-Investment (ROI) - Turbine Generation

$$ROI = \frac{\$50,503}{2,803,635} \times 100$$

$$ROI = 1.8\%$$

VI. Benefit-to-Cost Ratio (B/C) (Total Cogeneration)

PWF = 9.8729

Normal Plant Expansion PW of 15 year Costs

PW of 15 year Operating Costs	$(67,872,159)
PW of 15 year Steam Revenues	82,204,944
PW of 15 years	$ 14,332,785

Cogeneration Expansion PW of 15 year Costs

PW of 15 year Steam Operating Costs	$(79,198,084)
PW of 15 year Steam Revenues	96,056,199
PW of 15 year Gen. Operating Costs	(7,149,994)
PW of 15 year Gen. Revenues	11,229,308
PW of 15 years	$ 20,937,429

$$\text{B/C Ratio} = \frac{20,937,429 - 14,332,785}{6,355,055 + 2,803,635 - 4,445,655}$$

B/C Ratio = 1.401

VII. Benefit-to-Cost Ratio (Turbine-Generation)

$$\text{B/C Ratio} = \frac{11,229,308 - 7,149,994}{2,803,635}$$

B/C Ratio = 1.46

B. COST EFFECTIVENESS ANALYSIS

Normal Plant Expansion Steam Operation
Combined Escalation Rate:

$$CER = [.03(9,408) + .1(343,904) + .08(99,000) + .0698(983,076) + .07399(5,364,296) + .07(74,908)] \div 6,874,592$$

CER = 8.14% a = 1.0226 PWF = 18.02

Cogeneration Plant Expansion Steam Operation
Combined Escalation Rate:

$$CER = [.03(39,200) + .1(381,424) + .08(132,000) + .0698(1,625,662) + .07399(5,763,004) + .07(80,475)] \div 8,021,765$$

CER = 8.04% a = 1.0217 PWF = 17.89

Electric Production Operation CER:

$$CER = [.03(2,180) + .1(7,000) + .08(24,800) + .0698(38,720) + .0804(651,504)] \div 724,204$$

CER = 7.99% a = 1.0211 PWF = 17.83

I. PRESENT WORTH OF 15 YEAR LONG TERM COSTS

Cost Item	PWF	Normal Plant Exp.	Cogeneration Plant PWF	Elec. Gen.	PWF	Steam Gen.
1979 Capital Budget	1.0	$ 4,445,655	1.0	$ 2,803,635	1.0	$ 6,355,055
Const. Cash Flow	1.84	828,552	1.84	522,523	1.84	1,184,415
Depreciation	11.71	11,726,745	11.71	921,577	11.71	12,457,215
Insurance	12.23	115,059	12.23	25,781	12.23	479,416
Purch. Utility	30.97	10,650,707	30.97	216,790	30.97	11,812,701
Administration	17.78	1,760,220	17.78	440,944	17.78	2,346,960
Labor Supplies,Maint.	16.52	16,240,416	16.52	639,654	16.52	26,855,936
Fuel-Community	18.23	97,791,116	-	-	18.23	97,791,116
Fuel-T-G	-	-	-	-	18.23	7,268,447
Ash Handling & Land.	16.52	1,237,480	-	-	16.52	1,329,447
Turbine Steam	-	-	17.89	11,655,407	-	-
PW of 15 year Owning & Operating		$144,795,950		$17,226,311		$167,880,708
PW of 15 year Revenues						
Steam	18.02	$150,040,322	-	-	17.89	$174,056,801
Electric	-	-	17.83	$20,279,610	-	-
Net PW of 15 years		$ 5,244,372		$ 3,053,299		$ 6,176,093

∴ The cogeneration plant is the better economic choice because it has a cost benefit PW of 15 year revenues of:

$6,176,093
+3,053,299
$9,229,392
-5,244,372
$3,985,020

II. BENEFIT-TO-COST RATIO (LIFE CYCLE) - TOTAL COGENERATION

$$\text{B/C Ratio} = \frac{\$3,985,020}{\$6,355,055 - 4,445,655 + 2,803,635}$$

$$= .85$$

III. BENEFIT-TO-COST RATIO (LIFE CYCLE) - TURBINE-GENERATOR

$$\text{B/C Ratio} = \frac{\$20,279,610 - 17,226,311}{\$2,803,635}$$

$$= 1.09$$

IV. PAYBACK PERIOD (TURBINE-GENERATOR)

$$\begin{aligned} \text{CER} = \; & [.03(39,200-9,408) + .03(2,180) + .1(381,424-343,904) \\ & +.1(7,000) + .08(132,000-99,000) + .08(24,800) \\ & +.0698(1,625,662-983,076) + .0698(38,720) \\ & +.07399(5,364,296+398,708-5,364,296) \\ & +.07(80,475-74,908) + .0804(651,504)] \\ & \div (8,021,765-6,874,592) \end{aligned}$$

CER = .1249 a = 1.0637 PWF = 24.85

$$n = \frac{\left[\log \frac{2,803,635}{(1.0637)(50,503)} (1.0637-1) + 1\right]}{\log 1.0637}$$

n = 23.71 years

V. RETURN ON INVESTMENT (LIFE CYCLE)

$$\text{Total 15 Year Savings} = \frac{(50,503)(1.1249)(1.1249^{15}-1)}{.1249}$$

$$= \$2,203,287$$

$$\text{Rate of Return, R} = \left(\frac{2,203,287}{2,803,635}\right)^{1/15} - 1$$

$$^{1}R = -1.59\%$$

1. The rate of return is less than 1.59%.

CASH FLOW ANALYSIS I.A.2(a)

The primary difference between this plan and I.A.1(a) is the cost sharing used for this comparison. It shows that with $11 million plus dollars of cost sharing the turbine-generator is paid off in the 14th year, but the total net cash flow is reduced.

COST COMPARISON I.A.2(A) EASTERN COAL VS EASTERN COAL WITH COST SHARING

ALL LOANS AMORTIZED IN 15 YEARS AT 5.75 PERCENT EFFECTIVE ANNUAL RETURN.
REVENUE REQUIREMENT BASED UPON FULL CONSTRUCTION BUDGET ESCALATED AT 7.0 PERCENT PER YR FROM JAN. 1978 TO JAN. 1981
DEPRECIATION SINKING FUND ACCUMULATED AT 7.0 PERCENT.
PRESENT WORTH CALCULATED USING 5.75 PERCENT

	NORMAL EXPANSION	TURBINE-GEN	COGEN-STEAM SIDE	TOTAL COGEN
TOTAL CAPITAL BUDGET (DOLLARS)	4445655	2803635	6355055	9158690
INTERNAL RATE OF RETURN (PERCENT)	0	-1.00	0	-1.00

CUMULATIVE NET CASH FLOWS AND PRESENT WORTH 78/03/13

	NORMAL PLANT EXPANSION		COGENERATION PLANT: TURBINE - GENERATOR		COGENERATION PLANT: STEAM SIDE		COGENERATION PLANT: TOTAL PLANT	
YEAR	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW
1	-450289	-425806	-283973	-268533	-643688	-608688	-927661	-877221
2	-900579	-828458	-567946	-522464	-1287375	-1184280	-1855322	-1706744
3	-900579	-828458	-517436	-479753	-1287375	-1184280	-1804811	-1664033
4	-900579	-828458	-466925	-439364	-1287375	-1184280	-1754301	-1623644
5	-900579	-828458	-416414	-401171	-1287375	-1184280	-1703790	-1585451
6	-900579	-828458	-365904	-365055	-1287375	-1184280	-1653279	-1549335
7	-900579	-828458	-315393	-330903	-1287375	-1184280	-1602769	-1515183
8	-900579	-828458	-264883	-298608	-1287375	-1184280	-1552258	-1482887
9	-900579	-828458	-214372	-268068	-1287375	-1184280	-1501747	-1452348
10	-900579	-828458	-163861	-239189	-1287375	-1184280	-1451237	-1423469
11	-900579	-828458	-113351	-211881	-1287375	-1184280	-1400726	-1396161
12	-900579	-828458	-62840	-186057	-1287375	-1184280	-1350215	-1370337
13	-900579	-828458	-12329	-161638	-1287375	-1184280	-1299705	-1345917
14	-900579	-828458	38181	-138546	-1287375	-1184280	-1249194	-1322826
15	-900579	-828458	88692	-116710	-1287375	-1184280	-1198683	-1300989
16	-900579	-828458	466279	37649	-1287375	-1184280	-821096	-1146631
17	-900579	-828458	843867	183615	-1287375	-1184280	-443509	-1000665
18	-900579	-828458	1221454	321644	-1287375	-1184280	-65922	-862636
19	-900579	-828458	1599041	452168	-1287375	-1184280	311666	-732112
20	-900579	-828458	1976628	575595	-1287375	-1184280	689253	-608685
21	-900579	-828458	2354216	692311	-1287375	-1184280	1066840	-491969
22	-900579	-828458	2731803	802680	-1287375	-1184280	1444428	-381600

COMPARISON I.A.2(A) UNIVERSITY NORMAL PLANT EXPANSION EASTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PUMCM UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	194664	255625	450289	0	450289	0	0	0	0	0	0	0	0	450
2	205857	244432	450289	0	450289	0	0	0	0	0	0	0	0	450
3	217694	232595	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
4	230212	220078	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
5	243449	206841	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
6	257447	192842	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
7	272250	178039	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
8	287905	162385	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
9	304459	145830	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
10	321966	128324	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
11	340479	109811	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
12	360056	90233	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
13	380759	69530	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
14	402653	47636	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
15	425806	24484	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
16	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
17	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
18	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
19	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
20	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
21	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
22	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
SUM	4445655	2308685	6754340	20028600	26782940	188160	6876080	1980000	19661520		107285920	1498800	137492480	164275
PW	2761194	1684461	4445655	10482925	14928580	98483	3599972	1036328	10290796		56153215	784469	71963262	86891

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-450289	-425806
2	0	0	0	0	0	0	0	0	0	0	0	0	-450289	-402653
3	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		163374841		0		0	0	0	-900579	-828458
PW	20988608	18950392	2038216	20988608		86063384		0		0	0	0	-828458	-828458

COMPARISON I.A.2(A) TURBINE-GENERATOR SIDE OF COGENERATION PLANT EASTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	122764	161209	283973	0	283973	0	0	0	0	0	0	0	0	283
2	129823	154150	283973	0	283973	0	0	0	0	0	0	0	0	283
3	137288	146685	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
4	145182	138791	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
5	153530	130443	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
6	162358	121615	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
7	171694	112280	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
8	181566	102407	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
9	192006	91967	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
10	203046	80927	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
11	214721	69252	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
12	227068	56905	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
13	240124	43849	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
14	253932	30042	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
15	268533	15441	283973	78700	362673	2180	7000	24800	38720	0	0	0	724203	1086
16	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
17	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
18	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
19	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
20	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
21	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
22	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	681100	759
SUM	2803635	1455963	4259598	1574000	5833598	43600	140000	496000	774400		0	0	14182339	20015
PW	1741336	1062299	2803635	823828	3627463	22820	73276	259605	405319		0	0	7475974	11103

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-283973	-268533
2	0	0	0	0	0	0	0	0	0	0	0	0	-283973	-253932
3	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	42711
4	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	40389
5	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	38193
6	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	36116
7	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	34152
8	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	32295
9	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	30539
10	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	28879
11	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	27309
12	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	25824
13	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	24420
14	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	23092
15	0	0	0	0	0	0	40566	651503	.0268	567924	569463	1137387	50511	21836
16	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	154359
17	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	145966
18	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	138029
19	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	130524
20	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	123427
21	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	116716
22	0	0	0	0	0	0	40566	608400	.0187	567924	569463	1137387	377587	110370
SUM	0	0	0	0		0		12728339		11358480	11389260	22747740	2731803	802680
PW	0	0	0	0		0		6714954		5945003	5961114	11906117	802680	802680

COMPARISON I.A.2(A) STEAM SIDE OF COGENERATION PLANT EASTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	278272	365416	643688	0	643688	0	0	0	0	0	0	0	0	643
2	294273	349415	643688	0	643688	0	0	0	0	0	0	0	0	643
3	311193	332494	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
4	329687	314001	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
5	348809	295678	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
6	368020	275668	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
7	389181	254507	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
8	411559	232129	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
9	435224	208464	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
10	460245	183439	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
11	486713	156974	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
12	514699	128988	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
13	544295	99393	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
14	575592	68096	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
15	608688	35000	643688	1063810	1707498	39200	381424	132000	1625662	109939	5763004	80478	8021768	9729
16	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	8021768	9085
17	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	8021768	9085
18	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	8021768	9085
19	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	8021768	9085
20	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	8021768	9085
21	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	8021768	9085
22	0	0	0	1063810	1063810	39200	381424	132000	1625662	109939	5763004	80478	8021768	9085
SUM	6355055	3300261	9655316	21276200	30931516	784000	7628480	2640000	32513240	115260080		1609560	160435360	191366
PW	3947121	2407934	6355055	11135916	17490971	410344	3992730	1381770	17017358	60326873		842440	83971515	101462

YR	STEAM GEN. BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-643688	-608688
2	0	0	0	0	0	0	0	0	0	0	0	0	-643688	-575592
3	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	4.527	9729266	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	4.228	9085578	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		190079500		0		0	0	0	-1287375	-1184280
PW	20988608	18950392	2038216	20988608		100278207		0		0	0	0	-1184280	-1184280

COMPARISON I.A.2(A) TOTAL COGENERATION PLANT EASTERN COAL WITH COST SHAKING

YR	PRINCIPLE	INTEPEST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	401036	526625	927661	0	927661	0	0	0	0	0	0	0	0	927
2	424096	503565	927661	0	927661	0	0	0	0	0	0	0	0	927
3	448481	479180	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
4	474269	453392	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
5	501539	426121	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
6	530378	397283	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
7	560875	366786	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
8	593125	334536	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
9	627230	300431	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
10	663295	264365	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
11	701435	226226	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
12	741767	185893	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
13	784419	143242	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
14	829523	98138	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
15	877221	50440	927661	1142510	2070171	41380	388424	156800	1664382	109939	5763004	80478	8745971	10816
16	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
17	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
18	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
19	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
20	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
21	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
22	0	0	0	1142510	1142510	41380	388424	156800	1664382	109939	5763004	80478	8702868	9845
SUM	9158690	4756224	13914914	22850200	36765114	827600	7768480	3136000	33287640		115260080	1609560	174617699	211382
PW	5688457	3470233	9158690	11959745	21118435	433164	4066005	1641376	17422678		60326873	842440	91447489	112565

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-927661	-877221
2	0	0	0	0	0	0	0	0	0	0	0	0	-927661	-829523
3	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	42711
4	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	40389
5	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	38193
6	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	36116
7	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	34152
8	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	32295
9	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	30539
10	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	28879
11	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	27309
12	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	25824
13	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	24420
14	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	23092
15	2005034	1810324	194710	2005034	4.527	9729266	40566	651503	.0268	567924	569463	1137387	50511	21836
16	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	154359
17	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	145966
18	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	138029
19	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	130524
20	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	123427
21	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	116716
22	2005034	1810324	194710	2005034	4.228	9085578	40566	608400	.0187	567924	569463	1137387	377587	110370
SUM	40100680	36206480	3894200	40100680		190079500		12728339		11358480	11389260	22747740	1444428	-381600
PW	20988608	18950392	2038216	20988608		100278207		6714954		5945003	5961114	11906117	-381600	-381600

3.3.5

COST BENEFITS - COMPARISON I.A.2(b)

Eastern Coal Vs. Western Coal, i = 5 3/4%, n = 15 years

Expense Item	Normal Combined Plant Expansion	Cogeneration Expansion	
		Elec. Gen.	Steam Gen.
Capital Budget - 1978	$14,829,760	$2,634,240	$16,917,800
Escalated Budget - 1979	15,867,845	2,818,635	18,102,045
Cost Sharing			
DOE	-0-	15,000	324,800
Legisl.	11,422,190	-0-	11,422,190
Total Cost Sharing	$11,422,190	$ 15,000	$11,476,990
Loan (U of M)	$ 4,445,655	$2,803,635	$ 6,355,055
Capital Recovery	$ 450,300	$ 283,980	$ 643,704
Depreciation	1,001,430	78,700	1,063,810
Total Owning	$ 1,451,730	$ 362,680	$ 1,707,514
Operating Expenses (End of 1981)			
Insurance	$ 9,408	$ 2,108	$ 39,200
Purchased Utilities	343,904	7,000	381,424
Administration	99,000	24,800	132,000
Labor Supplies, Maint.	983,076	38,720	1,625,662
Fuel-Community	5,364,286	-0-	3,044,041
Fuel-Generator	-0-	-0-	226,252
Ash Handling & Landfill	74,098	-0-	92,160
Turbine Steam Purch.	-0-	485,367	-0-
Total Operating Expense	$ 6,874,592	$ 557,995	$ 5,540,739
Gross Owning & Operating	$ 8,326,322	$ 920,675	$ 7,248,253
Gross Production Expense			
Steam, $/1000 lbs.	4.153	-	3.615
Electricity, $/KWh	-	.02269	-
Community Steam Charge	4.153	-	3.373
Revenue (Steam)			
a. Community Usage	$ 7,517,748	-	$ 6,106,138
b. Community Line Loss	566,002	-	459,723
c. Blowdown Allocation	242,572	-	197,025
d. T-G Steam	-0-	-	485,367
Total Steam Revenue	$ 8,326,322		$ 7,248,253
Revenue (Elec. Gen.)			
a. Capacity	-	$ 569,463	-
b. Energy	-	567,924	-
Total Elec. Gen. Revenue		$1,137,387	

Expense Item	Normal Combined Plant Expansion	Cogeneration Expansion	
		Elec. Gen.	Steam Gen.
Gross Plant Income	$ 8,326,322	$1,137,387	$ 7,248,253
Plant Cash Flow (one year operation)	-0-	$ 216,712	-0-
Const. Cash Flow (Debt) (1979 through 1980)	$ 828,552	$ 522,523	$ 1,184,415
Net Plant Cash Flow at end of 1981	($ 828,552)	($ 305,811)	($ 1,184,415)
Cash Flow Deficit at end of 1981	($ 828,552)	($ 305,811)	($ 1,184,415)

A. SIMPLE COST BENEFIT ANALYSIS

I. Payback Period - Total Cogeneration

$$\text{Payback Period} = \frac{\$6,355,055 + 2,803,635 - 4,445,655}{\$216,712}$$

$$= 21.75 \text{ years}$$

II. Payback Period - Turbine-Generator

$$\text{Payback Period} = \frac{\$2,803,635}{216,712}$$

$$= 12.93 \text{ years}$$

III. Minimum Acceptable Rate of Return

$$(\$6,355,055 + 2,803,635)CRF|_{15}^{i} + (5,540,739 + 557,995)$$

$$- (7,248,253 + 1,137,387) = (4,445,155)CRF|_{15}^{i}$$

$$+ 6,874,592 - 8,326,322$$

$$CRF|_{15}^{i} = \frac{835,176}{\$4,713,035}$$

$$CRF|_{15}^{i} = .17721$$

$$MAR \cong 16\%$$

IV. Return on Investment - Total Cogeneration

$$ROI = \frac{216,712}{6,355,055 + 2,803,635 - 4,445,655} \times 100$$

$$ROI = 4.60\%$$

V. Return on Investment - Turbine Generator

$$ROI = \frac{216,712}{2,803,635} \times 100$$

$$ROI = 7.73\%$$

VI. Benefit-to-Cost Ratio (B/C) - Total Cogeneration

PWF = 9.8729

Normal Plant Expansion PW of 15 Year Costs

PW of 15 year Steam Operating Costs	($67,872,159)
PW of 15 year Steam Revenues	82,204,944
PW of 15 years	$14,332,785

Cogeneration Expansion PW of 15 Year Costs

PW of 15 year Steam Operating Costs	($54,703,162)
PW of 15 year Steam Revenues	71,561,277
PW of 15 year Generator Operating Costs	(5,509,029)
PW of 15 year Generator Revenues	11,229,308
PW of 15 years	$22,578,394

$$\text{B/C Ratio} = \frac{\$22,578,394 - 14,332,785}{6,355,055 + 2,803,635 - 4,445,655}$$

B/C Ratio = 1.75

VII. Benefit-to-Cost Ratio - Turbine-Generator

$$\text{B/C Ratio} = \frac{11,229,308 - 5,509,029}{2,803,635}$$

B/C Ratio = 2.04

B. COST EFFECTIVENESS ANALYSIS

Normal Plant Expansion Steam Operation
Combined Escalation Rate:

CER = 8.14% a = 1.0226 PWF = 18.02

Cogeneration Plant Expansion Steam Operation
Combined Escalation Rate

CER = 7.9399% a = 1.02071 PWF = 17.74

Electric Production Operation CER

$$CER = [.03(2,180) + .1(7,000) + .08(24,800) + .0698(38,720) + .079399(485,367)] \div 557,995$$

CER = 7.884% a = 1.0202 PWF = 17.64

I. PRESENT WORTH OF 15 YEAR LONG TERM COSTS

Cost Item	PWF	Normal Expans. Plant	Cogeneration Plant PWF	Elec. Gen.	PWF	Steam Gen.
Sub total through Labor of I.A.2(a)	-	$ 45,767,354	-	$ 5,570,904	-	$ 61,491,698
Fuel Community	18.32	98,273,719	-	-0-	18.32	55,766,831
Fuel Turbine	18.32	-0-	-	-0-	18.32	4,144,937
Ash Handling	16.52	1,224,099	-	-0-	16.52	1,522,483
Turbine Steam	-	-0-	17.74	8,610,411	-	-0-
PW of 15 years Owning & Operating		($145,265,173)		($14,181,315)		($122,925,949)
PW of 15 years of Revenues						
Steam	18.02	$150,040,322	-	-0-	17.74	$128,584,008
Electric Gen.	-	-0-	17.64	$20,063,507	-	-0-
Net PW of 15 years		$ 4,775,150		$ 5,882,192		$ 5,658,059

∴ The cogeneration plant is the better economic choice because it has a cost benefit PW of 15 years of:

$5,658,059
+5,882,192
$11,540,251
-4,775,150
$6,765,101

II. BENEFIT-TO-COST RATIO (LIFE CYCLE) - TOTAL COGENERATION

$$\text{B/C Ratio} = \frac{\$6,765,101}{\$6,355,055 - 4,445,655 + 2,803,635}$$

$$= 1.44$$

III. BENEFIT-TO-COST RATIO (LIFE CYCLE) - TURBINE-GENERATOR

$$\text{B/C Ratio} = \frac{\$20,063,507 - \$14,181,315}{\$2,803,635}$$

$$\text{B/C Ratio} = 2.10$$

IV. PAYBACK PERIOD (TURBINE-GENERATOR)

$$\begin{aligned}\text{CER} = {} & [.03(39,200-9,408) + .03(2,180) + .1(381,424-343,904) \\ & +.1(7,000) + .08(132,000-99,000) + .08(24,800) \\ & +.0698(1,625,662-983,076) + .0698(38,720) \\ & +.07399(5,364,286-226,252-3,004,041) \\ & +.07(92,160-74,098) + .079399(485,367)] \\ & \div (6,874,592-5,540,739-557,995)\end{aligned}$$

$$\text{CER} = .3457 \qquad a = 1.2725$$

$$n = \frac{\left[\text{Log}\ \frac{2,803,635}{(1.2725)(216,712)}\ (1.2725-1) + 1)\right]}{\text{Log } 1.2725}$$

$$n = 5.51 \text{ years}$$

V. RETURN ON INVESTMENT (LIFE CYCLE)

$$\text{Total 15 Year Savings} = \frac{(216,712)(1.2725)(1.2725^{15}-1)}{.3457}$$

$$= \$28,830,699$$

$$\text{Rate of Return, R} = \left(\frac{28,830,699}{2,803,635}\right)^{1/15} - 1$$

$$R = 16.81\%$$

CASH FLOW ANALYSIS I.A.2(b)

The primary difference between I.A.1(a) and this plan is cost sharing used of $11 million plus dollars and Western coal. Payoff on the turbine-generator is reduced to 5 years.

COST COMPARISON 1.A.2(B) EASTERN COAL VS WESTERN COAL WITH COST SHARING

ALL LOANS AMORTIZED IN 15 YEARS AT 5.75 PERCENT EFFECTIVE ANNUAL RETURN.
REVENUE REQUIREMENT BASED UPON FULL CONSTRUCTION BUDGET ESCALATED AT 7.0 PERCENT PER YR FROM JAN. 1978 TO JAN. 1981
DEPRECIATION SINKING FUND ACCUMULATED AT 7.0 PERCENT.
PRESENT WORTH CALCULATED USING 5.75 PERCENT

	NORMAL EXPANSION	TURBINE-GEN	COGEN-STEAM SIDE	TOTAL COGEN
TOTAL CAPITAL BUDGET (DOLLARS)	4445655	2803635	6355055	9158690
INTERNAL RATE OF RETURN (PERCENT)	0	5.07	0	-1.00

CUMULATIVE NET CASH FLOWS AND PRESENT WORTH 78/03/13

	NORMAL PLANT EXPANSION		COGENERATION PLANT: TURBINE-GENERATOR		COGENERATION PLANT: STEAM SIDE		COGENERATION PLANT: TOTAL PLANT	
YEAR	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW
1	-450289	-425806	-283973	-268533	-643688	-608688	-927661	-877221
2	-900579	-828458	-567946	-522464	-1287375	-1184280	-1855322	-1706744
3	-900579	-828458	-351299	-339270	-1287375	-1184280	-1638674	-1523549
4	-900579	-828458	-134651	-166036	-1287375	-1184280	-1422027	-1350316
5	-900579	-828458	81996	-2221	-1287375	-1184280	-1205379	-1186501
6	-900579	-828458	298644	152686	-1287375	-1184280	-988732	-1031594
7	-900579	-828458	515291	299170	-1287375	-1184280	-772084	-885110
8	-900579	-828458	731939	437689	-1287375	-1184280	-555436	-746590
9	-900579	-828458	948587	568677	-1287375	-1184280	-338789	-615603
10	-900579	-828458	1165234	692543	-1287375	-1184280	-122141	-491737
11	-900579	-828458	1381882	809673	-1287375	-1184280	94506	-374607
12	-900579	-828458	1598529	920435	-1287375	-1184280	311154	-263845
13	-900579	-828458	1815177	1025174	-1287375	-1184280	527801	-159106
14	-900579	-828458	2031824	1124218	-1287375	-1184280	744449	-60062
15	-900579	-828458	2248472	1217877	-1287375	-1184280	961097	33597
16	-900579	-828458	2792196	1440153	-1287375	-1184280	1504821	255873
17	-900579	-828458	3335920	1650343	-1287375	-1184280	2048545	466063
18	-900579	-828458	3879645	1849104	-1287375	-1184280	2592269	664824
19	-900579	-828458	4423369	2037058	-1287375	-1184280	3135994	852778
20	-900579	-828458	4967093	2214792	-1287375	-1184280	3679718	1030513
21	-900579	-828458	5510817	2382863	-1287375	-1184280	4223442	1198583
22	-900579	-828458	6054542	2541794	-1287375	-1184280	4767166	1357514

COMPARISON I.A.2(B) UNIVERSITY NORMAL PLANT EXPANSION EASTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	194664	255625	450289	0	450289	0	0	0	0	0	0	0	0	450
2	205857	244432	450289	0	450289	0	0	0	0	0	0	0	0	450
3	217694	232595	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
4	230212	220078	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
5	243449	206841	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
6	257447	192842	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
7	272250	178039	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
8	287905	162385	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
9	304459	145830	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
10	321966	128324	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
11	340475	109811	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
12	360056	90233	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
13	380759	69530	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
14	402653	47636	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
15	425836	24484	450289	1001430	1451719	9408	343904	99000	983076	102333	5364296	74940	6874624	8326
16	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
17	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
18	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
19	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
20	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
21	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
22	0	0	0	1001430	1001430	9408	343904	99000	983076	102333	5364296	74940	6874624	7876
SUM	4445655	2308685	6754340	20028600	26782940	188160	6878080	1980000	19661520		107285920	1498800	137492480	164275
PW	2761194	1684461	4445655	10482925	14928580	98483	3599972	1036328	10290796		56153215	784469	71963262	86891

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-450289	-425806
2	0	0	0	0	0	0	0	0	0	0	0	0	-450289	-402653
3	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	4.153	8326343	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	3.928	7876054	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		163374841		0		0	0	0	-900579	-828458
PW	20988608	18950392	2038216	20988608		86063384		0		0	0	0	-828458	-828458

COMPARISON I.A.2(B) TURBINE-GENERATOR SIDE OF COGENERATION PLANT WESTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	122764	161229	283973	0	283973	0	0	0	0	0	0	0	0	283
2	129823	154150	283973	0	283973	0	0	0	0	0	0	0	0	283
3	137288	146685	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
4	145182	138791	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
5	153530	130443	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
6	162358	121615	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
7	171694	112280	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
8	181566	102407	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
9	192006	91967	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
10	203046	80927	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
11	214721	69252	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
12	227068	56905	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
13	240124	43849	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
14	253932	30042	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
15	268533	15441	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
16	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
17	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
18	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
19	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
20	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
21	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
22	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
SUM	2803635	1455963	4259598	1574000	5833598	43600	140000	496000	774400		0	0	10859600	16693
PW	1741336	1062299	2803635	823828	3627463	22820	73276	259605	405319		0	0	5736860	9364

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-283973	-268533
2	0	0	0	0	0	0	0	0	0	0	0	0	-283973	-253932
3	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	183195
4	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	173234
5	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	163814
6	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	154907
7	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	146484
8	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	138519
9	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	130988
10	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	123865
11	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	117130
12	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	110762
13	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	104739
14	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	99044
15	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	93659
16	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	222276
17	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	210190
18	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	198761
19	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	187954
20	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	177734
21	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	168070
22	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	158932
SUM	0	0	0	0		0		6570469		11358480	11389260	22747740	6054542	2541794
PW	0	0	0	0		0		3475971		5945003	5961114	11906117	2541794	2541794

COMPARISON I.A.2(B) STEAM SIDE OF COGENERATION PLANT WESTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LAND FILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	278272	365416	643688	0	643688	0	0	0	0	0	0	0	0	643
2	294273	349415	643688	0	643688	0	0	0	0	0	0	0	0	643
3	311193	332494	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
4	329087	314601	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
5	348009	295678	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
6	368020	275668	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
7	389181	254507	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
8	411559	232129	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
9	435224	208464	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
10	460249	183439	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
11	486713	156974	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
12	514699	128988	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
13	544295	99393	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
14	575592	68096	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
15	608688	35000	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
16	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
17	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
18	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
19	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
20	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
21	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
22	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
SUM	6355055	3300261	9655316	21276200	30931516	784000	7628480	2640000	32513240		65405880	1843200	110814800	141746
PW	3947121	2407934	6355055	11135916	17490971	410344	3992730	1381770	17017358		34233294	964727	58000223	75491

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-643688	-608688
2	0	0	0	0	0	0	0	0	0	0	0	0	-643688	-575592
3	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		140458940		0		0	0	0	-1287375	-1184280
PW	20988608	18950392	2038216	20988608		74306915		0		0	0	0	-1184280	-1184280

COMPARISON I.A.2(B) TOTAL COGENERATION PLANT WESTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PUMCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	401036	526625	927661	0	927661	0	0	0	0	0	0	0	0	927
2	424096	503565	927661	0	927661	0	0	0	0	0	0	0	0	927
3	448481	479180	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
4	474266	453392	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
5	501539	426121	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
6	530378	397283	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
7	560875	366786	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
8	593125	334536	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
9	627230	300431	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
10	663295	264365	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
11	701435	226226	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
12	741767	185893	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
13	784419	143242	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
14	829523	98138	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
15	877221	50440	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
16	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
17	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
18	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
19	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
20	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
21	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
22	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
SUM	9156690	4756224	13914914	22850200	36765114	827600	7768480	3136000	33287640		65405880	1843200	121674400	158439
PW	5688457	3470233	9158690	11959745	21118435	433164	4066005	1641376	17422678		34233294	964727	63737083	84855

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-927661	-877221
2	0	0	0	0	0	0	0	0	0	0	0	0	-927661	-829523
3	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	183195
4	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	173234
5	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	163814
6	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	154907
7	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	146484
8	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	138519
9	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	130988
10	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	123865
11	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	117130
12	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	110762
13	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	104739
14	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	99044
15	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	93659
16	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	222276
17	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	210190
18	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	198761
19	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	187954
20	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	177734
21	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	168070
22	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	158932
SUM	40100680	36206480	3894200	40100680		140458940		6570469		11358480	11389260	22747740	4767166	1357514
PW	20988608	18950392	2038216	20988608		74306915		3475971		5945003	5961114	11906117	1357514	1357514

3.3.6 COST BENEFITS - COMPARISON I.A.2(c)

Western Coal Vs. Western Coal, i = 5 3/4%, n = 15 years

Expense Item	Normal Plant Expansion	Cogeneration Expansion Elec. Gen.	Cogeneration Expansion Steam Gen.
Capital Budget - 1978	$14,829,760	$2,634,240	$16,917,800
Escalated Budget - 1979	15,867,845	2,818,635	18,102,045
Cost Sharing			
DOE	-0-	15,000	324,800
Legisl.	11,422,190	-0-	11,422,190
Total Cost Sharing	$11,422,190	$ 15,000	$11,476,990
Loan (U of M)	$ 4,445,655	$2,803,635	$ 6,355,055
Capital Recovery	$ 450,300	$ 283,980	$ 643,704
Depreciation	1,001,430	78,700	1,063,810
Total Owning	$ 1,451,730	$ 362,680	$ 1,707,514
Operating Expenses (end of 1981)			
Insurance	$ 9,408	$ 2,108	$ 39,200
Purchased Utilities	343,904	7,000	381,424
Administration	99,000	24,800	132,000
Labor, Supplies, Maint.	983,076	38,720	1,625,662
Fuel-Community	3,004,041	-0-	3,044,041
Fuel-Turbine-Gen.	-0-	-0-	226,252
Ash Handling & Landfill	85,784	-0-	92,160
Turbine Steam Purch.	-0-	485,367	-0-
Total Operating Expense	$ 4,525,213	$ 557,995	$ 5,540,739
Gross Owning & Operating	$ 5,976,943	$ 920,675	$ 7,248,253
Gross Production Expense			
Steam, $/1000 lbs.	2.981	-	3.6150
Electricity, $/KWh	-0-	.02269	-0-
Community Steam Charge	2.981	-	3.3730
Revenue (Steam)			
a. Community Usage	$ 5,396,519	-	$ 6,106,138
b. Community Line Loss	406,297	-	459,724
c. Blowdown Allocation	174,127	-	197,024
d. T-G Steam	-0-	-	485,367
Total Steam Revenue	$ 5,976,943		$ 7,248,253
Revenue (Elec. Gen.)			
a. Capacity	-	$ 569,463	-
b. Energy	-	567,924	-
Total Elec. Gen. Revenue		$1,137,387	

Expense Item	Normal Plant Expansion	Cogeneration Expansion	
		Elec. Gen.	Steam Gen.
Gross Plant Income	$ 5,976,943	$1,137,387	$ 7,248,253
Plant Cash Flow (one year operation)	-0-	$ 216,712	-0-
Const. Cash Flow (Debt) (1979 through 1980)	$ 828,552	$ 522,523	$ 1,184,415
Net Plant Cash Flow at end of 1981	($ 828,552)	($ 305,811)	($ 1,184,415)
Cash Flow Deficit at end of 1981	($ 428,552)	($ 305,811)	($ 1,184,415)

A. SIMPLE COST BENEFIT ANALYSIS

I. Payback Period (Total Cogeneration)

$$\text{Payback Period} = \frac{\$6,335,055 + 2,803,635 - 4,445,655}{\$216,712}$$

$$= 21.75 \text{ years}$$

II. Payback Period (Turbine-Generator)

$$\text{Payback Period} = \frac{\$2,803,635}{\$216,712}$$

$$= 12.93 \text{ years}$$

III. Minimum Acceptable Rate of Return

$$(\$6,355,055 + 2,803,635)CRF|_{15}^{i} + (5,540,739 + 557,995)$$

$$- (7,248,253 + 1,137,387) = (4,445,655)CRF|_{15}^{i}$$

$$+ (4,525,213 - 5,976,943)$$

$$CRF|_{15}^{i} = \frac{835,176}{\$4,713,035} = .17721$$

$$MAR \cong 16\%$$

IV. Return on Investment - Total Cogeneration

$$ROI = \frac{\$216,712}{\$6,355,055 + 2,803,635 - 4,445,655}$$

$$ROI = 4.6\%$$

V. Return on Investment - Turbine Generator

$$ROI = \frac{\$216,712}{2,803,635}$$

$$= 7.73\%$$

VI. Benefit-to-Cost Ratio (B/C) - Total Cogeneration

PWF = 9.8729

Normal Plant Expansion PW of 15 Year Costs

PW of 15 year Steam Operating Costs	($44,676,975)
PW of 15 year Steam Revenues	59,009,761
PW of 15 years	$14,332,786

Cogeneration Expansion PW of 15 Year Costs

PW of 15 year Steam Operating Costs	($54,703,162)
PW of 15 year Steam Revenues	71,561,277
PW of 15 year Gen. Operating Costs	(5,509,029)
PW of 15 year Gen. Revenues	11,229,308
PW of 15 years	$22,578,394

$$\text{Benefit to Cost Ratio} = \frac{\$22,578,394 - 14,332,786}{\$6,355,055 + 2,803,635 - 4,445,655}$$

B/C Ratio = 1.75

VII. Benefit-to-Cost Ratio - Turbine Generator

$$\text{B/C Ratio} = \frac{\$11,229,308 - 5,509,029}{\$2,803,635}$$

B/C Ratio = 2.04

B. COST EFFECTIVENESS ANALYSIS

Normal Plant Expansion Steam Operation
Combined Escalation Rate:

$$CER = \left[.03(9{,}408) + .1(343{,}904) + .08(99{,}000) + .0698(983{,}076) + .07399(3{,}004{,}041) + .07(85{,}784)\right] \div 4{,}525{,}213$$

CER = 8.074% a = 1.02197 PWF = 17.93

Cogeneration CER = 7.9399% a = 1.02071 PWF = 17.74

Electric Production Operation

CER = 7.884% a = 1.0202 PWF = 17.64

I. PRESENT WORTH OF 15 YEAR LONG TERM COSTS

Cost Item	PWF	Normal Exp. Plant	Cogeneration Plant PWF	Cogeneration Plant Elec. Gen.	Cogeneration Plant PWF	Cogeneration Plant Steam Gen.
Sub total through Labor of I.A.2(b)	-	$ 45,767,354	-	$ 5,570,904	-	$ 61,491,698
Fuel-Community	18.32	55,766,831	-	-0-	18.32	55,766,831
Fuel-Turbine	18.32	-0-	-	-0-	18.32	4,144,937
Ash Handling	16.52	1,417,152	-	-0-	16.52	1,522,483
Turbine Steam	-	-0-	17.74	8,610,411	-	-0-
PW of 15 years of Owning & Operating		($102,951,337)		($14,181,315)		($122,925,949)
PW of 15 years of Revenues						
Steam	17.93	$107,166,588		-0-	17.74	$128,584,008
Electric		-0-	17.64	20,063,507		-0-
New PW of 15 years		$ 4,215,251		$ 5,882,192		$ 5,658,059

∴ The cogeneration plant is the better economic choice because it has a cost benefit PW of 15 years of:

$11,540,251
- 4,215,251
$ 7,325,000

II. BENEFIT-TO-COST RATIO (LIFE CYCLE) - TOTAL COGENERATION

$$\text{B/C Ratio} = \frac{\$7,325,000}{\$6,355,055 - 4,445,655 + 2,803,635}$$

$$= 1.55$$

III. BENEFIT-TO-COST RATIO (LIFE CYCLE) - TURBINE-GENERATOR

B/C Ratio = 2.10

IV. PAYBACK PERIOD (TURBINE GENERATOR)

$$\begin{aligned} \text{CER} = \Big[& .03(39,200-9,408) + .03(2,180) + .1(381,424 - 343,904) \\ & +.1(7,000) + .08(132,000 - 99,000) + .08(24,800) \\ & +.0698(1,625,662 - 983,076) + .0698(38,720) \\ & +.07399(3,004,041 + 226,252 - 3,004,041) \\ & +.07(92,160 - 85,784) + .079399(485,367)\Big] \\ & \div (5,540,739 + 557,995 - 4,525,213) \end{aligned}$$

CER = 11.25% a = 1.052 PWF = 23.057

$$n = \frac{\log\left[\frac{2,803,635}{(1.052)(216,712)} (1.052-1) + 1\right]}{\log 1.052}$$

n = 9.75 years

V. RETURN ON INVESTMENT (LIFE CYCLE)

$$\text{Total 15 Years Savings} = \frac{(216,712)(1.052)(1.052^{15}-1)}{.1125}$$

$$= \$2,308,434$$

$$\text{Rate of Return, R} = \left(\frac{\$2,308,434}{2,803,635}\right)^{1/15} - 1$$

$$R = -1.29\%$$

CASH FLOW ANALYSIS I.A.2(c)

This plan presents the same benefit as I.A.2(b) except the overall cost benefit is decreased over the normal expansion because both plans are Western coal fired.

78/03/13

COST COMPARISON I.A.2(C) WESTERN COAL VS WESTERN COAL WITH COST SHARING

ALL LOANS AMORTIZED IN 15 YEARS AT 5.75 PERCENT EFFECTIVE ANNUAL RETURN.
REVENUE REQUIREMENT BASED UPON FULL CONSTRUCTION BUDGET ESCALATED AT 7.0 PERCENT PER YR FROM JAN. 1978 TO JAN. 1981
DEPRECIATION SINKING FUND ACCUMULATED AT 7.0 PERCENT.
PRESENT WORTH CALCULATED USING 5.75 PERCENT

	NORMAL EXPANSION	TURBINE-GEN	COGEN-STEAM SIDE	TOTAL COGEN
TOTAL CAPITAL BUDGET (DOLLARS)	4445655	2803635	6355055	9158690
INTERNAL RATE OF RETURN (PERCENT)	0	5.07	0	-1.00

CUMULATIVE NET CASH FLOWS AND PRESENT WORTH 78/03/13

			COGENERATION PLANT					
	NORMAL PLANT EXPANSION		TURBINE - GENERATOR		STEAM SIDE		TOTAL PLANT	
YEAR	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW	CUM. NET CASH FLOW	PRESENT WORTH OF CASH FLOW
1	-450289	-425806	-263973	-268533	-643688	-608688	-927661	-877221
2	-900579	-828458	-567946	-522464	-1287375	-1184280	-1855322	-1706744
3	-900579	-828458	-351299	-339270	-1287375	-1184280	-1638674	-1523549
4	-900579	-828458	-134651	-166036	-1287375	-1184280	-1422027	-1350316
5	-900579	-828458	81996	-2221	-1287375	-1184280	-1205379	-1186501
6	-900579	-828458	298644	152686	-1287375	-1184280	-988732	-1031594
7	-900579	-828458	515291	299170	-1287375	-1184280	-772084	-885110
8	-900579	-828458	731939	437689	-1287375	-1184280	-555436	-746590
9	-900579	-828458	948587	568677	-1287375	-1184280	-338789	-615603
10	-900579	-828458	1165234	692543	-1287375	-1184280	-122141	-491737
11	-900579	-828458	1381882	809673	-1287375	-1184280	94506	-374607
12	-900579	-828458	1598529	920435	-1287375	-1184280	311154	-263845
13	-900579	-828458	1815177	1025174	-1287375	-1184280	527801	-159106
14	-900579	-828458	2031824	1124218	-1287375	-1184280	744449	-60062
15	-900579	-828458	2248472	1217877	-1287375	-1184280	961097	33597
16	-900579	-828458	2792196	1440153	-1287375	-1184280	1504821	255873
17	-900579	-828458	3335920	1650343	-1287375	-1184280	2048545	466063
18	-900579	-828458	3879645	1849104	-1287375	-1184280	2592269	664824
19	-900579	-828458	4423369	2037058	-1287375	-1184280	3135994	852778
20	-900579	-828458	4967093	2214792	-1287375	-1184280	3679718	1030513
21	-900579	-828458	5510817	2382863	-1287375	-1184280	4223442	1198583
22	-900579	-828458	6054542	2541794	-1287375	-1184280	4767166	1357514

COMPARISON I.A.2(C) UNIVERSITY NORMAL PLANT EXPANSION WESTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	194664	255625	450289	0	450289	0	0	0	0	0	0	0	0	450
2	205857	244432	450289	0	450289	0	0	0	0	0	0	0	0	450
3	217694	232595	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
4	230212	220078	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
5	243449	206841	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
6	257447	192842	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
7	272250	178039	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
8	287905	162385	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
9	304459	145830	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
10	321966	128324	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
11	340479	109811	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
12	360056	90233	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
13	380759	69530	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
14	402653	47636	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
15	425806	24484	450289	1001430	1451719	9408	343904	99000	983076	146489	3044041	85784	4565213	6016
16	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
17	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
18	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
19	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
20	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
21	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
22	0	0	0	1001430	1001430	9408	343904	99000	983076	146489	3044041	85784	4565213	5566
SUM	4445655	2308685	6754340	20028600	26782940	188160	6878080	1980000	19661520		60880820	1715680	91304260	118087
PW	2761194	1684461	4445655	10482925	14928580	98483	3599972	1036328	10290796		31864888	897983	47788449	62717

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-450289	-425806
2	0	0	0	0	0	0	0	0	0	0	0	0	-450289	-402653
3	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	3.001	6016932	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	2.776	5566643	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		117186621		0		0	0	0	-900579	-828458
PW	20988608	18950392	2038216	20988608		61888571		0		0	0	0	-828458	-828458

COMPARISON 1.A.2(C) TURBINE-GENERATOR SIDE OF COGENERATION PLANT WESTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	122764	161209	283973	0	283973	0	0	0	0	0	0	0	0	283
2	129823	154150	283973	0	283973	0	0	0	0	0	0	0	0	283
3	137288	146685	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
4	145182	138791	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
5	153530	130443	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
6	162358	121615	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
7	171694	112280	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
8	181566	102407	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
9	192006	91967	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
10	203046	80927	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
11	214721	69252	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
12	227068	56905	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
13	240124	43849	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
14	253932	30042	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
15	268533	15441	283973	78700	362673	2180	7000	24800	38720	0	0	0	558066	920
16	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
17	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
18	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
19	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
20	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
21	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
22	0	0	0	78700	78700	2180	7000	24800	38720	0	0	0	514963	593
SUM	2803635	1455963	4259598	1574000	5833598	43600	140000	496000	774400		0	0	10859600	16693
PW	1741336	1062299	2803635	823828	3627463	22820	73276	259605	405319		0	0	5736860	9364

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-283973	-268533
2	0	0	0	0	0	0	0	0	0	0	0	0	-283973	-253932
3	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	183195
4	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	173234
5	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	163814
6	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	154907
7	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	146484
8	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	138519
9	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	130988
10	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	123865
11	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	117130
12	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	110762
13	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	104739
14	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	99044
15	0	0	0	0	0	0	40566	339062	.0227	567924	569463	1137387	216648	93659
16	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	222276
17	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	210190
18	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	198761
19	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	187954
20	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	177734
21	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	168070
22	0	0	0	0	0	0	40566	308951	.0146	567924	569463	1137387	543724	158932
SUM	0	0	0	0		0		6570469		11358480	11389260	22747740	6054542	2541794
PW	0	0	0	0		0		3475971		5945003	5961114	11906117	2541794	2541794

COMPARISON I.A.2(C) STEAM SIDE OF COGENERATION PLANT WESTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	278272	365416	643688	0	643688	0	0	0	0	0	0	0	0	643
2	294273	349415	643688	0	643688	0	0	0	0	0	0	0	0	643
3	311193	332494	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
4	329087	314601	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
5	348009	295678	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
6	368020	275668	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
7	389181	254507	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
8	411559	232129	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
9	435224	208464	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
10	460249	183439	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
11	486713	156974	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
12	514699	128988	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
13	544295	99393	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
14	575592	68096	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
15	608688	35000	643688	1063810	1707498	39200	381424	132000	1625662	157377	3270294	92160	5540740	7248
16	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
17	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
18	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
19	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
20	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
21	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
22	0	0	0	1063810	1063810	39200	381424	132000	1625662	157377	3270294	92160	5540740	6604
SUM	6355055	3300261	9655316	21276200	30931516	784000	7628480	2640000	32513240		65405880	1843200	110814800	141746
PW	3947121	2407934	6355055	11135916	17490971	410344	3992730	1381770	17017358		34233294	964727	58000223	75491

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-643688	-608688
2	0	0	0	0	0	0	0	0	0	0	0	0	-643688	-575592
3	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
4	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
5	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
6	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
7	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
8	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
9	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
10	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
11	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
12	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
13	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
14	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
15	2005034	1810324	194710	2005034	3.446	7248238	0	0	0	0	0	0	0	0
16	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
17	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
18	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
19	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
20	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
21	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
22	2005034	1810324	194710	2005034	3.140	6604550	0	0	0	0	0	0	0	0
SUM	40100680	36206480	3894200	40100680		140458940		0		0	0	0	-1287375	-1184280
PW	20988608	18950392	2038216	20988608		74306915		0		0	0	0	-1184280	-1184280

COMPARISON I.A.2(C) TOTAL COGENERATION PLANT WESTERN COAL WITH COST SHARING

YR	PRINCIPLE	INTEREST	TOTAL LOAN PMT	DEPREC. SINKING FUND PMT	TOTAL OWNING EXPENSE	INS.	PURCH UTIL.	ADMIN.	LABOR SUPPLIES MAINT.	TOTAL COAL CONSUMP TONS	TOTAL FUEL EXPENSE	ASH LANDFILL EXPENSE	TOTAL OPER. EXPENSE	GROSS OWN + OPER. 1000 $
1	401036	526625	927661	0	927661	0	0	0	0	0	0	0	0	927
2	424096	503565	927661	0	927661	0	0	0	0	0	0	0	0	927
3	448481	479180	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
4	474269	453392	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
5	501539	426121	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
6	530378	397283	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
7	560875	366786	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
8	593125	334536	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
9	627230	300431	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
10	663295	264365	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
11	701435	226226	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
12	741767	185893	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
13	784419	143242	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
14	829523	98138	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
15	877221	50440	927661	1142510	2070171	41380	388424	156800	1664382	157377	3270294	92160	6098806	8168
16	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
17	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
18	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
19	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
20	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
21	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
22	0	0	0	1142510	1142510	41380	388424	156800	1664382	157377	3270294	92160	6055703	7198
SUM	9158690	4756224	13914914	22850200	36765114	827600	7768480	3136000	33287640		65405880	1843200	121674400	158439
PW	5688457	3470233	9158690	11959745	21118435	433164	4066005	1641376	17422678		34233294	964727	63737083	84855

YR	STEAM GEN. + BLOWDN 1000LBS	COMM. METERED USAGE 1000LBS	LINE LOSS + BLOWDN 1000LBS	GROSS COMM. USAGE 1000LBS	COMM. COST $ PER 1000LB	TOTAL STEAM REVENUE	ELEC. GEN. 1000S KWH	STEAM EXPENSE FOR T-G	ELECT. COST $/KWH	POOL ENERGY REVENUE (CREDIT)	POOL CAPACITY REVENUE (CREDIT)	TOTAL ELECT. REVENUE (CREDITS)	NET CASH FLOW	NET PRESENT WORTH
1	0	0	0	0	0	0	0	0	0	0	0	0	-927661	-877221
2	0	0	0	0	0	0	0	0	0	0	0	0	-927661	-829523
3	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	183195
4	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	173234
5	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	163814
6	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	154907
7	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	146484
8	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	138519
9	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	130988
10	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	123865
11	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	117130
12	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	110762
13	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	104739
14	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	99044
15	2005034	1810324	194710	2005034	3.446	7248238	40566	339062	.0227	567924	569463	1137387	216648	93659
16	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	222276
17	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	210190
18	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	198761
19	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	187954
20	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	177734
21	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	168070
22	2005034	1810324	194710	2005034	3.140	6604550	40566	308951	.0146	567924	569463	1137387	543724	158932
SUM	40100680	36206480	3894200	40100680		140458940		6570469		11358480	11389260	22747740	4767166	1357514
PW	20988608	18950392	2038216	20988608		74306915		3475971		5945003	5961114	11906117	1357514	1357514

3.3.7

COST BENEFIT COMPARISON II.A.2(b)

Eastern Coal vs. Western Coal
i = 5 3/4%, n = 15 years
OPTION I - ADD-ON CUSTOMERS

Expense Item	Normal Expansion	Cogeneration Expansion		
		Add-on's	Elec. Gen.	Steam Gen.
Capital Budget - 1978	$14,829,760	$1,359,640	$2,634,240	$16,917,800
Escalated - 1979	15,867,845	1,485,640	2,818,635	18,102,045
Cost Sharing				
DOE	-0-	-0-	15,000	324,800
Legisl.	11,422,190	-0-	-0-	11,422,190
*Add-on	-0-	20,160	-0-	-0-
Total Cost Sharing	$11,422,190	$ 20,160	$ 15,000	$11,746,990
Loan (U of M)	$ 4,445,655	$1,465,455	$2,803,635	$ 6,355,055
Capital Recovery	$ 450,300	$ 148,435	$ 283,980	$ 643,704
Depreciation	1,001,430	35,500	78,700	1,063,810
Total Owning	$ 1,451,730	$ 183,935	$ 362,680	$ 1,704,514
Owning Surcharge ($ per 1000 lbs.)	-0-	$ .56648	-0-	-0-
Operating Expenses (End of 1981)				
Insurance	$ 9,408	-0-	$ 2,108	$ 39,200
Purchased Utilities	343,904	$ 10,671	7,000	381,424
Administration	99,000	4,830	24,800	132,000
Labor,Supplies,Maint.	983,076	12,860	38,720	1,625,662
Fuel-Community	5,364,286	492,860	-0-	3,043,812
Fuel-Generator	-0-	-0-	-0-	243,750
Ash Handling	74,098	13,889	-0-	92,647
Turbine Steam Purch.	-0-	-0-	510,354	-0-
Total Operating	$ 6,874,592	$ 535,110	$ 582,982	$ 5,558,495
Gross Owning and Operating	$ 8,326,322	$ 719,045	$ 945,662	$ 7,263,009
Community Steam Charge ($ per 1000 lbs.)				
**University	$ 4.152708	-	-	$ 3.36785
**Add-on Cust.	-0-	-	-	3.93433
Gross Elec. Prod. Cost ($/KWH)	-	-	$ .02112	-

* Add-on customers provide out-of-pocket expenses for metering.

**See "Steam Charge Allocation" calculation.

Expense Item	Normal Expansion	Cogeneration Expansion		
		Add-on's	Elec. Gen.	Steam Gen.
Revenue - Steam				
University	$ 8,326,304	-	-	$ 6,752,654
Add-on Cust.	-0-	-	-	1,277,477
T-G	-0-	-	-	510,354
Total Revenues	$ 8,326,322	-0-	-0-	$ 8,540,485
Revenues - Elec.				
Capacity	-0-	-0-	$ 579,340	-0-
Energy	-0-	-0-	626,850	-0-
Total Revenues	-0-	-0-	$1,206,190	-0-
Net Cash Flow	-0-	-0-	$ 260,528	$ 387,231

STEAM CHARGE ALLOCATION

Gross Owning and Operating (Cogeneration less T-G)	$5,558,495
	535,110
	1,704,514
	183,935
	$7,982,054

Turbine Steam Cost $= \$7,982,054\left(\frac{4619 \times 44,775,000}{181,926 \times 2000 \times 8890}\right)$

$= 510,354$

U of M Steam Cost $= \frac{7,982,054 - 510,354 - 103,935 - 535,110}{2,005,034}$

$= \$3.36785/1000$ lbs.

Add-on Surcharge (Steam Total) $= \frac{535,110 + 183,935}{2,005,034 + 324,700}$

$= \$\ .308638/1000$ lbs.

Surcharge (Tunnel) $= \frac{183,935}{324,700} = \$\ .05664767$

less .308638

$\$\ .2578387$

Total Add-on Steam and Tunnel Charge $= \$3.36785 + .308638 + .2578387$

$= \$3.93433/1000$ lbs.

COST BENEFIT COMPARISON II.A.2.(b)
EASTERN COAL VS. WESTERN COAL
i = 5 3/4% n = 15 years
INCREMENTAL COSTS (STEAM SIDE OF PLANTS)

	NORMAL EXPANSION WITH OPTION I					COGENERATION EXPANSION WITH OPTION I					
	Total	SHARED EXPENSES			NON-SHARED		SHARED EXPENSES			NON-SHARED	
	Main Tunnel	St. Mary's	Fairview	Augsburg	Augsburg Pri & Sec	Main Tunnel	St. Mary's	Fairview	Augsburg	Augsburg Pri & Sec	Elec. Generation
Capital Budget - 1978	$1,359,640				$431,760	$1,359,640				$431,760	-0-
Escalated Budget - 1979	1,454,815				461,983	1,454,815				461,983	-0-
Cost Sharing - DOE	16,800				-0-	16,800				-0-	
- Legis.	-0-				-0-	-0-				-0-	-0-
- St. Mary's	-0-	($ 6,720) out-of-pocket expense			-0-	-0-	($ 6,720) out-of-pocket expense			-0-	-0-
- Fairview	-0-		($ 6,720) out-of-pocket		-0-	-0-		($ 6,720) out-of-pocket		-0-	-0-
- Augsburg	-0-			($ 6,720)"	-0-	-0-			($ 6,720)"	-0-	-0-
- U of M	10,640				-0-	10,640				-0-	-0-
Total	($ 27,440)					($ 27,440)				-0-	-0-
Total Loan	$1,427,375				$461,983	$1,427,375				$461,983	-0-
Capital Recovery	$ 144,579	$ 75,369	$ 36,253	$ 32,957	$ 46,794	$ 144,579	$ 75,369	$ 36,253	$ 32,957	$ 46,794	-0-
Depreciation (20 year)	35,468	18,489	8,894	8,085	11,268	11,268	18,489	8,894	8,085	11,268	-0-
(1) Total Tunnel Owning	$ 180,047	$ 93,858	$ 45,147	$ 41,042	$ 58,062	$ 180,047	$ 93,858	$ 45,147	$ 41,042	$ 58,062	-0-
Tunnel Operating Expenses											
Insurance	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Purch. Utilities	$ 10,671	$ 5,563	$ 2,676	$ 2,432	-0-	$ 10,671	$ 5,563	$ 2,676	$ 2,432	-0-	-0-
Administration	4,000	2,085	1,003	912	-0-	4,000	2,085	1,003	912	-0-	-0-
Labor, Supplies, Maint.	9,680	5,046	2,427	2,207	-0-	9,680	5,046	2,427	2,207	-0-	-0-
Total Tunnel Operating	$ 24,351	$ 12,694	$ 6,106	$ 5,551	$ -0-	$ 24,351	$ 12,694	$ 6,106	$ 5,551	-0-	-0-
Total Owning & Operating	204,398	106,552	51,253	46,593	58,062	204,398	106,552	51,253	46,593		
(2) Owning & Operating Surcharge ($ per 1000 lbs)	.6295	.32816	.15785	.14349	.78445	.6295	.32816	.15785	.14349		
Augsburg Pri Add-On Operating Expense											
Insurance	-0-				-0-	-0-				-0-	-0-
Purch. Utilities	-0-				-0-	-0-				-0-	-0-
Administration	-0-				830	-0-				830	-0-
Labor, Supplies, Maint.	-0-				3,000	-0-				3,000	-0-
Total Augsburg, Steam Operating	-0-	-0-	-0-	-0-	$ 3,830	-0-	-0-	-0-	-0-	$ 3,830	-0-
Gross Augsburg Add-On Costs	-0-	-0-	-0-	-0-	61,892	-0-	-0-	-0-	-0-	61,892	
Owning & Operating Surcharge ($ per 1000 lbs)	-0-	-0-	-0-	-0-	.83619	-0-	-0-	-0-	-0-	.83619	

COST BENEFIT COMPARISON II.A.2.(b) (Cont'd)
EASTERN COAL VS. WESTERN COAL
i = 5 3/4% n = 15 years
INCREMENTAL COSTS (STEAM SIDE OF PLANTS)

	NORMAL EXPANSION WITH OPTION I					COGENERATION EXPANSION WITH OPTION I					
	Total	SHARED EXPENSES			NON-SHARED		SHARED EXPENSES			NON-SHARED	
	Main Tunnel	St. Mary's	Fairview	Augsburg	Augsburg Pri & Sec	Main Tunnel	St. Mary's	Fairview	Augsburg	Augsburg Pri & Sec.	Elec. Generation
Plant Operating											
Community Fuel	$ 868,495	$452,743	$217,776	$197,975	-0-	$ 510,357	$266,047	$127,973	$116,337	-0-	-0-
T-G Fuel	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Community Ash	12,129	6,323	3,041	2,765	-0-	16,177	8,433	4,056	3,688	-0-	-0-
T-G Ash	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Turbine-Steam	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	$ 18,112
Total Plant Operating	$ 880,624	$459,066	$220,817	$200,740	-0-	$ 526,534	$274,480	$132,029	$120,025	-0-	$ 18,112
(3) Plant Operating Surcharge ($ per 1000 lbs)	.37799	.19704	.09478	.08616	-0-	(4) .22098	(5) .11519	.05541	.05037	-0-	-0-
Base University Charge ($ per 1000 lbs)	4.15300	4.15300	4.15300	4.15300	-0-	3.37290	3.37290	3.37290	3.37290	-0-	-0-
Gross Steam Cost Surcharge ($ per 1000 lbs)	1.00749	.52520	.25263	.22966	-0-	.85048	.44335	.213259	.19387	-0-	-0-
Gross Steam Cost	5.16050	4.67820	4.40563	4.38266	-0-	4.22338	3.81630	3.586200	3.56680	-0-	-0-
Augsburg Surcharge for Distribution Add-On (St. Mary's to Augsburg and Augsburg Reconnect)	-0-	-0-	-0-	-0-	.83619	-0-	-0-	-0-	.83619	-0-	-0-
Gross Augsburg Steam Cost ($ per 1000 lbs)	-0-	-0-	-0-	-0-	5.21885	-0-	-0-	-0-	4.20299	-0-	-0-

COST BENEFIT COMPARISON II.A.2.(b) (cont.)
EASTERN COAL VS. WESTERN COAL
(STEAM SIDE OF PLANTS)

Cost Item (Incremental)	NORMAL PLANT EXPANSION WITH OPTION I INCREMENTAL EXPENSE SUMMARY (AUGSBURG AMORTIZES ITS PRIMARY & SECONDARY DIST. CAPITAL)						COGENERATION EXPANSION WITH OPTION I INCREMENTAL EXPENSE SUMMARY (AUGSBURG AMORTIZES ITS PRIMARY & SECONDARY DIST. CAPITAL)						
	Tunnel	SHARED EXPENSES			AUGS. DIST.		Tunnel	SHARED EXPENSES			AUGS. DIST.		Elec.
	Surcharge	St. Mary's	Fairview	Augsburg	Dist.	Total	Surcharge	St. Mary's	Fairview	Augsburg	Dist.	Total	Gen.
Owning	$ 180,047	$ 93,858	$ 45,147	$ 41,042	$58,062	$ 92,232	$180,047	$ 93,858	$ 45,147	$ 41,042	$58,062	$ 99,104	-0-
Tunnel Operating	24,351	12,694	6,106	5,551	-0-	5,551	24,351	12,694	6,106	5,551	-0-	-0-	-0-
Plant Operating	880,624	459,066	220,817	200,740	-0-	200,740	526,534	274,480	132,029	120,025	-0-	-0-	-0-
Augsburg Operating	-0-	-0-	-0-	-0-	3,830	3,830	-0-	-0-	-0-	-0-	3,830	3,830	-0-
Turbine Gen.	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	$ 58,926
Total Owning-Operating	$1,085,022	$565,618	$231,440	$247,333	$61,892	$302,353	$730,932	$381,032	$183,282	$116,618	$61,892	$102,934	$ 58,926
(6) Gross Steam Surcharge ($ per 1000 lbs)	1.00749	.5252	.25263	.22966	.83619	1.06585	.85048	.44335	.213259	.19387	.83619	1.03006	-0-
University Base Cost ($ per 1000 lbs) See I.A.2(b)	4.15300	4.1530	4.15300	4.15300	-0-	4.15300	3.37290	3.37290	3.372900	3.37290	-0-	3.37290	-0-
Gross Steam Charge ($ per 1000 lbs)	$ 5.16050	$ 4.6782	$4.40563	$4.38266	-0-	$5.21885	$4.22338	$3.81630	$3.586200	$3.56680	-0-	$4.40296	-0-

	INCREMENTAL EXPENSE SUMMARY (ALL DISTRIBUTION ADD-ON COSTS ARE SHARED)						INCREMENTAL EXPENSE SUMMARY (ALL DISTRIBUTION ADD-ON COSTS ARE SHARED)						
Owning	$ 180,047	$ 93,858	$ 45,147	$ 41,042	-0-	-0-	$180,047	$ 93,858	$ 45,147	$ 41,042	-0-	-0-	-0-
Add-on (Augsburg)	46,794	24,394	11,734	10,667	-0-	-0-	46,794	24,394	11,734	10,667	-0-	-0-	-0-
Tunnel Operating	24,351	12,694	6,106	5,551	-0-	-0-	24,357	12,694	6,106	5,551	-0-	-0-	-0-
Plant Operating	880,624	459,066	220,817	200,740	-0-	-0-	526,534	274,480	132,029	120,025	-0-	-0-	-0-
Augsburg Operating	-0-	-0-	-0-	-0-	$ 3,830	$ 3,830	-0-	-0-	-0-	-0-	$ 3,830	$ 3,830	-0-
Turbine Gen.	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	$ 56,287
Total Owning & Operating	$1,131,816	$565,618	$283,804	$258,000	$ 3,830	$ 3,830	$777,732	$405,426	$ 195,016	$177,285	$ 3,830	$ 3,830	$ 56,287
Total Steam Surcharge ($ per 1000 lbs)	1.15159	.6003	.28876	.26250	.051700	.05170	.99460	.51850	.249400	.22670	.051700	.05170	-0-
University Base Cost ($ per 1000 lbs)	4.15300	4.1530	4.15300	4.15300	-0-	-0-	3.37290	3.37290	3.372900	3.37290	-0-	-0-	-0-
Gross Steam Charge ($ per 1000 lbs)	$ 5.30460	$ 4.7533	$4.44176	$4.41550	-0-	-0-	$4.36750	$3.89140	$3.622300	$3.59960	-0-	-0-	-0-
Augsburg Operation ($ per 1000 lbs)	-0-	-0-	-0-	.05170	-0-	-0-	-0-	-0-	-0-	.05170	-0-	-0-	-0-
Gross Augsburg Cost ($ per 1000 lbs)	-0-	-0-	-0-	$4.46720	-0-	-0-	-0-	-0-	-0-	$3.65130	-0-	-0-	-0-

COST BENEFIT COMPARISON II.A.2(b) (Cont'd)
EASTERN COAL VS. WESTERN COAL
i = 5 3/4% n = 15 years

Item (Incremental)	NORMAL PLANT EXPANSION WITH OPTION I INCREMENTAL SUMMARY (AUGSBURG AMORTIZES ITS PRIMARY AND SECONDARY DISTRIBUTION CAPITAL)					COGENERATION EXPANSION WITH OPTION I INCREMENTAL SUMMARY (AUGSBURG AMORTIZES ITS PRIMARY AND SECONDARY DISTRIBUTION CAPITAL)					
	St. Mary's	Fairview	Augsburg	Augsburg Dist.	Total	St. Mary's	Fairview	Augsburg	Augsburg Dist.	Elec. Gen.	Total
Steam Revenues											
a. Community Usage	$714,604	$323,708	$292,757	$ 55,857	$1,386,926	$582,947	$263,500	$238,259	$ 55,857	$ -0-	$1,140,563
b. Community Loss	54,075	24,495	22,141	4,224	104,935	44,113	19,940	18,019	4,224	-0-	86,296
c. Community Blowdown	23,176	10,499	9,488	1,810	44,972	18,906	8,546	7,722	1,810	-0-	36,984
d. Turbine Generator	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	58,844	58,844
Total Steam Revenues	$791,854	$358,702	$324,386	$ 61,891	$1,536,833	$645,966	$291,986	$264,000	$ 61,891	$ 58,844	$1,322,687
Gross Plant Owning & Operating	$791,854	$358,702	$324,386	$ 61,891	$1,536,833	$645,966	$291,986	$264,000	$ 61,891	$ 18,112	$1,281,955
Net Plant Income (Steam Generation)	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	$ 40,732

Item (Incremental)	INCREMENTAL SUMMARY (ALL DISTRIBUTION ADD-ON COSTS ARE SHARED)					INCREMENTAL SUMMARY (ALL DISTRIBUTION ADD-ON COSTS ARE SHARED)					
	St. Mary's	Fairview	Augsburg	Augsburg Dist.	Total	St. Mary's	Fairview	Augsburg	Augsburg Dist.	Elec. Gen.	Total
Steam Revenues											
a. Community Usage	$726,076	$326,363	$294,951	$ 3,454	$1,350,844	$594,419	$266,152	$240,450	$ 3,454	$ -0-	$1,104,475
b. Community Loss	54,943	24,696	22,307	261	102,207	44,981	20,140	18,185	261	-0-	185,774
c. Community Blowdown	23,548	10,585	9,560	112	43,805	19,278	8,631	7,793	112	-0-	35,814
d. Turbine Generator	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	56,287	56,287
Total Steam Revenues	$804,567	$361,644	$326,818	$ 3,827	$1,496,856	$658,678	$294,923	$266,428	$ 3,827	$ 56,287	$1,382,350
Gross Plant Owning & Operating (Steam)	$804,567	$361,644	$326,818	$ 3,827	$1,496,856	$658,678	$294,923	$266,428	$ 3,827	$ 18,112	$1,241,968
Net Plant Income (Steam Generation)	$ -0-	$ -0-	$ -0-	$ -0-	$ -0-	$ -0-	$ -0-	$ -0-	$ -0-	$ -0-	$ 140,382

COST BENEFIT COMPARISON II.A.2(b) - (Cont.)
EASTERN COAL VS. WESTERN COAL
i = 5 3/4%, n = 15 years

TURBINE-GENERATOR SIDE
(AUGSBURG AMORTIZES ITS PRIMARY & SECONDARY DISTRIBUTION)

Elec. Gen. Revenues (Incremental)	
a. Capacity	$ 9,877
b. Energy	58,926
Total Elec. Gen. Revenues	$68,803
Incremental Operating	$58,844
Net Gain (End of 1981)	$ 9,959

TURBINE-GENERATOR SIDE
(AUGSBURG ADD-ON IS COST SHARED BY PARTNERS)

Total Elec. Gen. Revenues (Incremental)	$68,803
Incremental Operating	$56,287
Net Gain (End of 1981)	$12,516

SUMMARY - COST BENEFIT COMPARISON II.A.2(b)
EASTERN COAL VS. WESTERN COAL

	NORMAL PLANT EXPANSION WITH OPTION I (AUGSBURG AMORTIZES ITS PRIMARY AND SECONDARY)			COGENERATION EXPANSION WITH OPTION I (AUGSBURG AMORTIZES ITS PRIMARY AND SECONDARY)						
	Normal Expansion			Elec. Gen.			Steam Gen.			
	Base Cost (I.A.2(b))	Incremental II.A.2(b)	Total	Base Cost (I.A.2(b))	Incremental II.A.2(b)	Subtotal	Base Cost I.A.2(b)	Incremental II.A.2(b)	Subtotal	Total
Gross Owning & Operating	$8,326,322	$1,536,833	$9,863,155	$ 920,675	$58,844	$ 979,519	$7,248,253	$1,281,955	$8,530,208	$9,509,727
Revenues	8,326,322	1,536,833	9,863,833	1,137,387	68,803	1,206,190	7,248,253	1,322,687	8,570,940	9,777,130
Annual Gain	-0-	-0-	-0-	$ 216,712	$ 9,959	$ 226,671	-0-	$ 40,732	$ 40,732	$ 267,403

SUMMARY - COST BENEFIT COMPARISON II.A.2(b)
EASTERN COAL VS. WESTERN COAL

	NORMAL PLANT EXPANSION WITH OPTION I (ALL DISTRIBUTION ADD-ON COSTS ARE SHARED)			COGENERATION EXPANSION WITH OPTION I (ALL DISTRIBUTION ADD-ON COSTS ARE SHARED)						
	Normal Expansion			Elec. Gen.			Steam Gen.			
	Base Cost (I.A.2(b))	Incremental II.A.2(b)	Total	Base Cost (I.A.2(b))	Incremental II.A.2(b)	Subtotal	Base Cost I.A.2(b)	Incremental II.A.2(b)	Subtotal	Total
Gross Owning & Operating	$8,326,322	$1,536,833	$9,863,155	$ 920,675	$56,287	$ 976,962	$7,248,253	$1,241,968	$8,490,221	$9,467,183
Revenues	8,326,322	1,536,833	9,863,155	1,137,387	68,803	1,206,190	7,248,253	1,382,350	8,630,603	9,836,793
Annual Gain	-0-	-0-	-0-	$ 216,712	$12,516	$ 229,228	-0-	$ 140,382	$ 140,382	$ 369,610

A. SIMPLE COST BENEFIT ANALYSIS - OPTION I

I. Payback Period of Total Cogeneration with Option I

Normal Expansion Capital = $ 4,445,655
Cogeneration with Option I = 10,624,145

$$\text{Payback Period} = \frac{10,624,145 - 4,445,655}{(260,528) + 387,231)}$$

$$= 9.538 \text{ years}$$

II. Payback Period of Turbine Generator

$$\text{Payback Period} = \frac{\$2,803,635}{260,528}$$

$$= 10.76 \text{ years}$$

$$\text{or Payback Period (Steam Savings Allocated)} = \frac{\$2,803,635}{647,759} = 4.33 \text{ years}$$

III. Minimum Acceptable Rate of Return

$$(10,624,145 + 2,803,635 + 1,465,455)CRF\Big|_{15}^{i} + (5,558,495 + 582,982 + 535,110) - (7,263,009 + 945,622 + 719,045) + (1,206,190 + 8,540,485)$$

$$= (4,445,655)CRF\Big|_{15}^{i} + 6,874,592 - 8,326,322$$

$$CRF\Big|_{15}^{i} = \frac{2,251,089}{10,447,580} = .2155$$

$$MAR \cong 21\%$$

IV. Return on Investment - Total Cogeneration

$$ROI = \frac{1}{9.538} = 10.48\%$$

V. Return on Investment - Turbine Generator

$$ROI = \frac{1}{10.76} \times 100$$

$$ROI = 9.29\%$$

VI. Benefit-to-Cost Ratio (B/C) - Total Cogeneration

PWF = 9.8729

Normal Expansion

PW of Steam Operating	($67,872,159)
PW of Steam Revenue	82,204,945
PW of 15 years	$14,332,786

Cogeneration Expansion

PW of Steam Operating	($60,161,553)
PW of Gen. Operating	(5,755,723)
PW of Steam Revenue	84,319,354
PW of Gen. Revenue	11,908,593
PW of 15 years	$30,310,671

$$\text{B/C Ratio} = \frac{\$30,310,671 - 14,332,786}{10,624,145 - 4,445,655}$$

$$= 2.586$$

VII. Benefit-to-Cost Ratio - Turbine-Generator

$$\text{B/C Ratio} = \frac{\$11,908,593 - 5,775,723}{2,803,635}$$

$$= 2.1946$$

B. COST EFFECTIVENESS ANALYSIS

I. Rate of Return on Investment (Turbine-Generator)

Total 15 year Savings $= \frac{(260,528)(1.2725)(1.2725^{15} - 1)}{.3457}$

$= \$34,659,845$

Rate of Return $= \left(\frac{34,659,845}{2,803,635}\right)^{1/15} - 1$

$= 18.25\%$

II. Payback Period (Turbine-Generator)

$$n = \frac{\text{Log}\left[\frac{2,803,635}{(1.2725)(260,528)}(1.2725 - 1) + 1\right]}{\text{Log } 1.2725}$$

$n = 4.96$ years

NOTES (II.A.2(b))

1. Typical Owning Share:

St. Mary's: $\$180,046 \times \frac{169,265}{324,700} = \$93,858$

2. Typical Owning & Operating Tunnel Unit Surcharge:

St. Mary's: $\frac{\$204,398}{324,700}\left(\frac{169,265}{324,700}\right) = \$.328/1,000$ lbs

3. Typical Plant Operating Surcharge:

St. Mary's: $\frac{\$880,624}{(2,005,034 + 324,700)}\left(\frac{169,265}{324,700}\right) = \$.19704/1,000$ lbs

4. Plant Operating Surcharge:

$\frac{\$526,534 - 11,704^{(a)}}{2,005,034 + 324,700} = \$.22098/1,000$ lbs

a. Total Turbine Steam Cost:

$\frac{1,619 \times (40,566,000 + 4,209,000)}{181,937 \times 8,890 \times 2,000} \times \$(7,248,253 + 526,534) = \$497,072$

Incremental Turbine Steam Cost $= \$497,072 - 485,367 = \$11,704$

5. Typical Plant Operating Share

St. Mary's: $\frac{(\$526,534 - \$11,704)}{(2,005,034 + 324,700)}\left(\frac{169,265}{324,700}\right) = \$.11519/1,000$ lbs

6. Steam Charge is not calculable by dividing Total Owning and Operating by total steam since University steam and University steam plus add-on steam are different ratios.

3.3.8

COST BENEFIT COMPARISON III.A.2(b)

PYROLYSIS

i = 5 3/4%, n = 15 years

Eastern Coal vs. Western Coal

Expense Item	Normal Plant Expansion	Cogeneration Plant Expansion		
	Steam Gen.	Elec. Gen.	Pyrolysis	Steam Gen.
Capital Budget - 1978	$14,829,760	$2,634,240	$7,700,800	$16,917,800
Escalated Budget - 1979	15,867,843	2,818,635	8,239,856	18,102,045
Cost Sharing				
DOE	-0-	15,000	-0-	324,800
Legislative	11,422,190	-0-	-0-	11,422,190
Total Cost Sharing	$11,422,190	$ 15,000	-0-	$11,746,990
Loan (U of M)	$ 4,445,653	$2,803,635	$8,239,856	$ 6,355,055
Capital Recovery	$ 450,300	$ 283,980	$ 834,615	$ 643,704
Depreciation	1,001,430	78,700	200,970	1,063,810
Total Owning	$ 1,451,730	$ 362,680	$1,035,585	$ 1,707,514
Steam and T-G Operating Expenses (End of 1981)		BASIC PLAN		
Insurance	$ 9,408	$ 2,108		$ 39,200
Purch. Utilities	343,904	7,000		381,424
Administration	99,000	24,800		132,000
Labor, Supplies, Maint. (Plant)	983,076	38,720		1,625,662
Fuel-Community	5,364,286	-0-		2,574,642
Fuel-Generator	-0-	-0-		258,129
Ash Hand. & Landfill	74,098	-0-		79,830
Turbine Steam Purch.	-0-	524,330		-0-
Pyrolysis Steam Purch.	-0-	-0-		-0-
Pyrolysis				
Administration			$ 11,885	
Labor			357,127	
Electric Power			158,035	
Fuel Oil (No. 2)			94,660	
Insurance, Water, Gas			48,785	
Building and Grounds			5,650	
Service Contracts			7,358	
Slag Disposal			15,847	
Maint. and Repair			114,892	
Total Operating	$ 6,874,592	$ 596,958	$ 814,239	$ 5,090,887
Gross Owning & Operating	$ 8,326,322	$ 959,638	$1,849,824	$ 6,798,401
Gross Production Expense				
Steam ($/1000 lb.)	$ 4.153			$ 3.3907
Elec. ($/KWh)		$ .01989		
Waste ($/ton)			$ 40.04	

COST BENEFIT COMPARISON III.A.2(b) - (Continued)

Expense Item	Normal Plant Expansion	Cogeneration Plant Expansion		
	Steam Gen.	Elec. Gen.	Pyrolysis	Steam Gen.
Community Steam Charge ($/1000 lbs.)	$ 4.153			
Add-on Expense				
Steam Purchase	-0-	-0-	-0-	$ 875,187 (Pyrolysis)
Expense Reduction				
Phoenix Ind.			$ 75,600	
HHC			273,000	
Turbine Steam	-0-	-0-	-0-	$ 524,330
Pyrolysis Steam	-0-	-0-	875,187	-0-
Total Expense Reduction	-0-	-0-	$1,223,787	$ 524,330
Net Owning & Operating	$ 8,326,322	$ 959,638	($ 626,037)	$ 7,149,258
Net Production Cost				
Comm. Steam ($/1000 lbs.)	$ 4.153			$ 3.5657
Gen. Electricity ($/KWh)		$ .01989		
Pyrolysis ($/ton)			($ 13.55)	

Therefore, the conclusion is that in order for the pyrolysis to just break even the drop charge to the HHC must be $23.55 per ton assuming the drop charge from Phoenix Industries is fixed. Since the turbine-generator was required to stand alone as a self-supporting unit the payoff period does not change. However, the steam cost to the community is increased from $3.373 per 1000 lbs. to $3.5657 per 1000 lbs.

However, not factored into pyrolysis is the transportation of wastes into the central plant at $6.00 per ton for general waste and $35.000 per ton for special waste. This would increase the breakeven cost to approximately $30.00 per ton.

Revenues - Electric Production

	Basic	Option I	Option II
Basic Plan plus Option II	$1,137,387		$59,953
Basic Plan plus Option II & III	1,137,387	$68,803	59,953
Gross Operating & Maint. - Elec.	$ 959,638		

Net Annual Cash Flow

Basic Plan plus Option II	$ 237,702
Basic Plan plus Option I, II	306,505

NOTES III.A.2(b)

Equivalent Pyrolysis KWH $= \frac{38,000(1385-220)(8400)}{4619}$

$= 80,508,335$ KWH

Turbine KWH $= 48,233,000$ KWH

Pyrolysis Fuel Credit Multiplier $= \frac{80,508,335}{48,233,000}$

$= 1.66915$

Turbine Steam Purchase $= \$6,798,401 \left(\frac{4619 \times 48,233,000}{162,466 \times 200,048,890}\right)$

$= \$524,330$

Pyrolysis Steam Credit $= \$524,330 \times 1.66915$

$= \$875,187$

Annual KWH $= 48,233,000$

Western Coal, Tons

132,900	U of M
- 26,144	Pyrolysis
12,422	Elec. Generator

A. SIMPLE COST BENEFIT ANALYSIS

I. Turbine Generator Payback Period
(Basic Plan plus Option II)

$$\text{Payback Period} = \frac{\$2,803,635}{237,702}$$

$$= 11.79 \text{ years}$$

II. Turbine Generator Payback Period
(Basic Plan plus Option I and II)

$$\text{Payback Period} = \frac{\$2,803,635}{306,505}$$

$$= 9.15 \text{ years}$$

III. Return on Investment - Turbine Generator
(Basic Plan plus Option II)

$$\text{ROI} = \frac{1}{11.79} \times 100$$

$$= 8.48\%$$

IV. Return on Investment - Turbine Generator
(Basic Plan plus Option I and Option II)

$$\text{ROI} = \frac{1}{9.15} \times 100$$

$$= 10.93\%$$

V. Benefit-to-Cost Ratio (B/C) Turbine Generator
(Basic Plan plus Option II)

PW = 9.8729

PW of Gen. Income	$11,821,218
PW of Gen. Operating	($ 5,893,707)
PW of 15 years	$ 5,927,511

$$\text{B/C Ratio} = \frac{\$5,927,511}{\$2,803,635} = 2.11$$

VI. Benefit-to-Cost Ratio (B/C) Turbine Generator
(Basic Plan plus Option I and II)

PW of Gen. Income		$12,500,503
PW of Gen. Operating		($ 5,893,707)
	PW of 15 years	$ 6,606,796

$$\text{B/C Ratio} = \frac{\$6,606,796}{\$2,803,635} = 2.36$$

B. COST EFFECTIVE ANALYSIS

I. Rate of Return on Investment (Turbine Generator)
(Basic Plan plus Option II)

$$\text{Total 15 year Savings} = \frac{(237,702)(1.2725)(1.2725^{15} - 1)}{.3457}$$

$$= \$31,623,144$$

$$\text{Rate of Return} = \left(\frac{31,623,144}{2,803,635}^{1/15}\right) - 1$$

$$= 17.53\%$$

II. Rate of Return on Investment (Turbine Generator)
(Basic Plan plus Option I and II)

$$\text{Total 15 year Savings} = \frac{(306,505)(1.2725)(1.2725^{15} - 1)}{\$\ .3457}$$

$$= \$40,776,484$$

$$\text{Rate of Return} = \left(\frac{40,776,484}{2,803,635}\right)^{1/15} - 1)$$

$$= 19.54\%$$

III. Payback Period (Turbine Generator)
(Basic Plan plus Option II)

$$n = \frac{\text{Log}\left[\frac{2,803,635}{(1.2725)(237,702)}(1.2725 - 1) + 1\right]}{\text{Log } 1.2725}$$

$$n = 5.23 \text{ years}$$

IV. Payback Period (Turbine Generator)
(Basic Plan plus Option I and II)

$$n = \frac{\text{Log}\left[\frac{2,803,635}{(1.2725)(306,505)}(1.2725 - 1) + 1\right]}{\text{Log } 1.2725}$$

$$n = 4.5 \text{ years}$$

3.3.9

COST BENEFIT COMPARISON IV.A.2(b)

Eastern Coal vs. Western Coal

i = 5 3/4%, n = 15 years

OPTION III - HOT WATER REVISIONS

Expense Item	Normal Expansion	Cogeneration Expansion		
		Hot H_2O	Elec. Gen.	Steam Gen.
Capital Budget	$14,829,760	$1,930,000	$2,634,240	$16,917,800
Escalated Budget	15,857,845	2,065,100	2,818,635	18,102,045
Cost Sharing				
DOE	-0-	-0-	15,000	324,800
Legislt.	11,422,190	-0-	-0-	11,422,190
Total Cost Sharing	$11,422,190	-0-	$ 15,000	$11,746,990
Loan (U of M)	$ 4,445,655	$2,065,100	$2,803,635	$ 6,355,055
Capital Recovery	$ 450,300	$ 209,174	$ 283,980	$ 643,704
Depreciation	1,001,430	50,368	78,700	1,063,810
Total Owning	$ 1,451,730	$ 259,542	$ 362,680	$ 1,707,514
Operating Expenses (End of 1981)				
Insurance	$ 9,408	-0-	$ 2,108	$ 39,200
*Purchased Utilities	343,904	$ 15,000	7,000	381,424
Administration	99,000	-0-	24,800	132,000
Labor, Supplies, Maint.	983,076	-0-	38,720	1,625,662
Fuel-Community	5,364,286	-0-	-0-	3,044,041
Fuel-Turbine	-0-	-0-	-0-	260,498
Ash Handling & Landfill	74,098	-0-	-0-	93,125
Turbine Steam Purch.	-0-	-0-	551,705	-0-
Total Operating Expense	$ 6,874,592	$ 15,000	$ 624,333	$ 5,575,950
Owning & Operating	$ 8,326,322	$ 274,542	$ 987,013	$ 7,283,464
Gross Owning & Operating	$ 8,326,322	-0-	$ 987,013	$ 7,558,006
Gross Steam Cost ($/1000 lbs.)	$ 4.1527	-	-	$ 3.7695
Community Steam ($/1000 lbs.)	$ 4.1527	-	-	$ 3.4944
Elec. Prod. Cost ($/KWH)	-	-	$ .02129	-
Revenues				
Elec. Gen.	-	-	$1,229,631	-
Steam Gen.	$ 8,326,322	-	-	$ 8,109,711
Net Annual Cash Flow	-0-	-0-	$ 242,618	$ 551,705

*Avg. pumping horsepower (hot water) per year = 60 HP @ $.028/KWH x 8760 hours.

NOTES IV.A.2(b)

- 1981 -

KWH Generated (Basic Plan Base) = 40,566,000 + 5,802,000

= 46,368,000

Revenues Electric Generation = $162,456 + $1,137,387

Total Steam (1000's) = 2,005,034 lbs.

Hot Water Steam (1000's) = 2,005,034 - 41,000 lbs.

Steam District (1000's) = 1,964,034 lbs. Steam

Hot Water District (1000's) = 41,000 lbs. Steam

Annual Total Coal Requirements		159,025 tons
	Elec. Gen.	10,888 tons
		1,648
		12,536 tons
	Community	146,489 tons

A. SIMPLE COST BENEFIT ANALYSIS

I. Turbine Generator Payback Period (Basic Plan plus Option III)

$$\text{Payback Period} = \frac{\$2,803,635}{312,830}$$

$$= 8.96 \text{ years}$$

II. Turbine Generation Payback Period (Combined Options)

	Basic	I	II	III
Basic Gen. Revenue	$1,137,387	$1,137,387	$1,137,387	$1,137,387
Add-on	-0-	68,803	59,953	92,244
Gross Gen. Revenues	$1,137,387	$1,206,190	$1,197,340	$1,229,631
Gross Gen. Owning & Operating	920,675	945,662	959,638	987,013
Net Gain	$ 216,712	$ 260,528	$ 237,702	$ 242,618
Incremental	BASE	$ 43,816	$ 20,990	$ 25,906

Payback Period Basic plus I, II, III

$$= \frac{\$2,803,635}{43,816 + 20,990 + 25,906 + 216,712}$$

$$= 9.12 \text{ years}$$

Payback Period (Basic plus I)

$$= \frac{\$2,803,635}{260,528}$$

$$= 10.76 \text{ years}$$

Payback Period (Basic plus I, III)

$$= \frac{\$2,803,635}{260,528 + 25,906}$$

$$= 9.79 \text{ years}$$

Payback Period (Basic plus II)

$$= \frac{\$2,803,635}{216,712 + 20,990}$$

$$= 11.79 \text{ years}$$

Payback Period (Basic plus II, III)

$$= \frac{\$2,803,635}{216,712 + 20,990 + 25,906}$$

$$= 10.64 \text{ years}$$

III. Return on Investment

$$ROI_{B+III} = \frac{1}{8.96} = 11.16\%$$

$$ROI_{B,I,\ II,III} = 10.96\%$$

$$ROI_{B,I} = 9.29\%$$

$$ROI_{B,I,III} = 10.21\%$$

$$ROI_{B,II} = 8.48\%$$

$$ROI_{B,II,III} = 9.40\%$$

IV. Benefit-to-Cost Ratio (B/C) - Turbine-Generator
(Basic Plan plus Option III)

PWF = 9.8729

PW of Gen. Revenues = $12,140,024

PW of Gen. Operating = ($ 6,163,977)

PW of 15 years = $ 5,976,047

$$\text{B/C Ratio} = \frac{\$5,976,047}{2,805,635}$$

$$= 2.13$$

B. COST EFFECTIVENESS ANALYSIS

I. Rate of Return on Investment of T-G
(Basic Plan plus Option III)

$$\text{Total 15 year Savings} = \frac{(\$242,618)(1.2725)(1.2725^{15}-1)}{.3457}$$

$$= \$32,277,154$$

$$\text{Rate of Return} = \left(\frac{32,277,154}{2,803,635}\right)^{1/15} - 1$$

$$= 17.69\%$$

II. Payback Period (Turbine-Generator)
(Basic Plan plus Option III)

$$n = \frac{\text{Log}\left[\frac{2,803,635}{(1.2725)(242,618)}(1.2725-1) + 1\right]}{\text{Log } 1.2725}$$

$$n = 3.76 \text{ years}$$

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COST ACCOUNTING BASIS

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3.4.1 DEPRECIATION BASIS

The following table represents the revenue requirements for equipment replacement using life expectancies of the service life table. For the analysis, it is assumed that depreciation dispersion methods at 7% EAR would be made a part of steam and electric energy expense costs. The depreciation annuity, i^d, will be used to recover capital replacement costs based upon average remaining total plant life.

Regardless, the method presented for depreciation dispersion and resulting capital recovery factor below will follow the accounting or cost concept of depreciation. Under this concept the cost of plant is a prepaid expense. This expense is then allocated to accounting periods (annual) during the life of the plant. Obviously, the amount allocated to any one accounting period does not accurately represent the loss or decrease in value of plant which might have occurred during that particular period. Thus, depreciation in the aforementioned sense is in terms of an expense or cost of doing business rather than as a loss or decrease in value. Contrary to the belief of many people, the purpose of the depreciation expense is not capital goods replacement, but the retainment within plant of the capital investment. Obviously, if we did not recognize this as an expense in doing business the steam and electric production rates would not be adequate at some future date to support the costs of the ICES.

For depreciation methods there are five that could be applied to ICES:

a. Sinking fund and compound interest methods where charges to expense are smaller in the early years and larger in the later years.

b. Declining balance and sum-of-the-year digits where charges to expense are greater in the early years and smaller in the later years.

c. Production methods where charges to expense are based on the plant's amount of output each year.

d. Straight line method wherein the cost of plant is equally distributed to each accounting period over the life of the plant. This is accomplished by applying an annual depreciation rate to the average plant account balance.

e. Depreciation dispersion methods that are used to develop an annual rate of return of capital based upon a dispersion of plant retirement around an average plant life and an application to a sinking fund accumulation.

While any of the above methods can be employed, we will use for purposes of the ICES analysis method a, depreciation dispersion, or a straight sinking fund.

3.4.2 REMAINING AVERAGE SERVICE LIFE

Service life will indicate the period or number of years from the time a unit of property is first in service until it is removed or abandoned. Average service life then is the average of the lives of all such units within a plant account, new or old. The service lives will be based upon experience, past studies, published data, IRS guidelines, ASHRE guidelines, and University practices.

Several methods are generally acceptable that use past experience for determining average service life:

a. Actuarial Methods

b. Simulated Plant-Record Method

c. Turnover Methods

d. Forecast Methods

Since anyone familiar with plant accounting methods will recognize that methods (a) through (c) are quite complicated, and in fact cannot be reasonably applied to ICES at this time, we will use a forecasting method. In actual plant accounting where time is available one of the above methods will be used. However, a considerable amount of researching of past plant experience is required.

The forecasting method is straight forward in that projected retirement dates based upon one of the aforementioned data bases of remaining life of equipment is used.

Note that the remaining average service life of all plant equipment is over 20 years. Since the amortization period of borrowed capital is 15 to 20 years, the use of a 20 year life of all plant equipment seems reasonable. The dispersion retirement curves will take care of discrepancies in this choice.

TABLE 17

REMAINING SERVICE LIFE EXPECTANCY TABLES

FOR DEPRECIATION (1981 BASE)

	Forecasted Remaining Life (Years)	Forecated Retirement Date
Centrifugal Fans	25	2006
Absorption Machines	20	2001
Ducts	40	2021
Water Piping	40	2021
Steam or Hot Water Piping	40	2021
Electric Motors, Starters	20	2001
Pumps	25	2006
Control Systems	20	2001
Steam Turbine-Generators	25	2006
*Boilers - S. E. Plant - #1 (1932) - Oil	-	-
#3 (1940) - Coal	23	2004
#4 (1947) - Coal	23	2004
**Waste Heat (New)	20	2004
*Boilers - University Plant		
#1 (1949) - Peaking	-	-
#2 (1951) - Coal	16	1997
#3 (1953) - Coal	18	1999
#4 (1963) - Coal	28	2009
#5 (1964) - Coal	29	2010
#6 (1972) - Peaking	37	2018
#12 (1936) - Coal	-	-
Cranes - Electric Motor	20	2001
Baghouses	20	2001
**Secondary Combustion Chamber &	20	2001
**Pyrolytic Gasifier	20	2001
**Regeneration Towers	20	2001
Plant Buildings and Structures	40	2021
Coal Bunkers	40	2021
Primary Coal Handling (Conveyor Systems)	30	2011
Secondary Coal Handling (In-Plant)	30	2011
Storage Tanks - Oil	25	2006
Computer Systems	10	1991
Water Treatment Systems	25	2006
Heat Exchangers	25	2006
	AVERAGE 22 Years	

*Boilers are rated upon total 40 year life and past usage. #1, 3, 4 at Southeast were retired from service in 1974. No. 1 at Southeast, and #1 and #12 at the University Plant would see emergency service only.

**Secondary Combustion Chamber, gasifier, waste heat, and regenerative towers rated as a refactory lined package boiler.

3.4.3 SALVAGE AND REMOVAL COSTS

Salvage is the value of plant realized when it is removed. Removal is the cost incurred to remove and dispose of plant. Net Salvage is the difference between salvage and removal. Where salvage is estimated to exceed removal costs the Net Salvage can be used to reduce the depreciation cost. Estimating salvage and removal of a piece of equipment is primarily a matter of judgement. This judgement must take into account in addition to past experience and published life expectancy values, the changes occurring in labor removal cost, technological change, etc.

For our purposes we will assume that the estimated net salvage is 0% of the plant costs. This is a reasonable figure based primarily upon evaluating the initial capital investment and a judgement of salvage value less removal cost. As we remove old equipment from Southeast Steam Plant, removal records will be generated which will aid in salvage forecasting in the future. However, the University does not experience much plant removal.

3.4.4 DEPRECIATION RESERVE

For simplicity the depreciation reserve will represent the portion of cost of surviving plant which had been recovered according to the accounting records. The reserve does not represent a fund such as a bank account; and the cost of plant minus reserve does not represent the true value of the remaining plant. It only indicates the portion of the cost of plant not yet recovered. This is referred to as book value and should not be confused with market or fair value.

It will not be the intent of this analysis to establish reserve reporting by individual plant account. That, at this time, is beyond the scope of work. Where individual plant account depreciation rates are established on a remaining life concept, obviously a reserve by plant account is required.

3.4.5 TAX ASPECTS

The Grid Connected Integrated Community Energy System will be a non profit, tax free business. Since ICES is free from federal and state taxing the problem of tax saving and tax deferral related to the depreciation accounting is not a problem. In business, if the depreciation results in a tax saving then it has the effect of reducing the cost of doing business and thus reducing rate structures. If it results in tax deferment until the later years when depreciation would be less, then it only amounts to an interest free loan.

For ICES the depreciation account will be handled as a straight cost of doing business. Any interest on money recovered by the depreciation account will be accumulated and used to purchase replacement equipment in the later years or reduce debt service.

3.4.6

DEPRECIATION DISPERSION[1]

The following overview explains the method used to obtain a depreciation cost for ICES.

Table 1 explains the fundamental relation between capital cost and the annual costs of capital recovery (return plus depreciation). The depreciation annuity is there calculated for a facility having 10-year life and no dispersion of retirements--all retirements occur on its 10th anniversary. This latter phenomenon is almost never actually experienced.

Table 2 shows how the same arithmetic is applied in the more usual case. Here estimated average life is 20 years, but some retirements occur before the end of year 20; accordingly, some must occur later. The anticipated type of dispersion is Iowa Type S_0.

Table 3 presents annual costs of depreciation, calculated in the manner of Table 2, for:

a. Average lives of 10, 15, 20, 25, 30, 35, 40, 45, and 50 years.

b. 16 standard types of dispersion, and for no dispersion

c. 5%, 6%, and 7% return

d. With zero net salvage

Interpolations may be readily made for any other values of (a), (b), or (c).

Because the nature and effects of retirement dispersion may be relatively unfamiliar, the following brief explanation is made

The percentage for "no dispersion", derived per Table 1, may be picked directly from tables showing the annual payment that will recover $1, at i% interest, in the stipulated period. Such tables are available in engineering handbooks or standard texts on financial mathematics.

Actually, of course, individual property units do not all have the same life. Some have more, some less than average; hence the term average life. The curve showing percentage of the original group still in service at each age is called "survivor curve". The survivor curve is said to be generalized when percent survivors are plotted against percent of average life, instead of years.

Several codified families of generalized survivor curves have been developed, most widely used being the Iowa Type Curves, developed by the Iowa Engineering Experiment Station, Iowa State College. They are illustrated by Figures 1, 2, and 3; the three series consist of:

1. The S series, representing plant whose retirements are symmetrically distributed before and after average life.

[1]Paul H. Jeynes, "Economic Comparisons of Alternative Plans", Public Service Electric and Gas Company. New Jersey.

2. The L series, representing plant whose retirements occur more rapidly before average life is reached (i.e., to the left of average).

3. The R series, representing plant whose retirements occur more rapidly after average life is passed (i.e., to the right of average).

Subscripts describe the maximum annual retirement rate. Subscripts near zero mean a low and nearly constant rate of retirement until all units are gone; subscripts near 6 mean that all retirements take place rapidly within a brief period near average life. Thus, the estimate of $30,S_0$ means the retirements begin at an early age and continue at a nearly constant rate for 60 years; the rate becomes a maximum near the average life of 30 years. On the other hand $30,R_5$ means that few retirements occur before age 20, after which they increase rapidly to a maximum near age 31, declining thereafter until the last unit is retired at about age 40.

Table 2 shows the application of these principles to facilities having dispersed retirements.

3.4.7 CAPITAL COST, PRESENT WORTH AND ANNUAL CAPITAL-RECOVERY COSTS

The capital cost, or first cost of a facility is its present worth at date of installation.

Thus, capital cost C equals the present worth, at installation, of lifetime (= n years) annual costs of capital recovery, which are return (= i%) and depreciation (= i^d).

Assuming zero net salvage, for simplicity:

$$\text{Sinking Fund} = i^d = \frac{i}{(1+i)^n - 1}, \text{ by definition.}$$

The present-worth factor is designated by the stardard symbol $PWF_{\overline{n}|}$:

$$PWF_{\overline{n}|} = \frac{1 - v^n}{i}, \text{ by definition}$$

where v^n is the discounting factor $\frac{1}{(1+i)^n}$, also by definition.

Thus, by definition:

$$C = PWF\ (iC + i^dC)$$

For a spceific case where:

C = 100% (first cost)

i = 6% (return)

n = 10 years (life)

$i^d = 6^d = 7.5868\%$, from standard tables of $\frac{i}{(1+i)^n - 1}$

= the annuity, at 6%, that will recover 100% in 10 years.

$PWF_{\overline{n}|}$ = 7.360 087, from standard tables of $\frac{1 - v^n}{i}$

= the present worth, at 8%, of an annuity of $1 for 10 years, payable at the end of each year.

That is, by definition of the quantities:

$$C = 7.360\ 037\ (.06C + .075\ 866\ C) = 100\%C$$

Suppose net salvage is not zero, but 10% of C.

Then the depreciation annuity ($_6d$) is not 7.5868%, but 90% of 7.5868% = 6.82812%, since it is to recover (1.00 - 0.10) C.

Then C = present worth of lifetime annual charges for return and depreciation, plus the present worth of net salvage realized at retirement.

The present-worth factor applicable to net salvage 10 years hence:

v^n = 0.558 393, from standard tables of $\frac{1}{(1 + i)^n}$

= the present worth of $1, payable after 10 years, at 6%.

For the definition of C, above:

$$C = 7.360\ 087\ (.060 + .0682812C) + 0.558\ 395 \times 0.10C$$

$$= 0.944\ 161C + 0.055\ 839\ C$$

$$= 100\%\ C$$

TABLE 18

CALCULATION OF THE DEPRECIATION ANNUITY i^{d*}

10-YEAR LIFE: IOWA TYPE S_0 DISPERSION: RETURN (i) = 6%; NET SALVAGE @ 15%

Column 1	Column 2	Column 3	Column 4
Year	Mean Survivors (Figure 1)	Present Worth Factors (v^n)	Column 2 x Column 3
1	0.9942	0.9434	0.9379
2	.9751	.8900	.8678
3	.9432	.8396	.7919
4	.9015	.7921	.7141
5	.8520	.7473	.6367
6	.7962	.7050	.5613
7	.7353	.6651	.4890
8	.6707	.6274	.4208
9	.6035	.5919	.3572
10	.5347	.5584	.2986
11	.4653	.5268	.2451
12	.3965	.4970	.1971
13	.3293	.4688	.1544
14	.2647	.4423	.1171
15	.2038	.4173	.0850
16	.1480	.3936	.0583
17	.0985	.3714	.0366
18	.0568	.3503	.0199
19	.0249	.3305	.0082
20	.0058	.3118	.0018

Total Mean Survivors = 10.0000 Present worth (PWF_n) of Mean Survivors = 6.9988

For Table 1, for zero net salvage:

$$C = PWF_n\ (iC + i^dC) = 100\%$$

$$= 6.9988\ (.06 \times 100\% + 6^d \times 100\%) = 100\%$$

Therefore, $i^d = 6^d = \frac{1.00}{6.9988} - .06 = 8.2882\%$ before salvage adjustment.

Adjusted for 15% net salvage:

$$i^d = 6^d = 0.85 \times 6.2882 = 7.0450\%$$

*The pre-superscript i^d indicates that the annuity applies to a group having dispersed retirements.

TABLE 19

ANNUAL COST OF DEPRECIATION (= i^d)

FOR VARIOUS AVERAGE LIVES, TYPES OF DISPERSION, RATES OF RETURN

Type of Dispersion	Average Life in Years								
	10	15	20	25	30	35	40	45	50
				At 5% Return					
SC*	8.84	5.62	3.93	2.99	2.39	1.96	1.68	1.46	1.28
S_0	8.54	5.41	3.60	2.64	2.06	1.63	1.34	1.13	0.95
S_1	8.34	5.17	3.40	2.44	1.86	1.44	1.15	0.94	0.77
S_2	8.20	4.98	3.26	2.33	1.72	1.33	1.03	0.82	0.66
S_3	8.11	4.94	3.17	2.21	1.64	1.23	0.94	0.74	0.58
S_6	7.97	4.89	3.11	2.12	1.52	1.12	0.84	0.66	0.49
R_1	8.53	5.40	3.60	2.62	2.05	1.62	1.37	1.14	0.98
R_2	8.31	5.16	3.38	2.44	1.86	1.46	1.16	0.94	0.78
R_3	8.16	4.97	3.22	2.27	1.69	1.28	1.00	0.80	0.64
R_4	8.07	4.89	3.14	2.19	1.62	1.21	0.92	0.72	0.56
R_5	8.01	4.87	3.06	2.12	1.55	1.15	0.86	0.67	0.51
L_0	8.96	5.76	4.00	3.02	2.42	1.98	1.87	1.44	1.25
L_1	8.64	5.41	3.68	2.74	2.16	1.72	1.40	1.18	0.98
L_2	8.40	5.24	3.45	2.48	1.90	1.48	1.18	0.95	0.79
L_3	8.23	5.03	3.28	2.33	1.74	1.33	1.04	0.82	0.66
L_5	8.03	4.89	3.09	2.15	1.56	1.16	0.88	0.68	0.52
None	7.95	4.63	3.02	2.10	1.60	1.11	0.83	0.63	0.48
				At 6% Return					
SC*	8.66	5.51	3.79	2.89	2.31	1.91	1.62	1.40	1.24
S_0	8.29	5.07	3.40	2.48	1.90	1.50	1.23	1.02	0.86
S_1	8.05	4.91	3.19	2.25	1.67	1.28	1.01	0.80	0.66
S_2	7.88	4.71	2.97	2.10	1.51	1.15	0.86	0.69	0.53
S_3	7.78	4.64	2.88	1.97	1.41	1.03	0.77	0.58	0.45
S_6	7.61	4.46	2.74	1.82	1.29	0.90	0.66	0.46	0.35
R_1	8.28	5.12	3.38	2.50	1.93	1.53	1.27	1.08	0.92
R_2	8.02	4.89	3.14	2.24	1.67	1.29	1.02	0.84	0.68
R_3	7.84	4.73	2.96	2.06	1.48	1.10	0.84	0.67	0.52
R_4	7.72	4.62	2.84	1.95	1.38	1.00	0.74	0.57	0.43
R_5	7.65	4.51	2.77	1.87	1.31	0.95	0.68	0.50	0.37

TABLE 19 (Continued)

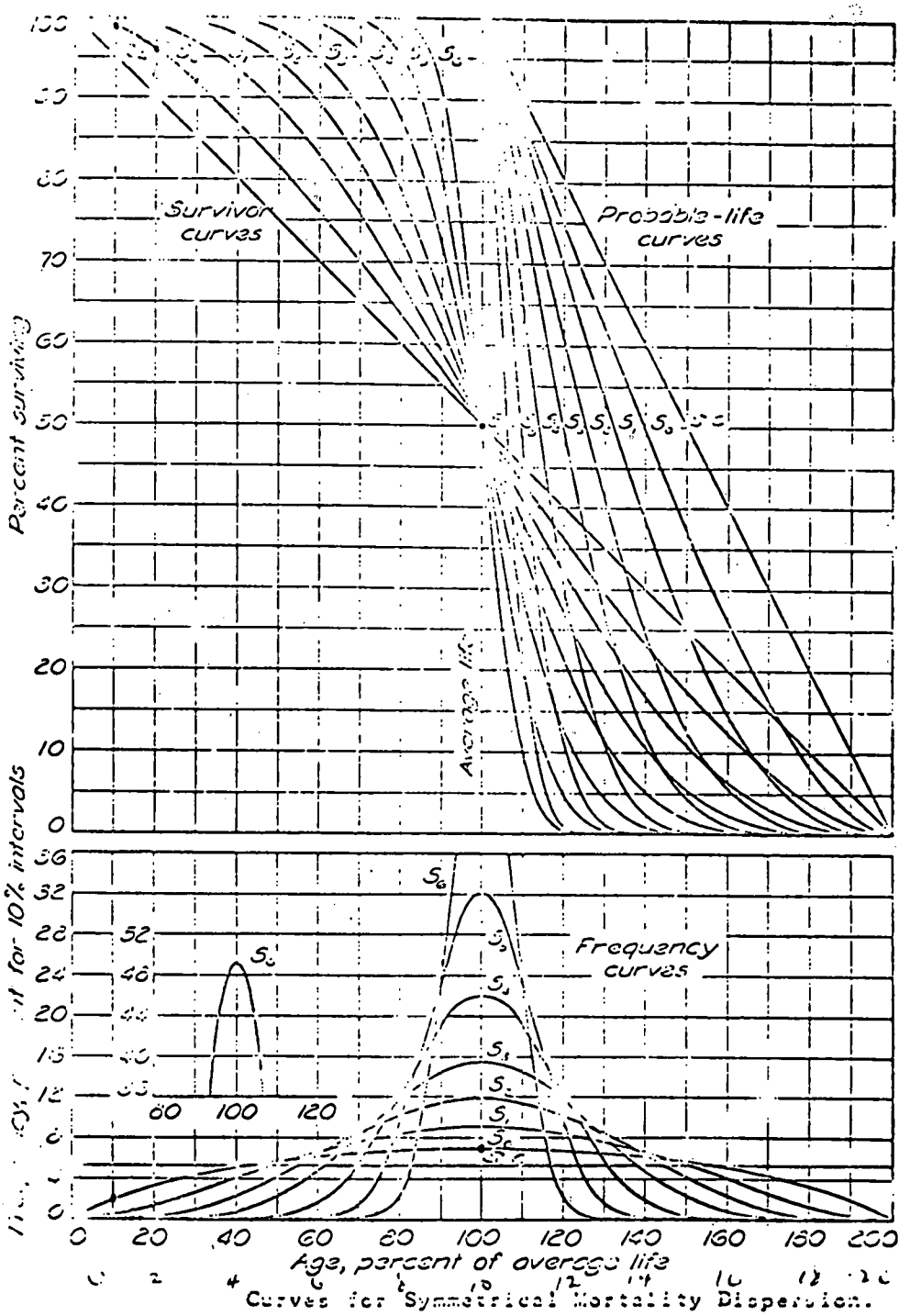
Type of Dispersion	Average Life in Years 10	15	20	25	30	35	40	45	50
				At 6% Return (Continued)					
L_0	8.79	5.65	3.86	2.90	2.32	1.88	1.60	1.36	1.12
L_1	8.40	5.25	3.49	2.55	1.97	1.57	1.27	1.07	0.89
L_2	8.14	5.01	3.22	2.29	1.71	1.30	1.03	0.82	0.67
L_3	7.92	4.32	3.02	2.11	1.52	1.13	0.87	0.68	0.53
L_5	7.67	4.55	2.79	1.88	1.33	0.95	0.70	0.52	0.38
None	7.59	4.30	2.72	1.82	1.26	0.90	0.65	0.47	0.34
				At 7% Return					
SC*	8.50	5.31	3.68	2.79	2.24	1.84	1.58	1.36	1.21
S_0	8.05	4.96	3.22	2.30	1.77	1.36	1.13	0.91	0.79
S_1	7.78	4.70	2.95	2.07	1.51	1.15	0.89	0.71	0.57
S_2	7.58	4.48	2.75	1.96	1.33	1.05	0.73	0.59	0.42
S_3	7.45	4.35	2.63	1.77	1.22	0.88	0.63	0.47	0.35
S_6	7.27	4.17	2.45	1.59	1.08	0.72	0.52	0.36	0.26
R_1	8.05	5.02	3.24	2.36	1.81	1.43	1.19	1.00	0.86
R_2	7.74	4.67	2.93	2.06	1.51	1.14	0.91	0.72	0.60
R_3	7.52	4.42	2.71	1.86	1.60	0.96	0.71	0.55	0.42
R_4	7.40	4.34	2.59	1.71	1.18	0.82	0.61	0.43	0.33
R_5	7.31	4.24	2.49	1.62	1.11	0.76	0.54	0.38	0.28
L_0	8.64	5.59	3.75	2.82	2.23	1.79	1.52	1.29	1.13
L_1	8.20	5.09	3.32	2.41	1.83	1.44	1.17	0.94	0.78
L_2	7.87	4.76	3.00	2.11	1.54	1.16	0.90	0.71	0.57
L_3	7.62	4.55	2.77	1.88	1.34	0.96	0.73	0.55	0.42
L_5	7.34	4.24	2.53	1.68	1.19	0.80	0.56	0.41	0.29
None	7.24	3.98	2.44	1.58	1.06	0.70	0.50	0.35	0.25

(All figures in percent of first cost, installed, before allowance for salvage)

*Type SC is the triangular form of survivor curve representing a constant rate of retirements at every age, in percent of the original group.

NOTE: The above percentages are appropriate for use in connection with a constant percentage return on investment no matter what method of accounting for depreciation ("straight-line", sinking fund, percentage of output or of gross receipts, retirement accounting, or other) may be used by the company for bookkeeping purposes.

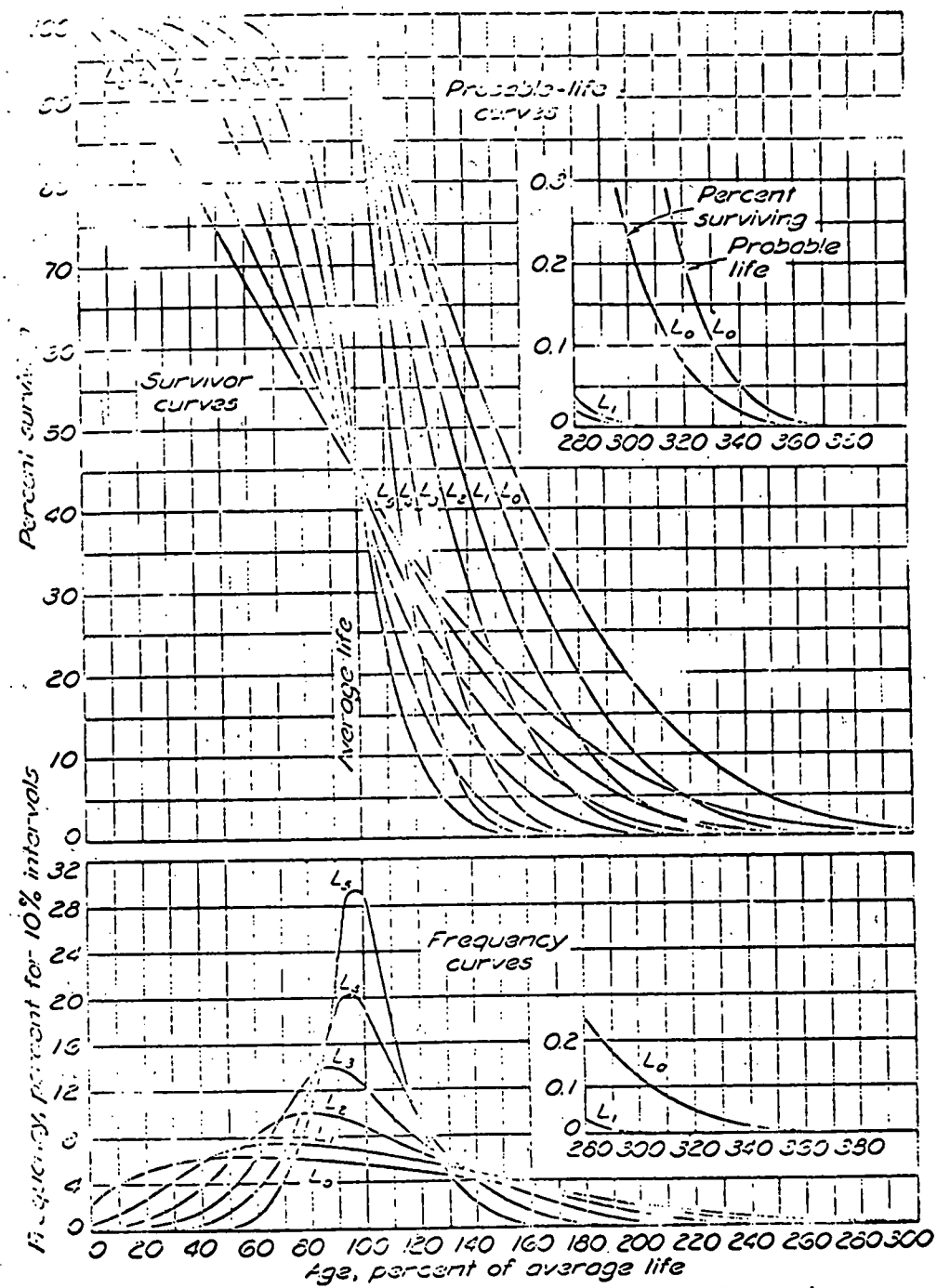
FIGURE 1



Curves for Symmetrical Mortality Dispersion.

(Reproduced from Iowa Engineering Experiment Station Bulletin 155 by Robley Winfrey, with type Sc added)

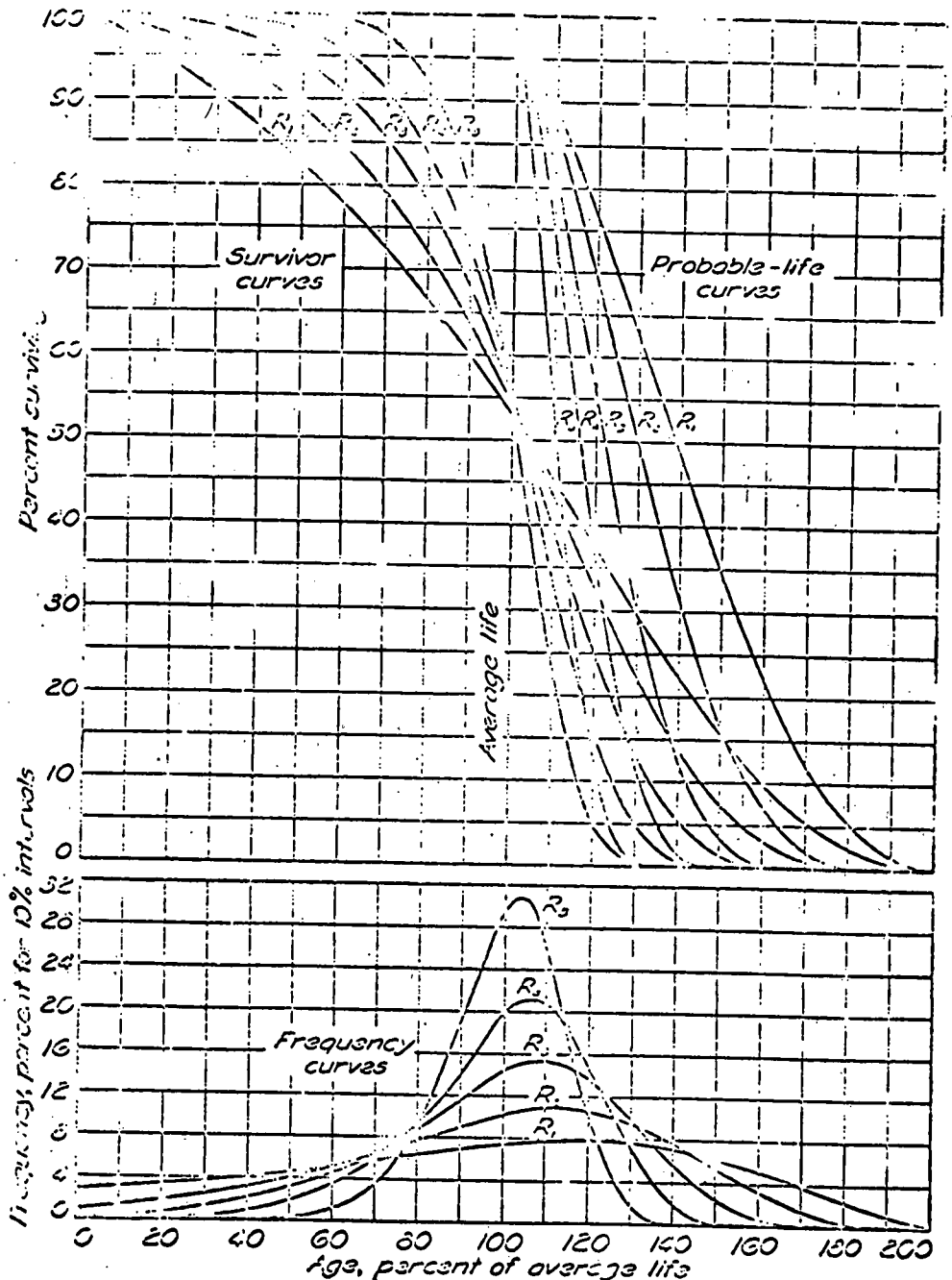
FIGURE 2



Curves for Left-Moded Mortality Dispersion.

(Reproduced from Yale Engineering Experiment Station Bulletin 308 by Robley Winfrey)

FIGURE 5



Curves for Right-Handed Mortality Dispersion.

(Reprinted from Iowa Engineering Department Station Bulletin 163 by Robley Winfrey)

It is not to be concluded that a given type curve is necessarily associated with any specific type of plant; the code is merely a simplified system for identifying and classifying curve shapes commonly encountered in actual experience. Studies of past history usually reveal that retirements have exhibited a pattern fairly well represented by one of the Iowa type curves. Even when it can be shown that past experience has been extremely variable and inconsistent, such surveys are helpful in predicting the future.

It can also be said that the appropriate type curve can usually be approximated, within acceptable limits, with considerable assurance. For example, although experience of different utilities varies, underground facilities appear to conform most frequently to types approaching S_0 to S_2, or R_1 to R_3. Referring to Table 3, it will be seen that this limits the depreciation estimate to a quite narrow range of percentages. If there were no basis for estimate available based on personal experience, it would be far better to assume a dispersion of this order (say R_2) rather than to assume no dispersion (per "None", Table 3). The latter unrealistic assumption, although frequently made, is indefensible.

Even when estimating the probable life of a single unit of property, this allowance for dispersion of retirements should be made. Obviously, a single unit must be retired all at once; however, it is possible to estimate only the probable date of retirement. The survivor curve then correctly evaluates the probability; the most probable annual cost is not the percentage for a single unit whose age at retirement equals probable life (i.e., no dispersion).

The allowance for ultimate net salvage value is made by estimating net salvage as a percentage of capital cost, installed. The complement of this percentage is then applied to the depreciation rate selected from the table. For example, if net salvage is +10% of capital cost (i.e., scrap value exceeds removal cost), the adjusted depreciation rate is 90% of the figure per the table. If net salvage is -10% (i.e., removal cost exceeds scrap value), the adjusted depreciation rate is 110% of the figure per the table.

Depreciation rates tabulated, represented by the standard symbol ${}_id$, are the group-basis present-worth annuities. ${}_id$ applied to the capital cost of surviving plant in each year will accumulate a reserve which, at i% return, will exactly recover the capital cost of plant by the date of its retirement. The particular method of depreciation accounting that may be used by the enterprise ("straight line", retirement accounting, percentage of sales, or other method) is of no moment in making these estimates.

Because so many analysts make the error of estimating "straight-line" depreciation costs at 1/life (for use in connection with return of i% of first cost), it seems desirable to review this popular misunderstanding.

Annual depreciation expense is not paid out like wages, taxes, etc. Depreciation charges are kept by the company, and accumulated in the depreciation reserve. These funds do not lie idle, but are used in the business in place of new capital that otherwise would be raised by selling the company's stocks or bonds. This practice obviously reduces the return at i% that has to be paid out to finance a given capital cost. This reduction in return payable to investors, sometimes termed "earnings of invested reserves", serves to reduce the net annual cost of depreciation. It will be neglected for ICES.

The bookkeeper charges depreciation expense against each property unit annually so long as it remains in service (a procedure known technically as the "group basis" for accounting), whether retirement occurs at the estimated life, or earlier, or later. When a property unit is retired, first cost of that unit is removed from the plant account; at the same time its first cost less net salvage is removed from the reserve account. Meanwhile, the accumulated reserve will have been reinvested in the business. Thus the original investor keeps his original stake in the business intact at all times, even though the original facilities bought with his money depreciate and finally disappear. At the same time, customers benefit by having the use of both the original plant and additions purchased with reserve funds, while paying a return only on the cost of the original plant.

By erroneously calculating the cost of depreciation at 1/life, the analyst overlooks an important part of the actual cost behavior--the saving from use of reserves. The amount of that saving, for a given facility, increases in each year of life as the accumulated reserve increases. For plant having no dispersion of retirments the reserve increases at the straight-line rate right up to the final retirement date. But in the usual case, the reserve is depleted from time to time as the scattered retirements occur, and as depreciation expense accruals for those retired units cease. Accordingly, the average lifetime reserve, and average savings from the reinvested reserve, depend upon the type of retirement dispersion. Thus, the net weighted average cost of depreciation depends upon the bookkeeping charge to depreciation expense and the weighted average annual savings from reinvested reserves.

It must also be obvious that it is the life and dispersion actually realized that determines the level equivalent annuity. For example, if the actual life were underestimated, annual expense at 1/life would be larger than necessary. By the time retirement occurred, more than original cost would have been recovered. But at retirement, the bookkeeper still removes original cost from the plant account, and original cost less net salvage from the reserve. That would leave a balance in the reserve, still reinvested in plant. Credits for that superfluous reinvested reserve would reduce net costs for depreciation expense that started the cycle.

The same self-correcting feature operates if actual life is overestimated, or if the annual charge for depreciation expense is made at any rate other than "straight-line".

Note that the term "straight line" is misleading, because the reserve does not actually grow at a straight-line rate, owing to the natural behavior of dispersed retirements. That situation is overlooked by the great majority of writers and analysts, which has lead to widespread and grossly fallacious conclusions concerning the effects of "straight-line" depreciation. It is for this reason that the phrase appears in quotation marks herein, as suggested within the Depreciation Accounting Committee of the Edison Electric Institute.

3.4.8 ANNUAL DEPRECIATION EXPENSE

The levelized annual depreciation expense calculation will utilize the retirement dispersion method outlined in the appendix. From this data the following information will be used.

1. Remaining Average Service Life of new plus old equipment — 20 years

2. Net Salvage Charges (2001) — $0

3. Retirement Dispersion Curves (See Appendix)

Steam Generation (All)	R_5 - 20 years
Hot Water Generation (New)	R_5 - 20 years
Steam and Hot Water Distribution (New)	R_5 - 40 years
Turbine Generator (New)	L_3 - 20 years
Incinerator (Existing)	R_5 - 20 years
Pyrolysis and Waste Heat Boiler (New)	L_3 - 20 years
Steam Distribution (Existing)	R_5 - 20 years

4. Levelized Annual Depreciation Expense as a percent of remaining capital value at 7% rate of return. The 7% rate of return is the investment rate of which the University could earn if the depreciation expense was applied to a sinking fund.

$$20 \text{ year} - R_5 = 2.49\%$$
$$20 \text{ year} - L_3 = 3.77\%$$
$$40 \text{ year} - R_5 = .54\%$$

Application of the above data to the 1978 Capital Cost Budget which was escalated to 1979 was used in preparing the aforementioned "Summary-Annual Depreciation Expenses."

3.4.9 CALCULATED COMBINED ESCALATION RATES - BASIC PLAN

Since the life cycle study must account for inflationary trends of all expense items, and for simplification the "Annual Owning and Operating Cost Analysis" have lumped sum cost items, it is necessary to forecast a reasonable combined escalation rate for the lumped expense items.

From the appendix for "Escalation Factors" and the "Annual Operating Expense Summary" the following major groupings were made for operating costs shown in the "Annual Owing and Operating Cost Analysis."

Annual Escalation Factors (Z) - Steam Production Operating Expenses

Purchased Utilities		Administration		Labor, Supplies, Maintenance	
City Water -	10%	Administration -	8%	Service Contracts	10%
Purchased Power -	10%			Supply & Repair	7%
				Custodial	4%
				Building & Grounds	4%
				Miscellaneous Labor	7%
				Tracks & Loco. Maint.	7%
				Direct Labor	7%
				Calculated @	6.98%

Fuel	Ash Hauling and Landfill
Western - 7.339	7%
Eastern - 7.339	

3.4.10 COST ESCALATION DATA FOR LIFE CYCLES

UNIVERSITY OF MINNESOTA

SUMMARY OF EXPENDITURES

	1975-76	1976-77	% Escalation
Labor	$14,963,361	$16,666,992	10.22
Water and Sewer	804,318	914,924	12.09
Administration	505,625	572,393	12.54

Electricity	Annual Cost	Annual Escalation, %
1972/73	$1,642,868	Base
1973/74	1,948,932	15.7
1974/75	2,798,243	30.3
1975/76	3,301,396	15.2
1976/77	4,006,955	17.61
	Total Escalation	78.81%
	Average Annual Increase	19.70%

Electric Energy Cost Annual Escalation per R.W.R. LeGrassie, ERDA = 7%
Annual Inflation on 10 year doubling = 7%
Average energy price increase = 1.071 x 1.07 = 1.146
Average Annual increase = 14.6%

Expected University of Minnesota Electric Energy Cost Increases = 10%

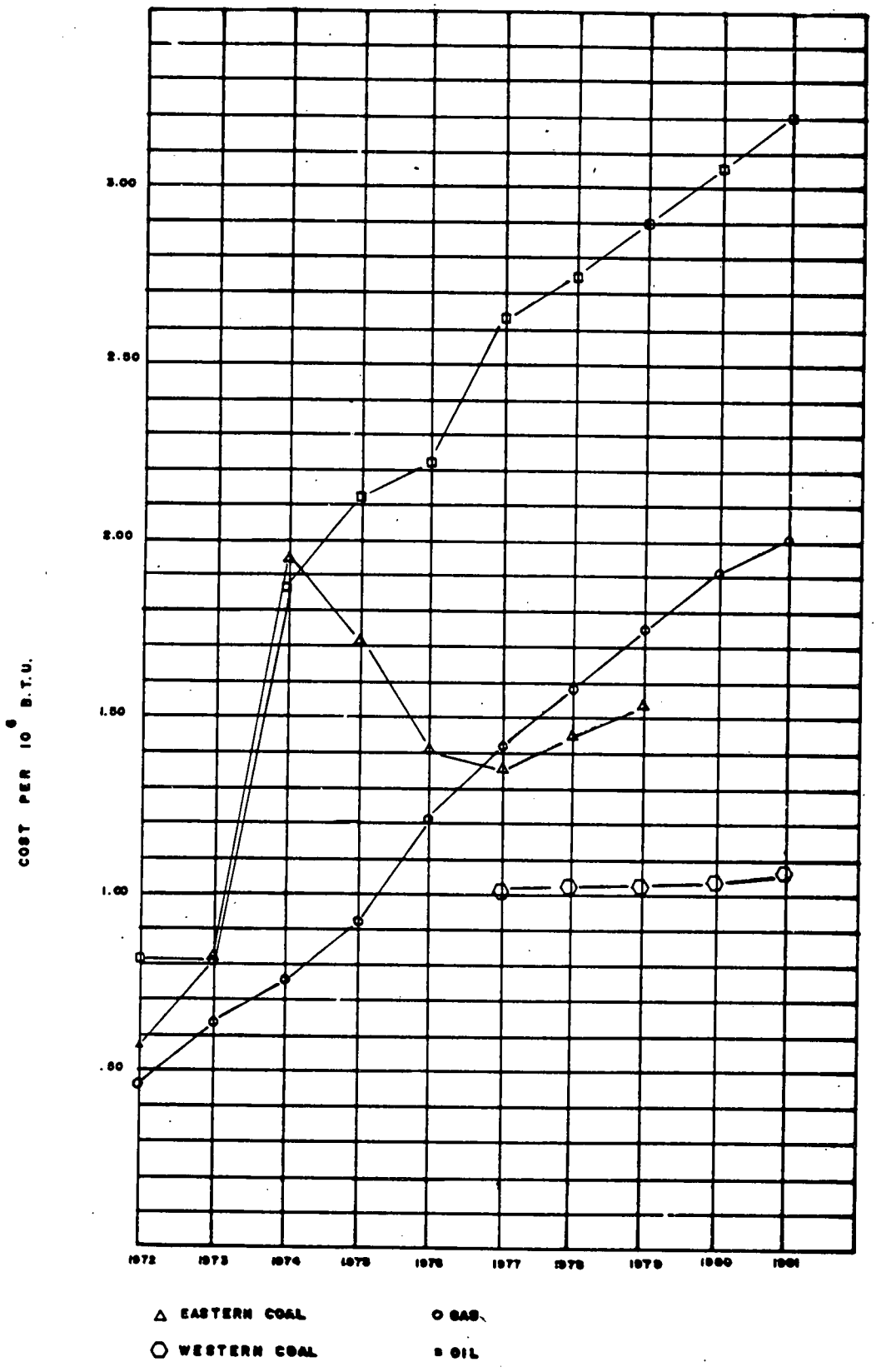
Ash Hauling and Landfill Escalation = 7%

University of Minnesota Construction Costs = 7% per annum

UNIVERSITY EXPERIENCED FUEL COST ESCALATION

See attached graph of actual costs.

Annual Average Escalation	
Coal	7.399%
Oil - No. 2	13.00%
Gas	28.00%



COST/10^6 BTU PER YEAR

BY S.E.F.
BUILDING
SCALE
SHEET
CHECKED
DATE
REVISED
DRAWING

UNIVERSITY OF MINNESOTA - PHYSICAL PLANT MAINTENANCE & OPERATIONS

NSP

NORTHERN STATES POWER COMPA

414 Nicollet Mall
MINNEAPOLIS, MINNESOTA 55401

RECEIVED
Nov 7 11 48 AM '77
UNIV. OF MINN.
PHYSICAL PLANT

November 3, 1977

Mr. Warren Soderberg
UNIVERSITY OF MINNESOTA
University Physical Plant
Room 200, Shops Bldg.
Minneapolis, MN 55455

Subject: 1981 Electricity Values

Dear Warren:

In my memo dated 5/17/77, I listed the 1977 electric energy values. We have projected these to 1981 as you have requested.

	1977		1981	
Capacity Rate	$64,000/MW		$83,000/MW	
	On Peak		Off Peak	
Energy Rates	1977	1981	1977	1981
Base Load	$11.00/MWhrs	$14.00/MWhrs	$11.00/MWhrs	$14.00/MWhrs
Economy Energy				
Summer	11.20 "	13.56 "	7.20 "	8.45 "
Winter	16.00 "	21.20 "	8.00 "	10.17 "

These figures are based on estimates and projections and will be altered to conform with actual costs when your plants goes into operation.

Sincerely,

John C. Pearce

John C. Pearce
Assistant to Director of
Planning & Research

jo

cc: Gerry Marx

UNIVERSITY OF MINNESOTA
TWIN CITIES

Physical Plant Maintenance and Operations
200 Shops Building
319 15th Avenue S.E.
Minneapolis, Minnesota 55455

March 27, 1978

TO: File

FROM: Jim O'Gara

RE: Tariff - Burlington Northern Shipments of Western Coal

PRESENT: G. F. Brown, Burlington Northern
Al Wirckler, Burlington Northern
J. O'Gara, University of Minnesota
W. Soderberg, University of Minnesota

Mr. Brown informed the University that the March, 1978 tariff for western coal (35 cars) combined with N.S.P. trains (70 cars) would be $10 per ton. This is an add-on of $2.39 per ton above N.S.P. tariff of $7.61 per ton. Mr. Brown also stated that 80% escalation of the $2.39 per ton would commence July 1, 1979. The base cost ($7.61) would escalate during the interim. Past escalation experience of the N.S.P. tariff has been as follows:

1973 - 7.00%
1974 - 6.61%
1975 - 9.95%
1976 - 11.64%
1977 - 7.50%
1978 - 7.00%

N.S.P. as part of this direct train shipment would receive all Burlington Northern billing. Non-Unit train costs would be around $12.86 per ton.

Another alternative, which Mr. Brown stated the Burlington Northern has no control over, is purchase of coal from N.S.P. with the coal being shipped on N.S.P. Company tariff, a savings of $2.39/ton. Mr. Soderberg said that the University would not attempt this unless cogeneration was a part of the plant operation.

This could be viewed as a significant contribution to Grid-ICES by N.S.P. At 180,000 tons per year the University's savings annually could be: 180,000 x $2.39 = $430,200. The writer feels N.S.P. purchase should be approached irregardless of the operations since generation is viable in the 1980's with or without DOE support.

JOO:skl

3.4.11 CONCLUSION

Hopefully, the rate of commercialization of ICES will grow, but with investment in these ventures growing so will the problems of tax and depreciation accounting. This in turn may require greater refinements and accuracy as well as new techniques in depreciation accounting. Further, once the federal government establishes co-generation rate regulations as an instrument for state public service commissions, co-generation accounting procedures may have to be designed around large utility accounting procedures wherein the FPC has established record keeping practices. This would cause smaller organizations without the accounting resources to take harder looks at co-generation.

DIRECT COMPARISON OF PRESENT WORTHED (PW) OF LONG-TERM SAVINGS

Let PW = Present worth of a cost (n years)

$$= F_x \frac{a(a^n - 1)}{a - 1} = F_x (PWF_x)$$

in which F_x = annual cost

and n = number of years of escalation

$$a_x = \frac{1 + f_x}{1 + i} = \text{discounting factor}$$

where i = EAR

The following calculations will use the combined escalation rates of the lumped sum operating expenses for a loan amortized at 5 3/4% and 15 years. (Standard U of M.)

Annual Discounting Factors (a_x)

	5 3/4 % - 15 years
Purchased Utilities a_{pu}	$f_x = 10\%$ $\frac{1 + .1}{1 + .0575} = 1.040$
Administration a_A	$f_x = 8\%$ $\frac{1 + .08}{1 + .0575} = 1.021$
Labor Supplies, Maintenance a_L	$f_x = 6.98\%$ $\frac{1 + .0698}{1 + .0575} = 1.012$
Fuel - Western Coal a_{fw}	$f_x = 8.26\%$ $\frac{1 + .0739}{1 + .0575} = 1.024$
Fuel - Eastern Coal a_{fe}	$f_x = 8.26\%$ $\frac{1 + .0739}{1 + .0575} = 1.024$

Oil - No. 2	$f_x = 13\%$
a_{fo}	$\frac{1 + .13}{1 + .0575} = 1.069$
Natural Gas	$f_x = 28\%$
a_{fg}	$\frac{1 + .28}{1 + .0575} = 1.210$
Ash Handling and Landfill	$f_x = 7\%$
a_h	$\frac{1 + .07}{1 + .0575} = 1.012$
Landfill	$f_x = 10\%$
a_l	$\frac{1 + .1}{1 + .0575} = 1.040$

Annual Present Worth Factors (PWF_x)

	5 3/4% - 15 years
Purchased Utilities PWF_{pu}	$\frac{1.04(1.04^{15}-1)}{1.04-1} = 30.97$
Administration PWF_A	$\frac{1.021(1.021^{15}-1)}{1.021-1} = 17.78$
Labor, Supplies, Maintenance PWF_L	$\frac{1.012(1.012^{15}-1)}{1.012-1} = 16.52$
Fuel Western Coal PWF_{fw}	$\frac{1.024(1.024^{15}-1)}{1.024-1} = 18.23$
Fuel Eastern Coal PWF_{fe}	$\frac{1.024(1.024^{15}-1)}{1.024-1} = 18.23$
Fuel Oil No. 2 PWF_{fo}	$\frac{1.069(1.069^{15}-1)}{1.069-1} = 26.66$
Fuel Natural Gas PWF_{fg}	$\frac{1.210(1.210^{15}-1)}{1.210-1} = 94.78$

Ash Handling Landfill PWF_h

$$\frac{1.012(1.012^{15}-1)}{1.012-1} = 16.52$$

Landfill PWF_l

$$\frac{1.040(1.04^{15}-1)}{1.04-1} = 20.82$$

3.5 UNIVERSITY'S COMPUTER SIMULATED GRID-ICES CENTRAL PLANT MODELS

The University's computer simulated Grid-ICES Central plant model uses historical and projected community steam demand and in-plant preliminary design parameters to estimate plant coal consumption, electric generation and truck traffic through the year 1985 for the Basic Plan and the three Options.

The program has been so constructed as to easily adapt to changes in steam demand projections or in-plant design. System optimization can also be explored by changing one or more of these parameters and observing its effect on output.

3.5.1 INPUT

The Grid-ICES Central plant model is based upon historical and projected hourly feedwater demand by the University (East and West Bank Campuses), St. Mary's and Fairview Hospitals and Augsburg College. The methods of steam demand projections are outlined below.

Design parameters, system formulae and plant models for computerization have been derived and are shown in the accompanying Sections.

3.5.2 STEAM DEMAND

In Stage 1 of Phase II, an analysis of historical feedwater flows and projected steam demand was updated. This information is contained in Sections 2.6 of the Stage 1 Final Report.

University

Steam data at the University Heating Plant is recorded by two means. A graphic meter on the feedwater line records instantaneous fluctuations at that point, while integrating meters record header steam for each boiler. The recording meters are interpreted to obtain hourly steam data while the integrating meters are read each twelve hours and summed to obtain daily data. Since readings of the exact hourly value from the continuous charts is quite difficult, these hourly values have been adjusted to the daily values. In this way our data retains the accuracy of the integrating meter while still reflecting the hourly changes which characterize a heating plant.

$$\text{Adjusted Hourly Data} = (\text{Hourly Data})\,(\text{Daily Data}) \div \left(\sum_{\text{Hour}=1}^{24} (\text{Hourly Data}) \right)$$

The existing University Heating Plant supplies steam at both 200 and 15 psig. the 15 psig load is considered to be 8% of the total flow to the University Community. The plant header will be operated at 180 psig for ICES.

St. Mary's and Fairview Hospitals

Hourly steam data for St. Mary's and Fairview Hospitals has been derived from a graphic meter located on the feedwater side of the boilers. No adjustment has been made to that data except where obviously erroneous figures were found.

Past meter readings have shown Fairview Hospital to consume about 31% of the total load between the two hospitals.

Augsburg College

Annual steam data for Augsburg College is estimated on a fuel consumption basis since they do not record steam flow. In order to obtain hourly data for the school, a typical University classroom-type building was selected and the Augsburg steam demand was broken up proportionately to that typical building. While this will cause some errors in steam flow demand, Augsburg constitutes only 3% of the total load and therefore, will not effect plant simulation significantly.

Projections

Projected annual increases in steam demand for each sector of the Community is calculated in the manner described in the Phase II, Stage 1 Report. The proportion of that annual increase which is added to each hour is determined

by the proportion of that hours value to the previous years total demand, i.e.:

$$UCYHD = UPYHD + UCAI \times UPYHD/UPYAD$$

where:

UCYHD = Current year University data for a given hour-day month
UPYHD = Previous year University data for the same hour-day-month
UCAI = Current year increase in University annual steam demand
UPYAD = Previous year University annual steam demand

3.5.3 PLANT PARAMETERS

Appearing on the following pages are the Central plant models for the Basic Plan and the three Options. As can be seen, Option I differs from the Basic Plan only in the steam distribution system which would be expanded to include St. Mary's and Fairview Hospitals, and Augsburg College. Option II adds a waste heat recovery boiler (which would be connected to the Andco-Torrax Pyrolysis unit) to the Southeast Steam Plant. Option III adds a hot water distribution loop which would provide hot water to the University's West Bank Campus existing hot water buildings.

Formulae for the different plant models were derived by defining the various flows and enthalpies for each system, setting up sets of simultaneous equations and solving those equations for header flow rates as a function of steam distribution system load. These equations were combined with the hourly community steam demand data to form the basis of the computer simulation.

It should be noted that the exhaust and extraction enthalpies out of the turbine have been defined as a constant 1,200 and 1,365 BTU/lb respectively. These enthalpies vary slightly with the amount and proportion of the exhaust to the extraction flow. However, these variances occur within a feedback loop and change at the rate of third and fourth degree polynomials, and would not significantly increase the program accuracy (see following graph).

The defined flows and enthalpies used for the preliminary design models are:

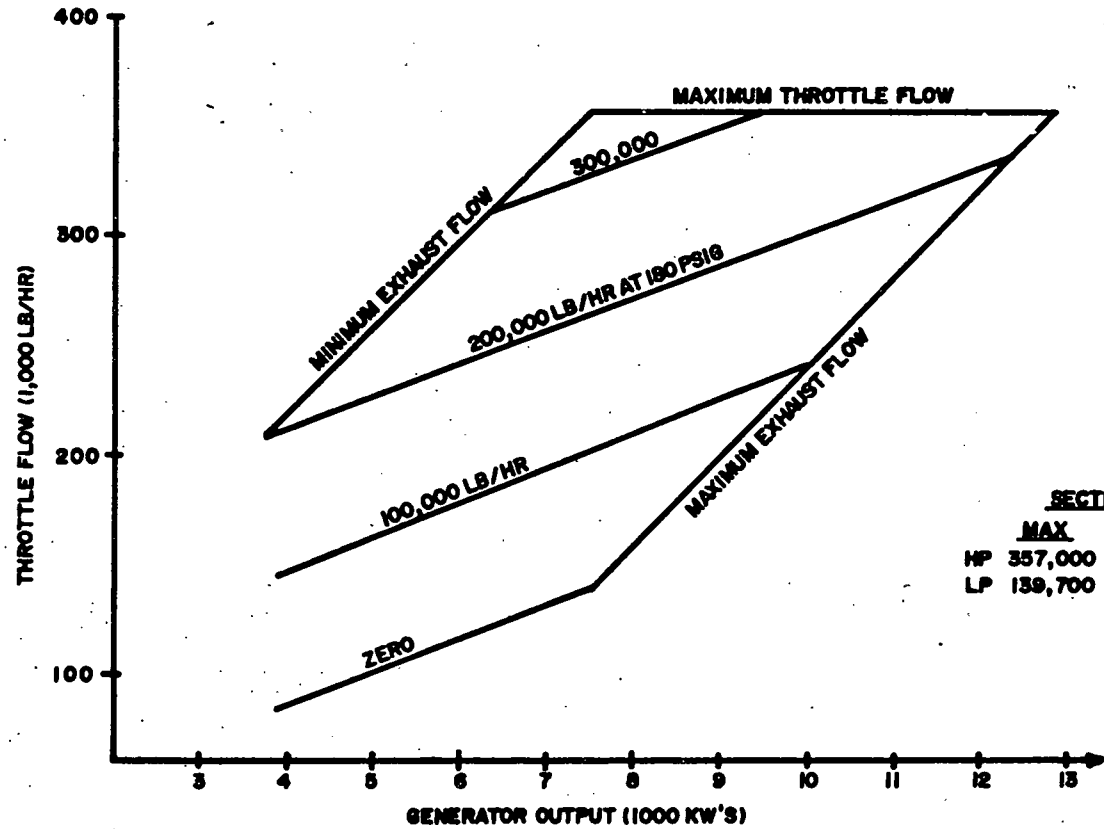
Steam Flows

Blowdown Steam	0.03 (Header Flow)
Line Losses	0.07 (Header Flow)
Makeup Water	0.10 (Header Flow)

Enthalpies

Header Enthalpy (Boiler)	1,385 BTU/lb
Exhaust from Turbine	1,200 BTU/lb
Extraction from Turbine	1,365 BTU/lb
Flow to High Pressure Load (180 psig)	1,200 BTU/lb
Flow to Low Pressure Load (20 psig)	1,200 BTU/lb
Condensate Return	150 BTU/lb
Makeup Water	30 BTU/lb
Feedwater	220 BTU/lb
Blowdown	441 BTU/lb
Hot Water to Load (300° F)	270 BTU/lb
Hot Water Return (maintained 160° F)	128 BTU/lb

7500 KW SAENC
450 PSIG-750°F_{TT}-20PSIG
A.E. AT 180 PSIG



SECTION FLOWS

	MAX	MIN
HP	357,000	—
LP	139,700	7800

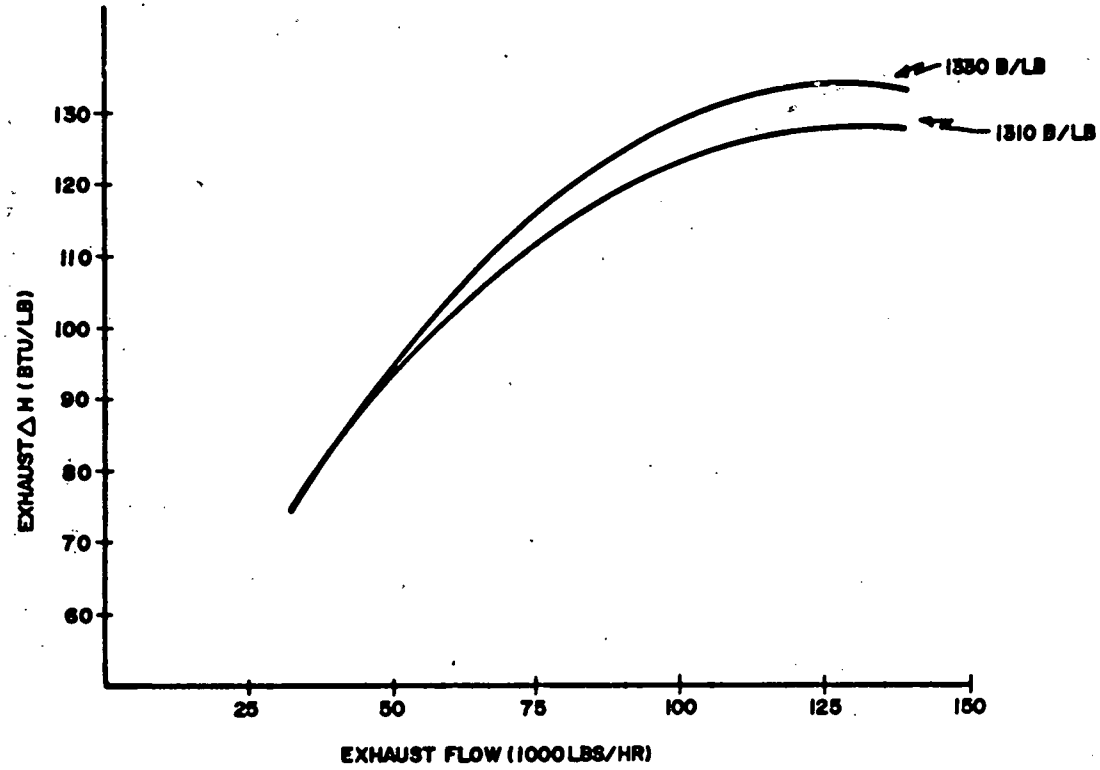
ESTIMATED PREFORMANCE BY GENERAL ELECTRIC

PRELIMINARY DESIGN-PHASE II-STAGE 2
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
SAENC TURBINE GENERATOR ESTIMATED PERFORMANCE

BY	BUILDING	SCALE	SHEET
GDM			
CHECKED	DATE	REVISED	DRAWING
JCO	2-20-76		

UNIVERSITY OF MINNESOTA PHYSICAL PLANT-MAINTENANCE & OPERATIONS

7500 KW SAENC
450 PSIG - 750° F_{TT} - 20 PSIG
A.E. AT 180 PSIG

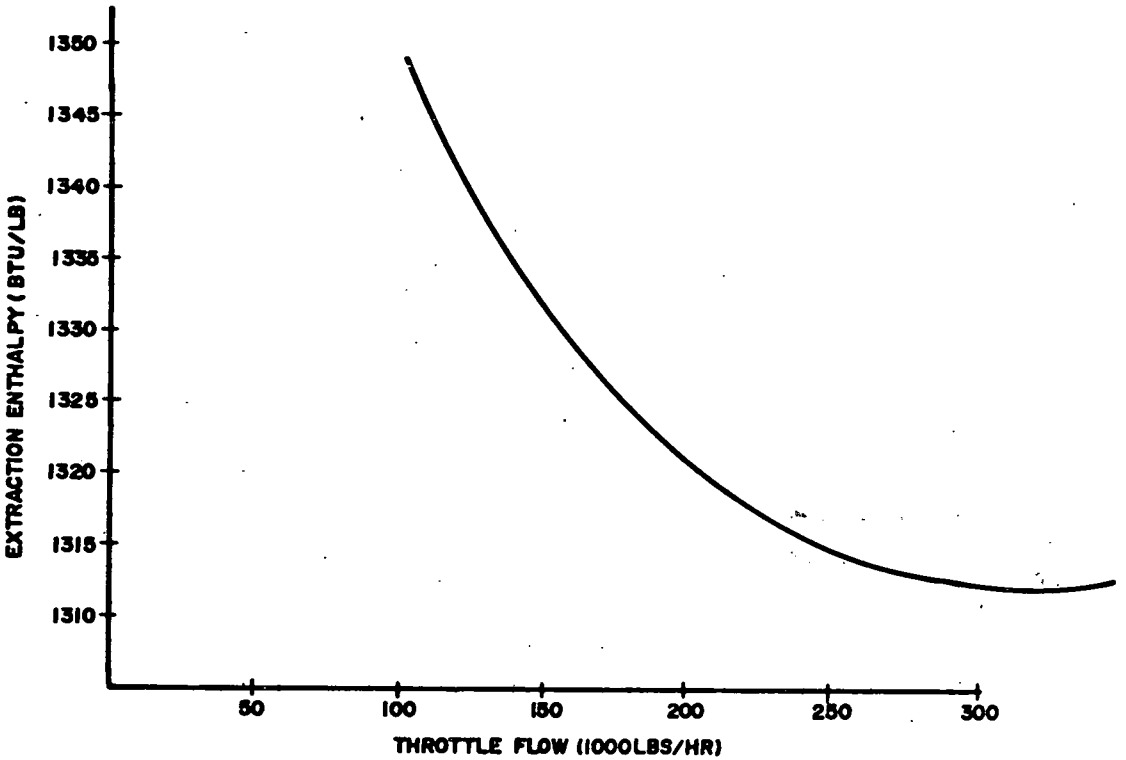


ESTIMATED PREFORMANCE BY GENERAL ELECTRIC

PRELIMINARY DESIGN - PHASE II - STAGE 2 GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM EXHAUST ENTHALPY FOR A 7500 KW SAENC TURBINE	BY GDM	BUILDING	SCALE	SHEET
	CHECKED JCO	DATE 2-21-78	REVISED	DRAWING

UNIVERSITY OF MINNESOTA PHYSICAL PLANT - MAINTENANCE & OPERATIONS

7500 KW SAENC
450 PSIG-750F$_{TT}$-20 PSIG
A.E. AT 180 PSIG



ESTIMATED PREFORMANCE BY GENERAL ELECTRIC

PRELIMINARY DESIGN - PHASE II - STAGE 2
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
EXTRACTION ENTHALPY FOR A 7500 KW SAENC TURBINE

BY	BUILDING	SCALE	SHEET
GDM			
CHECKED	DATE	REVISED	DRAWING
JCO	2-27-78		

UNIVERSITY OF MINNESOTA PHYSICAL PLANT - MAINTENANCE & OPERATIONS

3.5.4 BASIC PLAN

The steam distribution load for the Basic Plan consists of the University's East and West Bank Campus's high pressure load (180 psig) and the East Bank Campus low pressure load (20 psig). The low pressure load is estimated to be 8% of the total load. The maximum steam generation rate from the Southeast Steam Plant is estimated at 236,000 lbs/hr. For a total Community demand that is less than 239,000 lbs/hr:

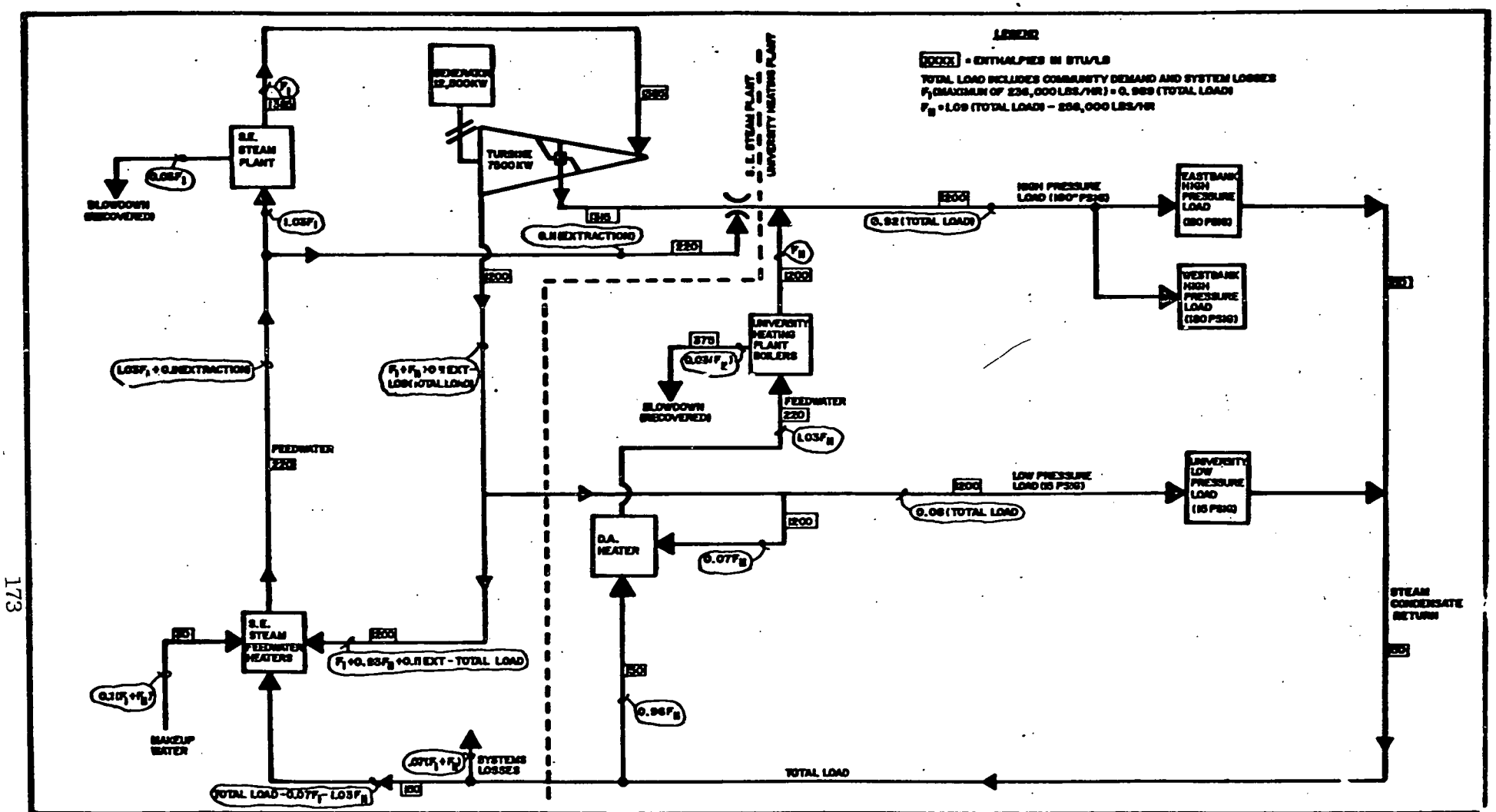
F_1 (Flow at S. E. Header) = 0.989 (total load)
F_{11} (Flow at U of M Plant Header) = 0

If total Community demand is greater than 239,000 lbs/hr:

F_1 = 236,000 lbs/hr
F_{11} = 1.09 (total load) - 258,000 lbs/hr

Extraction and Exhaust flow through the turbine are then:

Extraction = 0.82 (total load) - 0.89 (F_{11})
Exhuast = F_1 - Extraction = 0.7 (total load) - 0.89 (F_{11})



BASIC PLAN PRELIMINARY DESIGN-PHASE II-STAGE 2 GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM PROCESS FLOW MODELS FOR COMPUTER DEVELOPMENT	BY GDM	BUILDING	SCALE	SHEET
	CHECKED JCO	DATE 2-20-78	REVISED	DRAWING

UNIVERSITY OF MINNESOTA PHYSICAL PLANT—MAINTENANCE & OPERATIONS

3.5.5 OPTION I

The addition of St. Mary's and Fairview Hospitals and Augsburg College to the Community changes the proportion of low pressure steam demand to high pressure steam demand. This occurs even though the low pressure demand remains at 8.0% of the total University load it no longer is 8.0% of the total load, and it becomes necessary to separate out this low pressure load. For loads less than or around 239,000 lbs/hr:

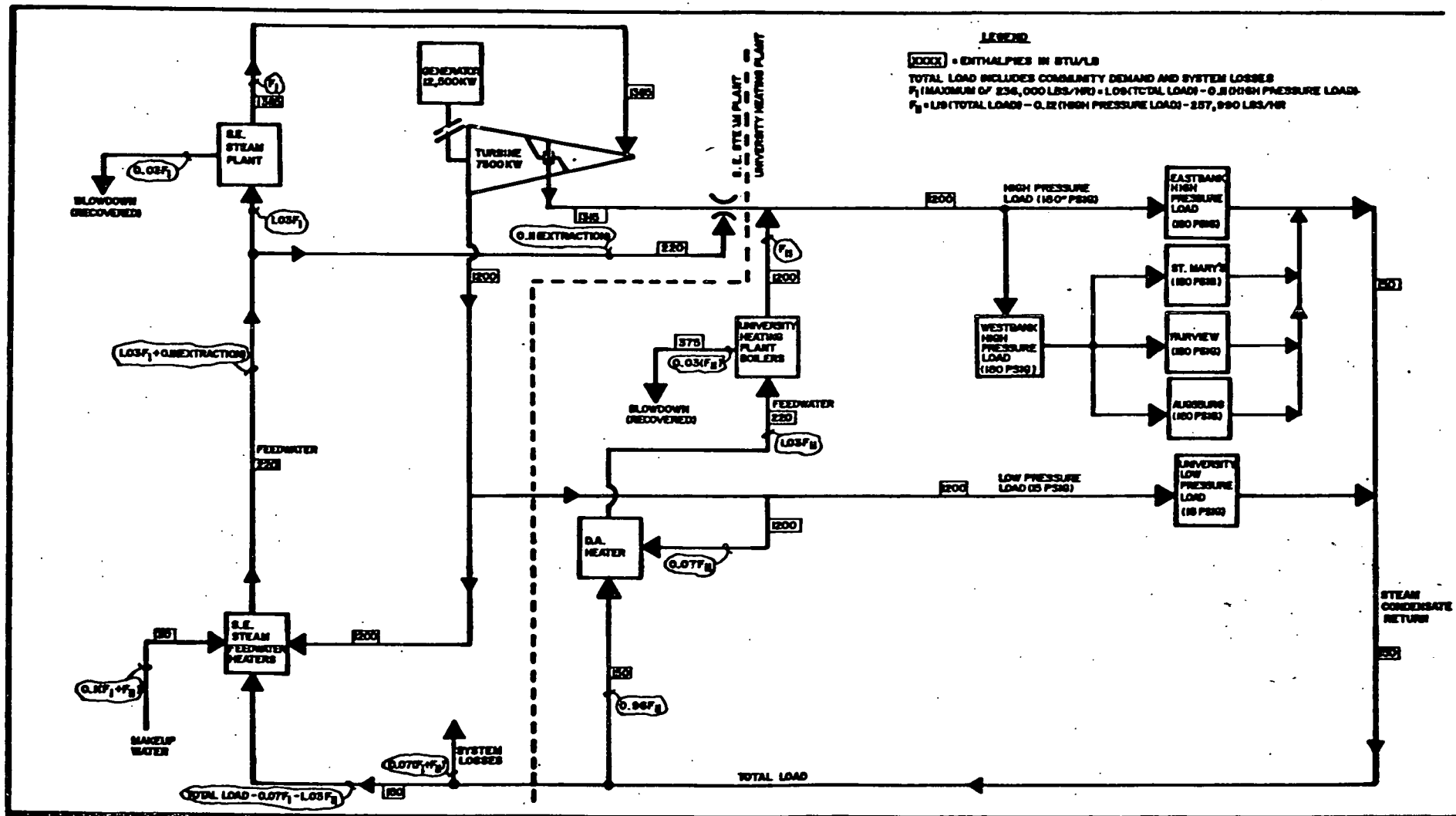
F_1 (Flow at S. E. Header) = 1.09 (total load) - 0.11 (high pressure load)

F_{11} (Flow at U of M Plant Header) = 0

For loads greater than 239,000 lbs/hr:

F_1 = 236,000 lbs/hr

F_{11} = 1.19 (total load) - 0.12 (high pressure load) - 257,990 lbs/hr


LEGEND
XXXX = ENTHALPIES IN BTU/LB
TOTAL LOAD INCLUDES COMMUNITY DEMAND AND SYSTEM LOSSES
F_I (MAXIMUM OF 236,000 LBS/HR) = LOG(TOTAL LOAD) - 0.8(HIGH PRESSURE LOAD)
F_{II} = 1.19 (TOTAL LOAD) - 0.12 (HIGH PRESSURE LOAD) - 257,990 LBS/HR
S.E. STEAM PLANT
GENERATOR 12,500KW
TURBINE 7500KW
S.E. STEAM PLANT
UNIVERSITY HEATING PLANT
BLOWDOWN (RECOVERED)
0.02F_I
1.03F_I
0.11 EXTRACTION
1345
220
1200
1200
HIGH PRESSURE LOAD (160 PSIG)
EASTBANK HIGH PRESSURE LOAD (160 PSIG)
ST. MARY'S (160 PSIG)
FAIRVIEW (160 PSIG)
AUGSBURG (160 PSIG)
WESTBANK HIGH PRESSURE LOAD (160 PSIG)
1.03F_I + 0.11 EXTRACTION
375
0.03(F_{II})
UNIVERSITY HEATING PLANT BOILERS
BLOWDOWN (RECOVERED)
FEEDWATER
220
1.03F_{II}
FEEDWATER
220
LOW PRESSURE LOAD (15 PSIG)
UNIVERSITY LOW PRESSURE LOAD (15 PSIG)
D.A. HEATER
0.07F_{II}
1200
S.E. STEAM FEEDWATER HEATERS
200
0.96F_{II}
0.17F_I + F_{II}
MAKEUP WATER
SYSTEM LOSSES
0.075F_I + F_{II}
TOTAL LOAD - 0.07F_I - 1.03F_{II}
TOTAL LOAD
STEAM CONDENSATE RETURN
OPTION I
PRELIMINARY DESIGN-PHASE II-STAGE 2
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
PROCESS FLOW MODELS FOR COMPUTER DEVELOPMENT
BY GDM
BUILDING
SCALE
SHEET
CHECKED JCO
DATE 2-20-78
REVISED
DRAWING
UNIVERSITY OF MINNESOTA PHYSICAL PLANT—MAINTENANCE & OPERATIONS

3.5.6 OPTION II

Option II is characterized by the addition of a waste heat recovery boiler which increases the maximum steam rate at the Southeast Steam Plant and the steam rate to the turbine. For the preliminary computer run the pyrolysis unit was assumed to handle 132 tons of solid waste per day with the waste heat recovery boiler producing an average steam output of 37,790 lbs/hr. This additional steam would increase the plant design maximum steam rate from 236,000 lbs/hr to 273,790 lbs/hr.

It is expected that the pyrolysis unit would need 15 days of unscheduled and scheduled maintenance per year. For the preliminary computer run we have simulated this maintenance to occur between May 15 - May 30.

For loads less than or equal to 279,000 lbs/hr:

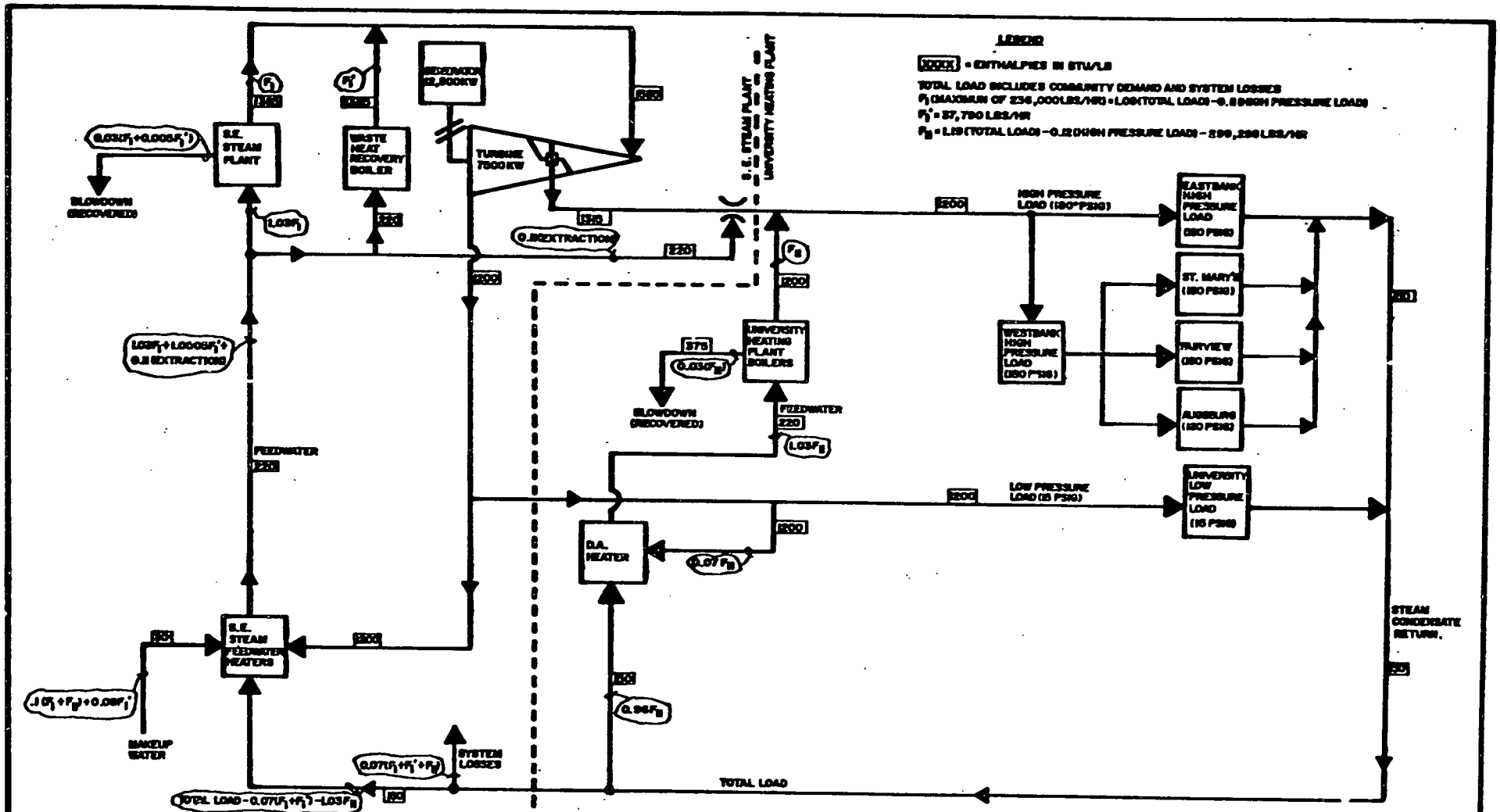
F_1 (Flow at S. E. Header) = 1.09 (total load) - 0.11 (high pressure load)

F_{11} (Flow at U of M Heating Header) = 0

For loads greater than 279,000 lbs/hr:

F_1 = 273,790 lbs/hr

F_{11} = 1.19 (total load) - 0.12 (high pressure load) - 299,298 lbs/hr



OPTION II
PRELIMINARY DESIGN-PHASE II-STAGE 2
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
PROCESS FLOW MODELS FOR COMPUTER DEVELOPMENT

BY	BUILDING	SCALE	SHEET
GDM			
CHECKED	DATE	REVISED	DRAWING
JCO	2-20-78		

UNIVERSITY OF MINNESOTA PHYSICAL PLANT—MAINTENANCE & OPERATIONS

3.5.7 OPTION III

Option III is characterized by the addition of a hot water loop which would provide the University's West Bank Campus with heating and steam adsoption cooling. The effect of the loop is to increase exhaust flow from the turbine thereby increasing the kilowatt output. A slight increase in steam to the turbine would be caused by a greater percentage of the load being provided by the lower enthalpy exhaust steam.

In formulating the hot water loop for the computer simulation it was necessary to determine the percentage of heating and cooling load of the West Bank Campus to the total campus. By comparing historic steam consumption patterns with the weather data during the same period, monthly average percentages of West Bank steam demand were arrived at:

Month	Steam Use %
January	11.0
February	8.5
March	5.5
April	5.7
May	15.0
June	19.5
July	25.5
August	26.5
September	23.5
October	8.5
November	8.5
December	9.5

The greater percentage of demand by the West Bank during the summer months is due to the fact that virtually the entire West Bank Campus is cooled by steam adsorption. For a total Community demand which is less than or equal to 300,000 lbs/hr:

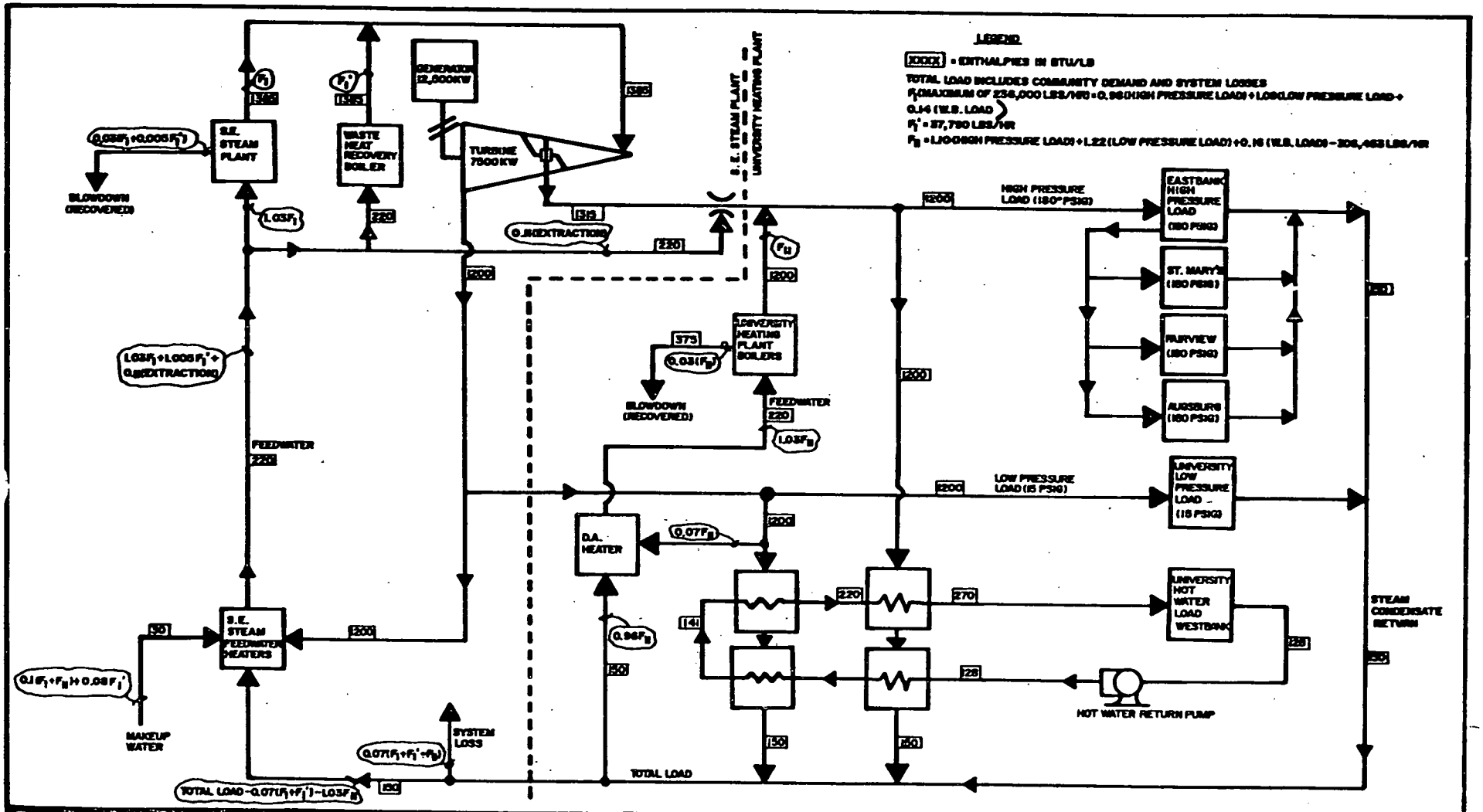
F_1 = 0.98 (high pressure load) + 1.09 (low pressure load) plus 0.14 (West Bank load)

F_{11} = 0

For Community demand greater than or equal to 300,000 lbs/hr:

F_1 = 273,790 lbs/hr

F_{11} = 1.10 (high pressure load) + 1.22 (low pressure load) plus 0.16 (West Bank load) - 306,453 lbs/hr



OPTION III
PRELIMINARY DESIGN-PHASE II-STAGE 2
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
PROCESS FLOW MODELS FOR COMPUTER DEVELOPMENT

BY	BUILDING	SCALE	SHEET
GDM			
CHECKED	DATE	REVISED	DRAWING
JCO	2-20-78		

UNIVERSITY OF MINNESOTA PHYSICAL PLANT—MAINTENANCE & OPERATIONS

3.5.8 OUTPUT

A complete printout of the results of the University's computer simulated Grid ICES central plant model may be found at the end of this section. The output gives a historical and projected scenario of monthly steam demand by the University, St. Mary's, Fairview and Augsburg. Additional scenarios of monthly electric production, coal consumption, and transportation for each Option for the first five years of ICES are also listed. Summaries are presented at the end of each section.

Steam Demand - Space

The steam demand figures listed include community needs and approximately 65% distributuion line losses. Gross square feet are considered to be constant throughout the year. Average hourly steam demand is the total steam demand in a given month or year divided by the number of hours in that period.

Electric Production

The computer model utilizes the consultant's design requirement of a 7500 KW SAENC turbine manufacturered by General Electric. From the General Electric performance characteristics a two variable linear equation was derived for use in the program.

$$KW = 65.15\ (TF) - 40.56\ (EXT) - 1585.02$$

where:

KW is the kilowatt production x 1,000
TF is the throttle flow in 1,000 lbs/hr
EXT is the extraction flow in 1,000 lbs/hr

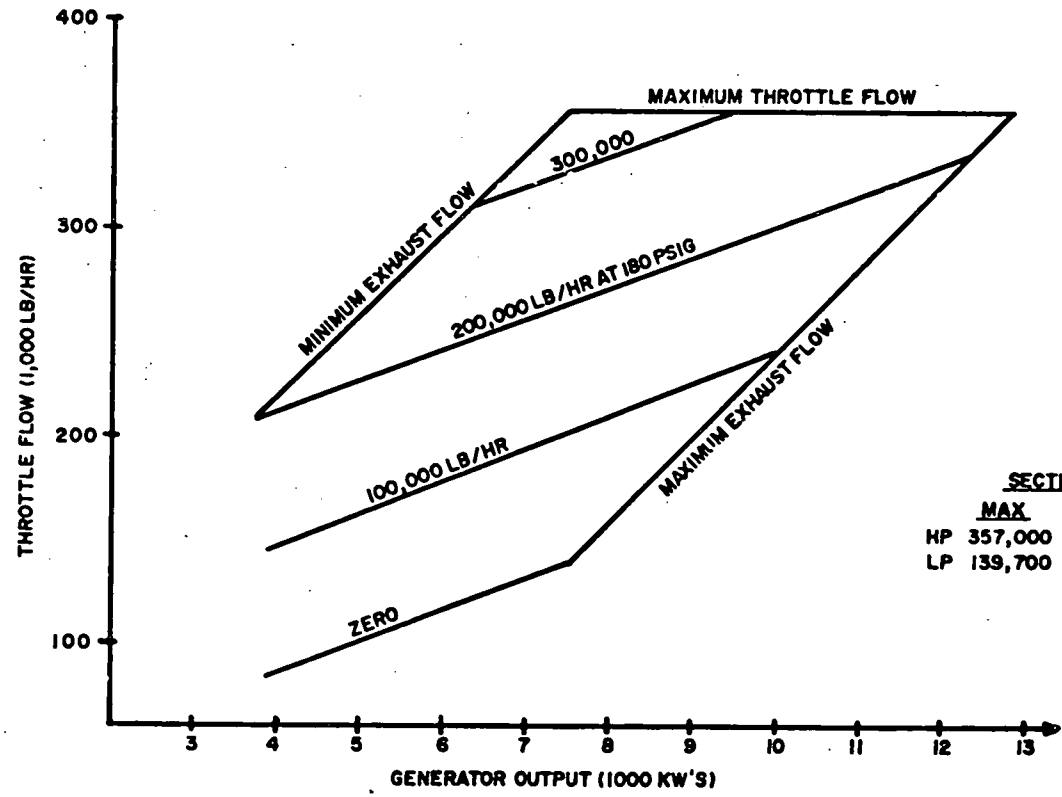
For the output, both kilowatt and kilowatt hour production are calculated on a monthly on-peak and off-peak and seasonal basis. As defined by N.S.P.'s credit structure on-peak hours constitute 40% of the total year and include weekdays from 8:00 A.M. to 10:00 P.M. excluding holidays. Off-peak hours constitute 60% of the total year and include weekdays from 10:00 P.M. to 8:00 A.M., all day weekends and holidays.

Two seasonal breakdowns of electric generation are also calculated. The first, with winter months of November through April and summer months of May through October coincides with N.S.P.'s credit structure. The second, with winter months of October through March and summer months of April through September coincides with the seasonal variations of steam demand of the community.

East Bank purchased power has been projected by analyzing 1977 East Bank electric use and adjusting for increased future building additions. Due to the recent installation of capacitor banks on the East Bank Campus, the projected purchased power was corrected for 100% power factor.

7500 KW SAENC
450 PSIG - 750° F_{TT} - 20PSIG
A.E. AT 180 PSIG

ESTIMATED PERFORMANCE - BY GENERAL ELECTRIC, 1978



SECTION FLOWS

	MAX	MIN
HP	357,000	—
LP	139,700	7800

see page 169

PRELIMINARY DESIGN - PHASE II - STAGE 2
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
SAENC TURBINE GENERATOR ESTIMATED PERFORMANCE

BY	BUILDING	SCALE	SHEET
GDM			
CHECKED	DATE	REVISED	DRAWING
JCO	2-20-78		

UNIVERSITY OF MINNESOTA PHYSICAL PLANT - MAINTENANCE & OPERATIONS

3.5.9 FUEL CONSUMPTION

In determining coal consumption, design values of 80% boiler efficiency and 3% blowdown are used. The fuel used is Western coal with a heating value of 8,890 BTU/lb. For the Southeast Steam Plant, the change in enthalpy from the feedwater, through the boiler, and to the point of the header is:

1,385 - 220 = 1,165 BTU/lb

And from the feedwater to blowdown is:

441 - 220 = 221 BTU/lb

For the University Heating Plant, operating at the same design values, the change of enthalpy from the feedwater, through the boiler, and to the point of the header is:

1,200 - 220 = 980 BTU/lb.

And from the feedwater to blowdown is:

350 - 220 = 130 BTU/lb

Coal consumption at the Southeast Plant then:

$$\frac{\text{Header Steam} \times (1{,}165 \text{ BTU/lb} + (0.03)\ (221 \text{ BTU/lb}))}{(8{,}890 \text{ BTU/lb})\ (0.8)\ (2{,}000 \text{ lbs/ton})}$$

And at the University Heating Plant:

$$\frac{\text{Header Steam} \times (980 \text{ BTU/lb} + (0.03)\ (130 \text{ BTU/lb}))}{(8{,}890 \text{ BTU/lb})\ (0.8)\ (2{,}000 \text{ lbs/ton})}$$

For Options II and III, a similar calculation is performed on the steam produced by the waste heat recovery boiler in order to determine the coal savings resulting from pyrolysis.

Coal savings from the waste heat recovery boiler is then:

$$\frac{\text{Header Steam} \times (1{,}165 \text{ BTU/lb} + (0.005)\ (130 \text{ BTU/lb}))}{(8{,}890 \text{ BTU/lb}\ (0.8)\ (2{,}000 \text{ lbs/ton})}$$

Since these figures represent an overall reduction in coal consumed, they have been given a negative value and can be found under the column titled "Reduction from Pyrolysis".

Fuel allocated to electric generation is calculated by determining the amount of coal required to produce the energy loss within the turbine. This energy loss is found by multiplying the monthly (or annual) steam flow from the exhaust and extraction points of the turbine by the change in enthalpy of the

steam as it passes from the throttle to the exit points. For the exhaust flow the change in enthalpy is:

$$1{,}385 - 1{,}200 = 185 \text{ BTU/lb}$$

and for the extraction flow the change is:

$$1{,}385 - 1{,}315 = 70 \text{ BTU/lb}$$

Coal allocated to electric generation is then:

$$\frac{(\text{EXH})\ (185 \text{ BTU/lb}) + (\text{EXT})\ (70 \text{ BTU/lb})}{(8{,}890 \text{ BTU/lb})\ (0.8)\ (2{,}000 \text{ lb/ton})}$$

Where:

EXH is the total exhaust flow for the given period
EXT is the total extraction flow for the given period

The individual Community's fuel allocation is then calculated by dividing up the remaining coal proportional to the steam demand of that Community.

3.5.10 TRANSPORTION

The transportation scenario explores the volumes of truck and train traffic servicing ICES during its first five years of operation. Unit trains consisting of 35, 100-ton cars will deliver coal to the ICES Plants directly from Western coal mines. A portion of this coal will then be trucked to the University's St. Paul Heating Plant to satisfy all of that Campus's coal requirements. Trucks will also be needed to remove coal ash (reduced in weight by 10% from the original coal) from the ICES Plants. With the inclusion of a pyrolysis unit, trucks will be used to deliver both health care and municipal solid waste. Additional trucks will be needed to remove the slag (reduced in weight by 20% from the original solid waste) from the Southeast Steam Plant.

For the computer simulation a unit train delivery is triggered if at the end of a 24 hour period the coal handling facilities in Minneapolis are able to absorb the 3,500 ton delivery, i.e.:

Maximum storage at University Heating Plant	=	12,100 tons
Maximum storage at Southeast Steam Plant	=	13,100 tons
Total Capacity	=	25,200 tons
		- 3,500 tons
		21,700 tons

So, if at the end of a 24 hour period the total storage in Minneapolis is below 21,700 tons, a unit train delivery will be made.

ICES and St. Paul Campus truck traffic involved with ash removal is given for both 10 and 14 ton trucks. A programming error has caused the number of ash trucks out of the St. Paul Plant to increase slightly from the Basic Plan to Option III. This problem will be corrected in the final computer run.

Health Care related solid waste is delivered in 7 ton trucks, while municipal wastes are delivered in 20 ton trucks. Deliveries total 132 tons of solid waste per day.

3.5.11

COMPUTER RUNS

The following materials contain the computer simulation of the Central Plants for ICES.

UNIVERSITY AND ADD-ON
STEAM DEMAND - SPACE

YEAR-MONTH	UNIVERSITY STEAM LBS (X1000)	UNIVERSITY DENS. LBS/GSF	ST. MARYS STEAM LBS (X1000)	ST. MARYS DENS. LBS/GSF	FAIRVIEW STEAM LBS (X1000)	FAIRVIEW DENS. LBS/GSF	AUGSBURG STEAM LBS (X1000)	AUGSBURG DENS. LBS/GSF	ADD-ON TOTAL STEAM LBS (X1000)	ADD-ON TOTAL DENS. LBS/GSF	TOTAL COMMUN. STEAM LBS (X1000)	TOTAL COMMUN. DENS. LBS/GSF	UNIVERSITY DEMAND PEAK (1000 LBS/HR)	UNIVERSITY DEMAND MIN (1000 LBS/HR)	UNIVERSITY DEMAND AVG (1000 LBS/HR)	TOTAL COMMUN. DEMAND PEAK (1000 LBS/HR)	TOTAL COMMUN. DEMAND MIN (1000 LBS/HR)	TOTAL COMMUN. DEMAND AVG (1000 LBS/HR)
7601	226403	22.5	21950	26.7	10611	28.5	9198	18.5	41159	24.7	267562	22.8	433	199	304	499	234	360
7602	174167	17.3	16388	19.9	7499	21.4	7344	14.8	31231	18.7	205398	17.5	418	160	250	462	193	295
7603	169234	16.8	13753	16.7	6277	17.9	6940	14.0	26970	16.2	196204	16.7	345	108	227	384	142	264
7604	103429	10.3	10142	12.3	4675	13.3	4338	8.7	19155	11.5	122584	10.4	224	86	144	259	105	170
7605	103795	10.3	8101	9.9	3680	10.5	3720	7.5	15501	9.3	119296	10.2	222	88	140	246	106	160
7606	125911	12.5	6899	8.4	3084	8.8	2904	5.9	12887	7.7	138798	11.8	248	108	175	269	124	193
7607	134415	13.3	6386	8.5	3125	8.9	2976	6.0	13087	7.8	147502	12.6	261	130	181	281	147	198
7608	130661	13.0	6991	8.5	3164	9.0	2976	6.0	13131	7.9	143792	12.3	257	119	176	276	135	193
7609	102212	10.2	7434	9.0	3364	9.6	2856	5.8	13654	8.2	115866	9.9	211	91	142	232	104	161
7610	136290	13.5	12023	14.6	5482	15.6	5314	10.7	22819	13.7	159109	13.6	276	110	183	322	130	214
7611	177496	17.6	16534	20.1	7524	21.4	7632	15.4	31690	19.0	209186	17.6	400	135	247	462	162	291
7612	245161	24.3	20734	25.2	9446	26.9	9426	19.0	39606	23.7	284767	24.3	464	209	330	527	246	383
TOTAL	1829174	181.7	147935	180.0	67331	191.8	65624	132.3	280890	168.3	2110064	179.8	464	86	208	527	104	240
(GSF X1000)		(10069)		(822)		(351)		(496)		(1669)		(11738)						
7701	265266	26.1	22250	27.1	10160	28.9	9299	18.7	41709	25.0	306975	26.0	495	219	357	553	258	413
7702	165075	16.3	15429	18.8	7035	20.0	6948	14.0	29412	17.6	194487	16.5	341	140	246	398	174	289
7703	136639	13.5	13912	16.9	6358	18.1	7074	14.3	27344	16.4	163983	13.9	289	82	184	334	108	220
7704	92350	9.1	10219	12.4	4683	13.3	4464	9.0	19366	11.6	111716	9.5	263	66	128	304	85	155
7705	96847	9.5	8538	10.4	3893	11.1	3840	7.7	16271	9.7	113118	9.6	216	73	130	235	96	152
7706	106491	10.5	7156	8.7	3170	9.0	2913	5.9	13239	7.9	119730	10.1	222	104	148	246	122	166
7707	126178	12.4	7314	8.9	3286	9.4	3031	6.1	13631	8.2	139809	11.8	253	118	170	273	134	188
7708	97664	9.6	7165	8.7	3231	9.2	3043	6.1	13439	8.1	110503	9.3	223	79	130	242	94	149
7709	85403	8.4	7996	9.7	3637	10.4	3072	6.2	14705	8.8	100108	8.5	200	82	119	220	98	139
7710	136290	13.4	12023	14.6	5482	15.6	5314	10.7	22819	13.7	159109	13.5	276	110	183	322	130	214
7711	177496	17.5	16534	20.1	7524	21.4	7632	15.4	31690	19.0	209186	17.7	400	135	247	462	162	291
7712	245161	24.1	20734	25.2	9446	26.9	9426	19.0	39606	23.7	284767	24.1	464	209	330	527	246	383
TOTAL	1730260	170.4	149270	181.6	67905	193.5	66056	133.2	283231	169.7	2013491	170.3	495	66	198	553	85	230
(GSF X1000)		(10152)		(822)		(351)		(496)		(1669)		(11821)						
7801	259368	23.6	20585	24.6	9356	25.9	8252	16.6	38193	22.5	297561	23.5	489	241	349	556	281	400
7802	181310	16.5	16027	19.1	7117	19.7	6948	14.0	30092	17.8	211402	16.7	375	154	270	433	188	315
7803	181790	16.6	17617	21.0	7742	21.4	8572	17.3	33931	20.0	215721	17.0	349	112	244	407	145	290
7804	110940	10.1	11285	13.5	5134	14.2	4992	10.1	21411	12.6	132351	10.5	289	82	154	331	104	184
7805	106352	9.7	8539	10.2	3893	10.8	3840	7.7	16272	9.6	122624	9.7	237	80	143	256	103	165
7806	116947	10.7	7157	8.6	3170	8.8	2913	5.9	13240	7.8	130187	10.3	244	114	162	268	132	181
7807	138590	12.6	7314	8.7	3286	9.1	3031	6.1	13631	8.0	152221	12.0	278	130	186	298	146	205
7808	140730	12.8	9447	11.3	4338	12.0	4105	8.3	17890	10.6	158620	12.5	331	116	189	357	136	213
7809	112302	10.2	7434	8.9	3364	9.3	2856	5.8	13654	8.1	125956	9.9	232	100	156	253	113	175
7810	134224	12.2	10889	13.0	4976	13.8	4780	9.6	20645	12.2	154869	12.2	272	108	180	314	126	208
7811	174987	16.0	15357	18.3	6837	18.9	6884	13.9	29078	17.2	204065	16.1	394	133	243	452	158	283
7812	255369	23.3	20388	24.4	9286	25.7	9077	18.3	38751	22.9	294120	23.2	463	217	343	526	252	395
TOTAL	1912909	174.4	152039	181.6	68499	189.7	66250	133.6	286788	169.3	2199697	173.7	489	80	218	556	103	251
(GSF X1000)		(10970)		(837)		(361)		(496)		(1694)		(12664)						

UNIVERSITY AND ADD-ON
STEAM DEMAND - SPACE.

YEAR-MONTH	UNIVERSITY STEAM LBS (X1000)	UNIVERSITY DENS. LBS/GSF	ST. MARYS STEAM LBS (X1000)	ST. MARYS DENS. LBS/GSF	FAIRVIEW STEAM LBS (X1000)	FAIRVIEW DENS. LBS/GSF	AUGSBURG STEAM LBS (X1000)	AUGSBURG DENS. LBS/GSF	ADD-ON STEAM LBS (X1000)	ADD-ON TOTAL DENS. LBS/GSF	TOTAL COMMUN. STEAM LBS (X1000)	TOTAL COMMUN. DENS. LBS/GSF	UNIVERSITY DEMAND PEAK (1000 LBS/HR)	UNIVERSITY DEMAND MIN (1000 LBS/HR)	UNIVERSITY DEMAND AVG (1000 LBS/HR)	TOTAL COMMUN. DEMAND PEAK (1000 LBS/HR)	TOTAL COMMUN. DEMAND MIN (1000 LBS/HR)	TOTAL COMMUN. DEMAND AVG (1000 LBS/HR)
7901	259368	23.6	20972	24.6	9801	26.4	8996	17.1	39769	22.7	299137	23.5	489	241	349	558	283	402
7902	181310	16.5	16235	19.1	7698	20.7	7620	14.5	31553	18.0	212863	16.7	375	154	270	435	191	317
7903	181790	16.6	17769	20.9	8423	22.7	9316	17.7	35508	20.3	217298	17.1	349	112	244	409	147	292
7904	110940	10.1	11860	13.9	5383	14.5	5712	10.9	22955	13.1	133895	10.5	289	82	154	333	105	186
7905	106352	9.7	8949	10.5	3897	10.5	3960	7.5	16806	9.6	123158	9.7	237	80	143	256	104	166
7906	116947	10.7	7235	8.5	3171	8.5	2913	5.5	13319	7.6	130266	10.2	244	114	162	269	132	181
7907	138590	12.6	7376	8.7	3286	8.9	3031	5.8	13693	7.8	152283	12.0	278	130	186	298	146	205
7908	140730	12.8	10056	11.6	4360	11.8	4498	8.6	18914	10.8	159644	12.6	331	116	189	358	136	215
7909	112302	10.2	7631	9.0	3376	9.1	2856	5.4	13863	7.9	126165	9.9	232	100	156	254	113	175
7910	134224	12.2	11334	13.3	5267	14.2	5524	10.5	22125	12.7	156349	12.3	272	108	180	316	127	210
7911	174987	16.0	15668	18.4	7370	19.9	7604	14.5	30642	17.5	205629	16.2	394	133	243	454	159	286
7912	255369	23.3	20807	24.4	9698	26.1	9821	18.7	40326	23.1	295695	23.2	463	217	343	528	255	397
TOTAL	1912909	174.4	155892	183.0	71730	193.3	71851	136.6	299473	171.2	2212382	173.9	489	80	218	558	104	253
(GSF X1000)		(10970)		(852)		(371)		(526)		(1749)		(12719)						
8001	263983	23.7	21380	24.7	10100	26.5	8996	17.1	40476	22.8	304459	23.6	498	245	355	569	288	409
8002	191546	17.2	17318	20.0	8051	21.1	7908	15.0	33277	18.8	224823	17.4	382	157	275	443	194	323
8003	185031	16.6	18362	21.2	8486	22.3	9316	17.7	36164	20.4	221195	17.1	355	114	249	416	150	297
8004	112881	10.1	12005	13.8	5854	15.4	5712	10.9	23571	13.3	136452	10.6	294	83	157	339	108	190
8005	108250	9.7	9283	10.7	4637	12.2	3960	7.5	17880	10.1	126130	9.8	241	81	145	262	106	170
8006	118995	10.7	7877	9.1	3890	10.2	2913	5.5	14680	8.3	133675	10.4	248	116	165	274	136	186
8007	141033	12.7	8058	9.3	4030	10.6	3031	5.8	15119	8.5	156152	12.1	283	132	190	305	150	210
8008	143228	12.9	10191	11.8	5082	13.3	4498	8.6	19771	11.1	162999	12.6	337	118	193	365	140	219
8009	114308	10.3	8154	9.4	4084	10.7	2856	5.4	15094	8.5	129402	10.0	236	102	159	259	117	180
8010	136608	12.3	11633	13.4	5720	15.0	5524	10.5	22877	12.9	159485	12.4	277	110	184	322	131	214
8011	178110	16.0	16078	18.5	7557	19.8	7604	14.5	31239	17.6	209349	16.2	401	135	247	462	163	291
8012	259893	23.4	21193	24.4	10030	26.3	9821	18.7	41044	23.1	300937	23.3	471	221	349	538	259	404
TOTAL	1953866	175.6	161532	186.3	77521	203.5	72139	137.1	311192	175.4	2265058	175.6	498	81	222	569	106	258
(GSF X1000)		(11127)		(867)		(381)		(526)		(1774)		(12901)						
8101	263983	23.7	21767	24.7	10545	27.0	8996	17.1	41308	23.0	305291	23.6	498	245	355	570	289	410
8102	184514	16.6	16932	19.2	8370	21.4	7620	14.5	32922	18.3	217436	16.8	382	157	275	444	196	324
8103	185031	16.6	18514	21.0	9167	23.4	9316	17.7	36997	20.6	222028	17.2	355	114	249	417	151	298
8104	112881	10.1	12580	14.3	6103	15.6	5712	10.9	24395	13.6	137276	10.6	294	83	157	340	108	191
8105	108250	9.7	9693	11.0	4641	11.9	3960	7.5	18294	10.2	126544	9.8	241	81	145	262	107	170
8106	118995	10.7	7955	9.0	3891	10.0	2913	5.5	14759	8.2	133754	10.3	248	116	165	275	136	186
8107	141033	12.7	8120	9.2	4030	10.3	3031	5.8	15181	8.4	156214	12.1	283	132	190	305	150	210
8108	143228	12.9	10800	12.2	5104	13.1	4498	8.6	20402	11.3	163630	12.7	337	118	193	366	140	220
8109	114308	10.3	8351	9.5	4096	10.5	2856	5.4	15303	8.5	129611	10.0	236	102	159	260	117	180
8110	136608	12.3	12078	13.7	6011	15.4	5524	10.5	23613	13.1	160221	12.4	277	110	184	323	131	215
8111	178110	16.0	16389	18.6	8090	20.7	7604	14.5	32083	17.8	210193	16.3	401	135	247	463	163	292
8112	259893	23.4	21612	24.5	10442	26.7	9821	18.7	41875	23.3	301768	23.3	471	221	349	539	261	406
TOTAL	1946834	175.0	164791	186.6	80490	205.9	71851	136.6	317132	176.3	2263966	175.1	498	81	222	570	107	258
(GSF X1000)		(11127)		(882)		(391)		(526)		(1799)		(12926)						

/8/02/14.

UNIVERSITY AND ADD-ON
STEAM DEMAND - SPACE

YEAR-MONTH	UNIVERSITY STEAM DENS. LBS (X1000)	LBS/GSF	ST. MARYS STEAM DENS. LBS (X1000)	LBS/GSF	FAIRVIEW STEAM DENS. LBS (X1000)	LBS/GSF	AUGSBURG STEAM DENS. LBS (X1000)	LBS/GSF	ADD-ON TOTAL STEAM DENS. LBS (X1000)	LBS/GSF	TOTAL COMMUN. STEAM DENS. LBS (X1000)	LBS/GSF	UNIVERSITY DEMAND PEAK (1000 LBS/HR)	MIN	AVG	TOTAL COMMUN. DEMAND PEAK (1000 LBS/HR)	MIN	AVG
8201	279642	23.9	23818	25.3	10844	27.0	8996	17.1	43658	23.4	323300	23.8	528	260	376	604	306	435
8202	195466	16.7	18455	19.6	8452	21.1	7620	14.5	34527	18.5	229993	16.9	405	166	291	471	206	342
8203	195971	16.7	20223	21.5	9213	23.0	9316	17.7	38752	20.7	234723	17.3	376	121	263	442	159	315
8204	119571	10.2	13426	14.3	6103	15.2	5712	10.9	25241	13.5	144812	10.7	311	88	166	359	114	201
8205	114668	9.8	10435	11.1	4641	11.6	3960	7.5	19036	10.2	133704	9.8	255	86	154	277	113	180
8206	126043	10.7	8676	9.2	3891	9.7	2913	5.5	15480	8.3	141523	10.4	263	123	175	291	144	197
8207	149411	12.7	8864	9.4	4030	10.0	3031	5.8	15925	8.5	165336	12.2	300	140	201	323	159	222
8208	151762	12.9	11546	12.3	5104	12.7	4498	8.6	21148	11.3	172910	12.7	357	125	204	387	148	232
8209	121058	10.3	9022	9.6	4096	10.2	2856	5.4	15974	8.5	137032	10.1	250	108	168	275	123	190
8210	144710	12.3	12933	13.7	6011	15.0	5524	10.5	24468	13.1	169178	12.4	293	117	195	341	139	227
8211	188682	16.1	17765	18.9	8174	20.4	7604	14.5	33543	17.9	222225	16.3	425	143	262	491	172	309
8212	275254	23.5	23567	25.0	10787	26.9	9821	18.7	44175	23.6	319429	23.5	499	234	370	571	275	429
TOTAL	2062238	175.9	178730	189.7	81346	202.9	71851	136.6	331927	177.6	2394165	176.1	528	86	235	604	113	273
(GSF X1000)		(11725)		(942)		(401)		(526)		(1869)		(13594)						
8301	279642	23.9	24987	25.3	10844	27.0	8996	17.1	44827	23.4	324469	23.8	528	260	376	607	307	436
8302	195466	16.7	19453	19.7	8452	21.1	7620	14.5	35525	18.6	230991	16.9	405	166	291	473	207	344
8303	195971	16.7	21341	21.6	9213	23.0	9316	17.7	39870	20.8	235841	17.3	376	121	263	444	160	317
8304	119571	10.2	14170	14.4	6103	15.2	5712	10.9	25985	13.6	145556	10.7	311	88	166	361	114	202
8305	114668	9.8	10849	11.0	4641	11.6	3960	7.5	19450	10.2	134118	9.8	255	86	154	277	114	180
8306	126043	10.7	8755	8.9	3891	9.7	2913	5.5	15559	8.1	141602	10.4	263	123	175	292	144	197
8307	149411	12.7	8926	9.0	4030	10.0	3031	5.8	15987	8.4	165398	12.1	300	140	201	323	159	222
8308	151762	12.9	12157	12.3	5104	12.7	4498	8.6	21759	11.4	173521	12.7	357	125	204	388	148	233
8309	121058	10.3	9268	9.4	4096	10.2	2856	5.4	16220	8.5	137278	10.1	250	108	168	276	124	191
8310	144710	12.3	13525	13.7	6011	15.0	5524	10.5	25060	13.1	169770	12.4	293	117	195	343	139	228
8311	188682	16.1	18714	19.0	8174	20.4	7604	14.5	34492	18.0	223174	16.4	425	143	262	493	172	310
8312	275254	23.5	24801	25.1	10787	26.9	9821	18.7	45409	23.7	320663	23.5	499	234	370	573	276	431
TOTAL	2062238	175.9	186946	189.4	81346	202.9	71851	136.6	340143	177.7	2402381	176.1	528	86	235	607	114	274
(GSF X1000)		(11725)		(987)		(401)		(526)		(1914)		(13639)						
8401	279642	23.9	24987	25.3	10844	27.0	8996	17.1	44827	23.4	324469	23.8	528	260	376	607	307	436
8402	202912	17.3	20071	20.3	8714	21.7	7908	15.0	36693	19.2	239605	17.6	405	166	292	473	207	344
8403	195971	16.7	21341	21.6	9213	23.0	9316	17.7	39870	20.8	235841	17.3	376	121	263	444	160	317
8404	119571	10.2	14170	14.4	6103	15.2	5712	10.9	25985	13.6	145556	10.7	311	88	166	361	114	202
8405	114668	9.8	10849	11.0	4641	11.6	3960	7.5	19450	10.2	134118	9.8	255	86	154	277	114	180
8406	126043	10.7	8755	8.9	3891	9.7	2913	5.5	15559	8.1	141602	10.4	263	123	175	292	144	197
8407	149411	12.7	8926	9.0	4030	10.0	3031	5.8	15987	8.4	165398	12.1	300	140	201	323	159	222
8408	151762	12.9	12157	12.3	5104	12.7	4498	8.6	21759	11.4	173521	12.7	357	125	204	388	148	233
8409	121058	10.3	9268	9.4	4096	10.2	2856	5.4	16220	8.5	137278	10.1	250	108	168	276	124	191
8410	144710	12.3	13525	13.7	6011	15.0	5524	10.5	25060	13.1	169770	12.4	293	117	195	343	139	228
8411	188682	16.1	18714	19.0	8174	20.4	7604	14.5	34492	18.0	223174	16.4	425	143	262	493	172	310
8412	275254	23.5	24801	25.1	10787	26.9	9821	18.7	45409	23.7	320663	23.5	499	234	370	573	276	431
TOTAL	2069684	176.5	187564	190.0	81608	203.5	72139	137.1	341311	178.3	2410995	176.8	528	86	236	607	114	274
(GSF X1000)		(11725)		(987)		(401)		(526)		(1914)		(13639)						

UNIVERSITY AND ADD-ON
STEAM DEMAND - SPACE

YEAR-MONTH	UNIVERSITY STEAM LBS (X1000)	UNIVERSITY DENS. LBS/GSF	ST. MARYS STEAM LBS (X1000)	ST. MARYS DENS. LBS/GSF	FAIRVIEW STEAM LBS (X1000)	FAIRVIEW DENS. LBS/GSF	AUGSBURG STEAM LBS (X1000)	AUGSBURG DENS. LBS/GSF	ADD-ON TOTAL STEAM LBS (X1000)	ADD-ON TOTAL DENS. LBS/GSF	TOTAL COMMUN. STEAM LBS (X1000)	TOTAL COMMUN. DENS. LBS/GSF	UNIVERSITY DEMAND PEAK (1000 LBS/HR)	UNIVERSITY DEMAND MIN	UNIVERSITY DEMAND AVG	TOTAL COMMUN. DEMAND PEAK (1000 LBS/HR)	TOTAL COMMUN. DEMAND MIN	TOTAL COMMUN. DEMAND AVG
8501	279642	23.9	24987	25.3	10844	27.0	8996	17.1	44827	23.4	324469	23.8	528	260	376	607	307	436
8502	195466	16.7	19453	19.7	8452	21.1	7620	14.5	35525	18.6	230991	16.9	405	166	291	473	207	344
8503	195971	16.7	21341	21.6	9213	23.0	9316	17.7	39870	20.8	235841	17.3	376	121	263	444	160	317
8504	119571	10.2	14170	14.4	6103	15.2	5712	10.9	25985	13.6	145556	10.7	311	88	166	361	114	202
8505	114668	9.8	10849	11.0	4641	11.6	3960	7.5	19450	10.2	134118	9.8	255	86	154	277	114	180
8506	125243	10.7	8755	8.9	3891	9.7	2913	5.5	15559	8.1	141602	10.4	263	123	175	292	144	197
8507	149411	12.7	8926	9.0	4050	10.0	3031	5.8	15987	8.4	165398	12.1	300	140	201	323	159	222
8508	151762	12.9	12157	12.3	5104	12.7	4498	8.6	21759	11.4	173521	12.7	357	125	204	388	148	233
8509	121058	10.3	9268	9.4	4096	10.2	2856	5.4	16220	8.5	137278	10.1	250	108	168	276	124	191
8510	144710	12.3	13525	13.7	6011	15.0	5524	10.5	25060	13.1	169770	12.4	293	117	195	343	139	228
8511	188682	16.1	18714	19.0	8174	20.4	7604	14.5	34492	18.0	223174	16.4	425	143	262	493	172	310
8512	275254	23.5	24801	25.1	10787	26.9	9821	18.7	45409	23.7	320663	23.5	499	234	370	573	276	431
TOTAL	2062238	175.9	186946	189.4	81346	202.9	71851	136.6	340143	177.7	2402381	176.1	528	86	235	607	114	274
(GSF X1000)		(11725)		(987)		(401)		(526)		(1914)		(13639)						

UNIVERSITY AND ADD-ON STEAM DEMAND - SPACE ANNUAL SUMMARY

YEAR	UNIVERSITY STEAM DENS. LBS (1000)	UNIVERSITY STEAM DENS. LBS/GSF	ST. MARYS STEAM DENS. LBS (X1000)	ST. MARYS STEAM DENS. LBS/GSF	FAIRVIEW STEAM DENS. LBS (X1000)	FAIRVIEW STEAM DENS. LBS/GSF	AUGSBURG STEAM DENS. LBS (X1000)	AUGSBURG STEAM DENS. LBS/GSF	ADD-ON TOTAL STEAM DENS. LBS (X1000)	ADD-ON TOTAL STEAM DENS. LBS/GSF	TOTAL COMMUN. STEAM DENS. LBS (X1000)	TOTAL COMMUN. STEAM DENS. LBS/GSF	UNIVERSITY DEMAND PEAK (1000 LBS/HR)	UNIVERSITY DEMAND MIN (1000 LBS/HR)	UNIVERSITY DEMAND AVG (1000 LBS/HR)	TOTAL COMMUN. DEMAND PEAK (1000 LBS/HR)	TOTAL COMMUN. DEMAND MIN (1000 LBS/HR)	TOTAL COMMUN. DEMAND AVG (1000 LBS/HR)
1976	1829174	181.7	147935	180.0	67331	191.8	65624	132.3	280890	168.3	2110064	179.8	464	86	208	527	104	240
1977	1730260	170.4	149270	181.6	67905	193.5	66056	133.2	283231	169.7	2013491	170.3	495	66	198	553	85	230
1978	1912909	174.4	152039	181.6	68499	189.7	66250	133.6	286788	169.3	2199697	173.7	489	80	219	556	103	251
1979	1912909	174.4	155892	183.0	71730	193.3	71851	136.6	299473	171.2	2212382	173.9	489	80	218	558	104	253
1980	1953866	175.6	161532	186.3	77521	203.5	72139	137.1	311192	175.4	2265058	175.6	498	81	222	569	106	258
1981	1946834	175.0	164791	186.8	80490	205.9	71851	136.6	317132	176.3	2263966	175.1	498	81	222	570	107	258
1982	2062238	175.9	178730	189.7	81346	202.9	71851	136.6	331927	177.6	2394165	176.1	528	86	235	604	113	273
1983	2062238	175.9	186946	189.4	81346	202.9	71851	136.6	340143	177.7	2402381	176.1	528	86	235	607	114	274
1984	2069684	176.5	187564	190.0	81608	203.5	72139	137.1	341311	178.3	2410995	176.8	528	86	236	607	114	274
1985	2062238	175.9	186946	189.4	81346	202.9	71851	136.6	340143	177.7	2402381	176.1	528	86	235	607	114	274

ELECTRIC PRODUCTION - S.E. STEAM PLANT
BASIC PLAN

YEAR-MONTH	KILOWATT PRODUCTION ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER KWHRS (X1000)	DEMAND (KW)
1981														
JAN	7332	5858	6525	7332	5858	6484	7332	5858	6500	1918	2918	4836	8694	19694
FEB	6648	3257	5849	6654	3629	5908	6654	3257	5883	1638	2316	3953	7157	19214
MAR	6472	1953	5427	6502	2326	5555	6502	1953	5502	1672	2422	4093	8694	19214
APR	6004	1394	3355	6145	1022	3189	6145	1022	3257	986	1359	2345	8454	19694
MAY	5835	1177	3301	5823	960	2688	5835	960	2930	970	1210	2180	8694	21616
JUN	5876	2357	3929	5584	2015	3257	5876	2015	3545	1210	1342	2552	9703	22096
JUL	5957	2543	4556	6080	2512	4056	6080	2512	4273	1467	1712	3179	9847	22096
AUG	6390	2729	4606	6080	2077	4127	6390	2077	4316	1354	1857	3211	10231	22096
SEP	5739	1581	3632	5150	1581	3118	5739	1581	3338	1119	1285	2403	8694	19694
OCT	6045	2077	4305	5940	1829	3942	6045	1829	4092	1326	1719	3045	9079	19694
NOV	6771	3132	5509	6771	2605	5491	6771	2605	5498	1542	2416	3958	8838	19694
DEC	7186	5522	6514	7093	5274	6428	7186	5274	6463	2006	2802	4809	8694	19694
TOTAL	7332	1177	4783	7332	960	4525	7332	960	4631	17209	23356	40566	106779	22096
OCT-MAR	7332	1953	5682	7332	1829	5634	7332	1829	5654	10102	14592	24695	51156	19694
APR-SEP	6390	1177	3905	6145	960	3407	6390	960	3614	7107	8764	15871	55623	22096
NOV-APR	7332	1394	5535	7332	1022	5516	7332	1022	5524	9763	14232	23995	50531	19694
MAY-OCT	6390	1177	4060	6080	960	3534	6390	960	3752	7446	9124	16571	56248	22096
1982														
JAN	7502	5946	6650	7502	5946	6606	7502	5946	6623	1955	2973	4928	9236	20920
FEB	6782	3536	5992	6788	3939	6062	6788	3536	6033	1676	2376	4054	7603	20410
MAR	6595	2170	5615	6625	2543	5750	6625	2170	5694	1729	2507	4237	9236	20410
APR	6098	1581	3635	6244	1177	3439	6244	1177	3519	1069	1465	2534	8980	20920
MAY	5917	1332	3588	5905	1115	2941	5917	1115	3197	1055	1323	2378	9236	22961
JUN	5963	2605	4250	5858	2232	3544	5963	2232	3846	1309	1460	2769	10307	23472
JUL	6051	2791	4874	6180	2760	4358	6180	2760	4581	1569	1839	3408	10660	23472
AUG	6507	2977	4890	6180	2294	4421	6507	2294	4606	1438	1989	3427	10868	23472
SEP	5887	1767	3931	5553	1767	3396	5887	1767	3625	1211	1399	2610	9236	20920
OCT	6139	2294	4607	6028	2046	4247	6139	2046	4396	1419	1852	3271	9644	20920
NOV	6911	3412	5733	6911	2853	5713	6911	2853	5721	1605	2514	4119	9389	20920
DEC	7350	5846	6645	7251	5677	6549	7350	5677	6589	2047	2856	4902	9236	20920
TOTAL	7502	1332	5026	7502	1115	4756	7502	1115	4867	18083	24553	42636	113431	23472
OCT-MAR	7502	2170	5868	7502	2046	5821	7502	2046	5840	10433	15077	25510	54344	20920
APR-SEP	6507	1332	4203	6244	1115	3684	6507	1115	3899	7650	9476	17126	59087	23472
NOV-APR	7502	1581	5716	7502	1177	5694	7502	1177	5703	10083	14690	24773	53680	20920
MAY-OCT	6507	1332	4362	6180	1115	3820	6507	1115	4045	8001	9863	17863	59751	23472

ELECTRIC PRODUCTION - S.E. STEAM PLANT
BASIC PLAN

YEAR-MONTH	KILOWATT PRODUCTION ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER KWHRS (X1000)	DEMAND (KW)
1983														
JAN	7502	5946	6650	7502	5946	6606	7502	5946	6623	1955	2973	4928	9236	20920
FEB	6782	3536	5992	6788	3939	6062	6788	3536	6033	1678	2376	4054	7603	20410
MAR	6595	2170	5615	6625	2543	5750	6625	2170	5694	1729	2507	4237	9236	20410
APR	6098	1581	3635	6244	1177	3439	6244	1177	3519	1069	1465	2534	8980	20920
MAY	5917	1332	3588	5905	1115	2941	5917	1115	3197	1059	1323	2378	9236	22961
JUN	5963	2605	4250	5858	2232	3544	5963	2232	3846	1309	1460	2769	10307	23472
JUL	6051	2791	4874	6180	2760	4358	6180	2760	4581	1569	1839	3408	10460	23472
AUG	6507	2977	4890	6180	2294	4421	6507	2294	4606	1438	1989	3427	10868	23472
SEP	5887	1767	3931	5553	1767	3396	5887	1767	3625	1211	1399	2610	9236	20920
OCT	6139	2294	4607	6028	2046	4247	6139	2046	4396	1419	1852	3271	9644	20920
NOV	6911	3412	5733	6911	2853	5713	6911	2853	5721	1605	2514	4119	9389	20920
DEC	7350	5846	6645	7251	5677	6549	7350	5677	6589	2047	2856	4902	9236	20920
TOTAL	7502	1332	5026	7502	1115	4756	7502	1115	4867	18083	24553	42636	113431	23472
OCT-MAR	7502	2170	5868	7502	2046	5821	7502	2046	5840	10433	15077	25510	54344	20920
APR-SEP	6507	1332	4203	6244	1115	3684	6507	1115	3899	7650	9476	17126	59087	23472
NOV-APR	7502	1581	5716	7502	1177	5694	7502	1177	5703	10083	14690	24773	53680	20920
MAY-OCT	6507	1332	4362	6180	1115	3820	6507	1115	4045	8001	9863	17863	59751	23472
1984														
JAN	7502	5946	6650	7502	5946	6606	7502	5946	6623	1955	2973	4928	9236	20920
FEB	6782	3536	5992	6788	3939	6073	6788	3536	6040	1678	2526	4204	7603	20410
MAR	6625	2170	5714	6537	2543	5679	6625	2170	5694	1840	2396	4237	9236	20410
APR	6244	1581	3803	6139	1177	3323	6244	1177	3519	1118	1416	2534	8980	20920
MAY	5917	1581	3791	5615	1115	2838	5917	1115	3197	1061	1317	2378	9236	22961
JUN	5963	2605	4350	5858	2232	3469	5963	2232	3846	1340	1429	2769	10307	23472
JUL	6051	2791	4984	6180	2760	4318	6180	2760	4581	1465	1943	3408	10460	23472
AUG	6507	2977	5013	6168	2294	4318	6507	2294	4606	1544	1883	3427	10868	23472
SEP	5887	1767	4120	5398	1767	3283	5887	1767	3625	1211	1399	2610	9236	20920
OCT	6139	2822	4679	6028	2046	4225	6139	2046	4396	1310	1961	3271	9644	20920
NOV	6911	3195	5751	6724	2853	5700	6911	2853	5721	1691	2428	4119	9389	20920
DEC	7350	5887	6743	7186	5677	6480	7350	5677	6589	2077	2825	4902	9236	20920
TOTAL	7502	1581	5144	7502	1115	4685	7502	1115	4871	18291	24495	42786	113431	23472
OCT-MAR	7502	2170	5934	7502	2046	5780	7502	2046	5842	10551	15109	25660	54344	20920
APR-SEP	6507	1581	4353	6180	1115	3591	6507	1115	3899	7740	9386	17126	59087	23472
NOV-APR	7502	1581	5780	7502	1177	5654	7502	1177	5706	10359	14564	24923	53680	20920
MAY-OCT	6507	1581	4497	6180	1115	3745	6507	1115	4045	7932	9931	17863	59751	23472

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ELECTRIC PRODUCTION - S.E. STEAM PLANT
BASIC PLAN

YEAR-MONTH	KILOWATT PRODUCTION ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER KWHRS (X1000)	DEMAND (KW)
1985														
JAN	7502	5946	6650	7502	5946	6606	7502	5946	6623	1955	2973	4928	9236	20920
FEB	6782	3536	5992	6788	3939	6062	6788	3536	6033	1678	2376	4054	7603	20410
MAR	6595	2170	5615	6625	2543	5750	6625	2170	5694	1729	2507	4237	9236	20410
APR	6098	1581	3635	6244	1177	3439	6244	1177	3519	1069	1465	2534	8980	20920
MAY	5917	1332	3588	5905	1115	2941	5917	1115	3197	1055	1323	2378	9236	22961
JUN	5963	2605	4250	5858	2232	3544	5963	2232	3846	1309	1460	2769	10307	23472
JUL	6051	2791	4874	6180	2760	4358	6180	2760	4581	1569	1839	3408	10460	23472
AUG	6507	2977	4890	6180	2294	4421	6507	2294	4606	1438	1989	3427	10868	23472
SEP	5887	1767	3931	5553	1767	3396	5887	1767	3625	1211	1399	2610	9236	20920
OCT	6139	2294	4607	6028	2046	4247	6139	2046	4396	1419	1852	3271	9644	20920
NOV	6911	3412	5733	6911	2853	5713	6911	2853	5721	1605	2514	4119	9389	20920
DEC	7350	5846	6645	7251	5677	6549	7350	5677	6589	2047	2856	4902	9236	20920
TOTAL	7502	1332	5026	7502	1115	4756	7502	1115	4867	18083	24553	42636	113431	23472
OCT-MAR	7502	2170	5868	7502	2046	5821	7502	2046	5840	10433	15077	25510	54344	20920
APR-SEP	6507	1332	4203	6244	1115	3684	6507	1115	3899	7650	9476	17126	59087	23472
NOV-APR	7502	1581	5716	7502	1177	5694	7502	1177	5703	10083	14690	24773	53680	20920
MAY-OCT	6507	1332	4362	6180	1115	3820	6507	1115	4045	8001	9863	17863	59751	23472

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 1

YEAR-MONTH	KILOWATT PRODUCTION: ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION: ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER: KWHRS (X1000)	DEMAND (KW)
1981														
JAN	7494	5970	6673	7523	5973	6628	7523	5970	6646	1962	2982	4944	8694	19694
FEB	6815	4305	6098	6805	4622	6156	6815	4305	6132	1707	2413	4121	7157	19214
MAR	6611	2973	5853	6663	3291	5950	6663	2973	5911	1803	2594	4398	8694	19214
APR	6119	2084	4208	6265	1711	3972	6265	1711	4068	1237	1692	2929	8454	19694
MAY	5887	2060	3976	5883	1649	3342	5887	1649	3592	1169	1504	2673	8694	21616
JUN	5940	2881	4500	5833	2567	3803	5940	2567	4101	1386	1567	2953	9703	22096
JUL	6017	3149	5051	6138	3008	4546	6138	3008	4765	1626	1919	3545	9847	22096
AUG	6466	3480	5177	6169	2684	4732	6466	2684	4908	1522	2130	3651	10231	22096
SEP	5865	2022	4216	5729	1967	3677	5865	1967	3908	1298	1515	2813	8694	19694
OCT	6165	2711	4988	6052	2408	4665	6165	2408	4799	1536	2034	3570	9079	19694
NOV	6912	4180	5954	6933	3377	5883	6933	3377	5911	1667	2589	4256	8838	19694
DEC	7364	5869	6667	7301	5819	6578	7364	5819	6615	2053	2868	4922	8694	19694
TOTAL	7494	2022	5272	7523	1649	4999	7523	1649	5111	18969	25806	44775	106779	22096
OCT-MAR	7494	2711	6035	7523	2408	5977	7523	2408	6001	10730	15481	26211	51156	19694
APR-SEP	6466	2022	4527	6265	1649	4015	6466	1649	4227	8239	10326	18565	55623	22096
NOV-APR	7494	2084	5913	7523	1711	5868	7523	1711	5886	10431	15139	25569	50531	19694
MAY-OCT	6466	2022	4655	6169	1649	4132	6466	1649	4349	8538	10668	19206	56248	22096
1982														
JAN	7674	6066	6805	7700	6068	6757	7700	6066	6776	2001	3041	5041	9236	20920
FEB	6960	4639	6220	6950	4960	6266	6960	4639	6247	1742	2456	4198	7603	20410
MAR	6739	3218	5989	6797	3536	6062	6797	3218	6032	1845	2643	4488	9236	20410
APR	6218	2298	4474	6369	1894	4219	6369	1894	4323	1315	1797	3113	8980	20920
MAY	5971	2242	4268	5967	1832	3618	5971	1832	3875	1255	1628	2883	9236	22961
JUN	6030	3156	4834	5918	2812	4110	6030	2812	4420	1489	1693	3182	10307	23472
JUL	6114	3425	5327	6240	3284	4855	6240	3284	5059	1715	2049	3764	10460	23472
AUG	6586	3756	5407	6274	2929	5005	6586	2929	5164	1590	2252	3842	10868	23472
SEP	5950	2263	4530	5828	2181	3980	5950	2181	4216	1395	1640	3035	9236	20920
OCT	6264	2956	5216	6145	2653	4909	6264	2653	5036	1607	2140	3747	9644	20920
NOV	7057	4515	6070	7083	3653	6008	7083	3653	6032	1700	2644	4343	9389	20920
DEC	7538	5956	6799	7472	5901	6705	7538	5901	6744	2094	2923	5017	9236	20920
TOTAL	7674	2242	5488	7700	1832	5213	7700	1832	5326	19746	26907	46653	113431	23472
OCT-MAR	7674	2956	6179	7700	2653	6119	7700	2653	6143	10987	15847	26834	54344	20920
APR-SEP	6586	2242	4813	6369	1832	4300	6586	1832	4512	8759	11060	19819	59087	23472
NOV-APR	7674	2298	6063	7700	1894	6009	7700	1894	6031	10696	15504	26200	53680	20920
MAY-OCT	6586	2242	4935	6274	1832	4416	6586	1832	4632	9050	11403	20453	59751	23472

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ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 1

YEAR-MONTH	KILOWATT PRODUCTION: ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION: ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER: KWHRS (X1000)	DEMAND (KW)
1983														
JAN	7680	6068	6810	7706	6071	6761	7706	6068	6780	2002	3042	5045	9236	20920
FEB	6965	4667	6226	6955	4987	6271	6965	4667	6252	1743	2458	4201	7603	20410
MAR	6741	3246	5996	6802	3563	6068	6802	3246	6038	1847	2646	4492	9236	20410
APR	6223	2325	4494	6375	1922	4237	6375	1922	4342	1321	1805	3126	8980	20920
MAY	5971	2270	4285	5970	1860	3636	5971	1860	3892	1260	1636	2896	9236	22961
JUN	6032	3156	4854	5921	2839	4124	6032	2839	4437	1495	1699	3194	10307	23472
JUL	6116	3453	5341	6242	3284	4865	6242	3284	5071	1720	2053	3773	10460	23472
AUG	6588	3784	5418	6276	2956	5021	6588	2956	5178	1593	2260	3852	10868	23472
SEP	5952	2263	4549	5830	2208	3997	5952	2208	4233	1401	1647	3048	9236	20920
OCT	6269	2984	5229	6150	2653	4922	6269	2653	5049	1611	2146	3757	9644	20920
NOV	7063	4542	6075	7089	3680	6013	7089	3680	6037	1701	2646	4347	9389	20920
DEC	7543	5958	6803	7480	5903	6710	7543	5903	6748	2095	2925	5021	9236	20920
TOTAL	7680	2263	5500	7706	1860	5223	7706	1860	5337	19789	26963	46752	113431	23472
OCT-MAR	7680	2984	6186	7706	2653	6125	7706	2653	6150	10999	15863	26863	54344	20920
APR-SEP	6588	2263	4829	6375	1860	4316	6588	1860	4528	8790	11100	19889	59087	23472
NOV-APR	7680	2325	6071	7706	1922	6016	7706	1922	6039	10710	15522	26232	53680	20920
MAY-OCT	6588	2263	4950	6276	1860	4431	6588	1860	4647	9079	11441	20520	59751	23472
1984														
JAN	7680	6068	6810	7706	6071	6761	7706	6068	6780	2002	3042	5045	9236	20920
FEB	6965	4667	6226	6955	4987	6276	6965	4667	6256	1743	2611	4354	7603	20410
MAR	6802	3246	6056	6717	3563	6025	6802	3246	6038	1950	2542	4492	9236	20410
APR	6375	2325	4627	6267	1922	4145	6375	1922	4342	1360	1766	3126	8980	20920
MAY	5971	2398	4464	5850	1860	3547	5971	1860	3892	1250	1646	2896	9236	22961
JUN	6032	3156	4958	5921	2839	4047	6032	2839	4437	1527	1667	3194	10307	23472
JUL	6116	3453	5422	6242	3284	4842	6242	3284	5071	1594	2179	3773	10460	23472
AUG	6588	3784	5496	6246	2956	4953	6588	2956	5178	1693	2160	3852	10868	23472
SEP	5952	2263	4753	5798	2208	3874	5952	2208	4233	1397	1650	3048	9236	20920
OCT	6269	3539	5256	6150	2653	4924	6269	2653	5049	1472	2285	3757	9644	20920
NOV	7089	4022	6059	6870	3680	6022	7089	3680	6037	1781	2566	4347	9389	20920
DEC	7543	5999	6907	7369	5903	6636	7543	5903	6748	2127	2893	5021	9236	20920
TOTAL	7680	2263	5595	7706	1860	5166	7706	1860	5340	19897	27007	46904	113431	23472
OCT-MAR	7680	3246	6229	7706	2653	6098	7706	2653	6151	11076	15940	27015	54344	20920
APR-SEP	6588	2263	4961	6267	1860	4234	6588	1860	4528	8821	11068	19889	59087	23472
NOV-APR	7680	2325	6118	7706	1922	5986	7706	1922	6040	10964	15420	26385	53680	20920
MAY-OCT	6588	2263	5064	6246	1860	4369	6588	1860	4647	8933	11587	20520	59751	23472

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ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 1

YEAR-MONTH	KILOWATT PRODUCTION: ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION: ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER: KWHRS (X1000)	DEMAND (KW)
1985														
JAN	7680	6068	6810	7706	6071	6761	7706	6068	6780	2002	3042	5045	9236	20920
FEB	6965	4667	6226	6955	4987	6271	6965	4667	6252	1743	2458	4201	7603	20410
MAR	6741	3246	5996	6802	3563	6068	6802	3246	6038	1847	2646	4492	9236	20410
APR	6223	2325	4494	6375	1922	4237	6375	1922	4342	1321	1805	3126	8980	20920
MAY	5971	2270	4285	5970	1860	3636	5971	1860	3892	1260	1636	2896	9236	22961
JUN	6032	3156	4854	5921	2839	4124	6032	2839	4437	1495	1699	3194	10307	23472
JUL	6116	3453	5341	6242	3284	4865	6242	3284	5071	1720	2053	3773	10460	23472
AUG	6588	3784	5418	6276	2956	5021	6588	2956	5178	1593	2260	3852	10868	23472
SEP	5952	2263	4549	5830	2208	3997	5952	2208	4233	1401	1647	3048	9236	20920
OCT	6269	2984	5229	6150	2653	4922	6269	2653	5049	1611	2146	3757	9644	20920
NOV	7063	4542	6075	7080	3680	6013	7080	3680	6037	1701	2646	4347	9389	20920
DEC	7543	5958	6803	7480	5903	6710	7543	5903	6748	2095	2925	5021	9236	20920
TOTAL	7680	2263	5500	7706	1860	5223	7706	1860	5337	19789	26963	46752	113431	23472
OCT-MAR	7680	2984	6186	7706	2653	6125	7706	2653	6150	10999	15863	20863	54344	20920
APR-SEP	6588	2263	4829	6375	1860	4316	6588	1860	4528	8790	11100	19889	59087	23472
NOV-APR	7680	2325	6071	7706	1922	6016	7706	1922	6039	10710	15522	26232	53680	20920
MAY-OCT	6588	2263	4950	6276	1860	4431	6588	1860	4647	9079	11441	20520	59751	23472

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 2

YEAR-MONTH	KILOWATT PRODUCTION ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER KWHRS (X1000)	DEMAND (KW)
1981														
JAN	8462	6938	7641	8491	6940	7595	8491	6938	7613	2246	3418	5664	8694	19694
FEB	7783	4305	6960	7773	4622	7011	7783	4305	6989	1945	2748	4697	7157	19214
MAR	7578	2973	6584	7631	2291	6722	7631	2973	6663	2028	2931	4959	8694	19214
APR	7087	2084	4287	7232	1711	4092	7232	1711	4172	1260	1743	3004	8454	19694
MAY	6446	2060	3985	6467	1649	3345	6467	1649	3598	1172	1505	2677	8694	21616
JUN	6850	2881	4511	6205	2567	3805	6850	2567	4107	1389	1568	2957	9703	22096
JUL	6985	3149	5147	7105	3008	4625	7105	3008	4851	1657	1952	3609	9847	22096
AUG	7434	3480	5414	7137	2684	4869	7434	2684	5084	1592	2191	3783	10231	22096
SEP	6374	2022	4234	5729	1967	3677	6374	1967	3915	1304	1515	2819	8694	19694
OCT	7133	2711	5193	7020	2408	4783	7133	2408	4953	1595	2085	3685	9079	19694
NOV	7879	4180	6622	7900	3377	6562	7900	3377	6585	1854	2887	4742	8838	19694
DEC	8331	6625	7631	8269	6349	7543	8331	6349	7579	2350	3289	5639	8694	19694
TOTAL	8462	2022	5670	8491	1649	5392	8491	1649	5506	20401	27832	48233	106779	22096
OCT-MAR	8462	2711	6764	8491	2408	6702	8491	2408	6727	12027	17358	29385	61156	19694
APR-SEP	7434	2022	4601	7232	1649	4072	7434	1649	4292	8374	10474	18848	55623	22096
NOV-APR	8462	2084	6626	8491	1711	6595	8491	1711	6608	11688	17016	28704	50531	19694
MAY-OCT	7434	2022	4751	7137	1649	4189	7434	1649	4422	8713	10816	19529	56248	22096
1982														
JAN	8662	7033	7773	8668	7036	7724	8668	7033	7744	2285	3476	5761	9236	20920
FEB	7928	4639	7104	7918	4960	7175	7928	4639	7146	1985	2813	4802	7603	20410
MAR	7706	3218	6780	7764	3536	6914	7764	3218	6858	2088	3014	5103	9236	20410
APR	7186	2298	4610	7337	1894	4379	7337	1894	4473	1355	1866	3221	8980	20920
MAY	6908	2242	4305	6929	1832	3631	6929	1832	3897	1266	1634	2900	9236	22961
JUN	6998	3156	4863	6653	2812	4121	6998	2812	4439	1498	1698	3196	10307	23472
JUL	7081	3425	5531	7207	3284	4968	7207	3284	5212	1781	2096	3877	10460	23472
AUG	7553	3756	5747	7241	2929	5204	7553	2929	5418	1690	2342	4031	10868	23472
SEP	6836	2263	4572	6160	2181	3987	6836	2181	4237	1408	1643	3051	9236	20920
OCT	7232	2956	5533	7113	2653	5123	7232	2653	5292	1704	2233	3938	9644	20920
NOV	8025	4515	6865	8051	3653	6801	8051	3653	6826	1922	2992	4915	9389	20920
DEC	8506	6924	7767	8440	6808	7672	8506	6808	7711	2392	3345	5737	9236	20920
TOTAL	8662	2242	5942	8668	1832	5647	8668	1832	5768	21375	29152	50531	113431	23472
OCT-MAR	8662	2956	6964	8668	2653	6901	8668	2653	6927	12381	17874	30255	54344	20920
APR-SEP	7553	2242	4944	7337	1832	4385	7553	1832	4617	8998	11278	20276	59087	23472
NOV-APR	8662	2298	6821	8668	1894	6785	8668	1894	6800	12032	17506	29539	53680	20920
MAY-OCT	7553	2242	5096	7241	1832	4510	7553	1832	4754	9346	11646	20992	59751	23472

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 2

YEAR-MONTH	KILOWATT PRODUCTION ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER KWHRS (X1000)	DEMAND (KW)
1983														
JAN	8647	7036	7777	8673	7039	7729	8673	7036	7748	2287	3478	5764	9236	20920
FEB	7933	4567	7111	7923	4987	7182	7933	4667	7153	1991	2815	4807	7603	20410
MAR	7709	3246	6793	7770	3563	6925	7770	3246	5871	2092	3019	5113	9236	20410
APR	7191	2325	4655	7342	1922	4399	7342	1922	4495	1363	1874	3237	8980	20920
MAY	6908	2270	4325	6938	1860	3649	6938	1860	3916	1271	1642	2914	9236	22961
JUN	7000	3156	4885	6681	2839	4137	7000	2839	4457	1504	1704	3209	10307	23472
JUL	7084	3453	5553	7210	3284	4979	7210	3284	5228	1788	2101	3889	10460	23472
AUG	7556	3784	5765	7244	2956	5224	7556	2956	5438	1695	2351	4046	10868	23472
SEP	6863	2263	4592	6188	2208	4004	6863	2208	4256	1414	1650	3064	9236	20920
OCT	7237	2984	5554	7118	2653	5143	7237	2653	5313	1711	2243	3953	9644	20920
NOV	8030	4542	6879	8056	3680	6812	8056	3680	6838	1926	2997	4923	9389	20920
DEC	8511	6926	7771	8448	6836	7677	8511	6836	7716	2393	3347	5741	9236	20920
TOTAL	8647	2263	5958	8673	1860	5661	8673	1860	5783	21436	29223	50659	113431	23472
OCT-MAR	8647	2984	6974	8673	2653	6911	8673	2653	6937	12400	17900	30300	54344	20920
APR-SEP	7556	2263	4965	7342	1860	4402	7556	1860	4635	9036	11323	20359	59087	23472
NOV-APR	8647	2325	6832	8673	1922	6795	8673	1922	6810	12052	17532	29584	53680	20920
MAY-OCT	7556	2263	5117	7244	1860	4528	7556	1860	4772	9384	11691	21075	59751	23472
1984														
JAN	8647	7036	7777	8673	7039	7729	8673	7036	7748	2287	3478	5764	9236	20920
FEB	7933	4667	7111	7923	4987	7191	7933	4667	7159	1991	2991	4983	7603	20410
MAR	7770	3246	6887	7684	3563	6858	7770	3246	6871	2218	2894	5112	9236	20410
APR	7342	2325	4792	7234	1922	4291	7342	1922	4495	1409	1828	3237	8980	20920
MAY	6938	2398	4524	6332	1860	3550	6938	1860	3916	1267	1647	2914	9236	22961
JUN	7000	3156	4990	6681	2839	4058	7000	2839	4457	1537	1672	3209	10307	23472
JUL	7084	3453	5681	7210	3284	4931	7210	3284	5228	1670	2219	3889	10460	23472
AUG	7556	3784	5890	7214	2956	5119	7556	2956	5438	1814	2232	4046	10868	23472
SEP	6863	2263	4804	6005	2208	3877	6863	2208	4256	1412	1652	3064	9236	20920
OCT	7237	3539	5613	7118	2653	5133	7237	2653	5313	1572	2382	3953	9644	20920
NOV	8056	4022	6858	7838	3680	6824	8056	3680	6838	2016	2907	4923	9389	20920
DEC	8511	6967	7874	8336	6836	7604	8511	6836	7716	2425	3315	5741	9236	20920
TOTAL	8647	2263	6079	8673	1860	5589	8673	1860	5787	21618	29217	50835	113431	23472
OCT-MAR	8647	3246	7035	8673	2653	6874	8673	2653	6939	12509	17968	30476	54344	20920
APR-SEP	7556	2263	5123	7234	1860	4303	7556	1860	4635	9109	11249	20359	59087	23472
NOV-APR	8647	2325	6889	8673	1922	6760	8673	1922	6813	12346	17414	29760	53680	20920
MAY-OCT	7556	2263	5256	7214	1860	4451	7556	1860	4772	9272	11803	21075	59751	23472

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ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 2

YEAR-MONTH	KILOWATT PRODUCTION ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER KWHRS (X1000)	DEMAND (KW)
1985														
JAN	8647	7036	7777	8673	7039	7729	8673	7036	7748	2287	3478	5764	9236	20920
FEB	7933	4667	7111	7923	4987	7182	7933	4667	7153	1991	2815	4807	7603	20410
MAR	7709	3246	6793	7770	3563	6925	7770	3246	6871	2092	3019	5112	9236	20410
APR	7191	2325	4635	7342	1922	4399	7342	1922	4495	1363	1874	3237	8980	20920
MAY	6908	2270	4325	6938	1860	3649	6938	1860	3916	1271	1642	2914	9236	22961
JUN	7000	3156	4885	6681	2839	4137	7000	2839	4457	1504	1704	3209	10307	23472
JUL	7084	3453	5553	7210	3284	4979	7210	3284	5228	1788	2101	3889	10460	23472
AUG	7556	3784	5765	7244	2956	5224	7556	2956	5438	1695	2351	4046	10868	23472
SEP	6863	2263	4592	6188	2208	4004	6863	2208	4256	1414	1650	3064	9236	20920
OCT	7237	2984	5554	7118	2653	5143	7237	2653	5313	1711	2243	3953	9644	20920
NOV	8030	4542	6879	8056	3680	6812	8056	3680	6838	1926	2997	4923	9389	20920
DEC	8511	6926	7771	8448	6836	7677	8511	6836	7716	2393	3347	5741	9236	20920
TOTAL	8647	2263	5956	8673	1860	5661	8673	1860	5783	21436	29223	50659	113431	23472
OCT-MAR	8647	2984	6974	8673	2653	6911	8673	2653	6937	12400	17900	30300	54344	20920
APR-SEP	7556	2263	4965	7342	1860	4402	7556	1860	4635	9036	11323	20359	59087	23472
NOV-APR	8647	2325	6832	8673	1922	6795	8673	1922	6810	12052	17532	29584	53680	20920
MAY-OCT	7556	2263	5117	7244	1860	4528	7556	1860	4772	9384	11691	21075	59751	23472

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 3

YEAR-MONTH	KILOWATT PRODUCTION: ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION: ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER: KWHRS (X1000)	DEMAND (KW)
1981														
JAN	9876	7515	8601	9915	7518	8531	9915	7515	8559	2529	3839	6368	8694	19694
FEB	8618	4602	7497	8605	4942	7559	8618	4602	7533	2099	2963	5062	7157	19214
MAR	8101	3114	6911	8173	3446	7044	8173	3114	6989	2129	3071	5200	8694	19214
APR	7445	2207	4490	7643	1819	4291	7643	1819	4372	1320	1828	3148	8454	19694
MAY	7256	2359	4514	7270	1925	3808	7270	1925	4087	1327	1714	3041	8694	21616
JUN	7914	3435	5287	7200	3073	4487	7914	3073	4829	1629	1849	3477	9703	22096
JUL	8398	3909	6279	8649	3762	5666	8649	3762	5931	2022	2391	4413	9847	22096
AUG	9389	4318	6608	8751	3384	5964	9389	3384	6219	1943	2684	4627	10231	22096
SEP	7616	2559	5119	6871	2504	4475	7616	2504	4751	1577	1844	3420	8694	19694
OCT	7671	2936	5555	7506	2618	5122	7671	2618	5301	1711	2233	3944	9079	19694
NOV	8763	4470	7105	8791	3634	7042	8791	3634	7066	1989	3098	5088	8838	19694
DEC	9521	7113	8476	9423	6820	8343	9521	6820	8398	2611	3638	6248	8694	19694
TOTAL	9876	2207	6360	9915	1819	6035	9915	1819	6168	22884	31151	54035	106779	22096
OCT-MAR	9876	2936	7350	9915	2618	7275	9915	2618	7305	13067	18842	31910	51156	19694
APR-SEP	9389	2207	5394	8751	1819	4786	9389	1819	5038	9817	12309	22126	55623	22096
NOV-APR	9876	2207	7186	9915	1819	7146	9915	1819	7162	12677	18437	31114	50531	19694
MAY-OCT	9389	2359	5566	8751	1925	4924	9389	1925	5191	10208	12714	22922	56248	22096
1982														
JAN	10154	7662	8805	10190	7665	8731	10190	7662	8760	2589	3929	6517	9236	20920
FEB	8830	4953	7684	8817	5299	7766	8830	4953	7732	2152	3044	5196	7603	20410
MAR	8275	3367	7135	8354	3700	7263	8354	3367	7210	2198	3167	5364	9236	20410
APR	7580	2428	4825	7786	2008	4590	7786	2008	4686	1419	1955	3374	8980	20920
MAY	7742	2558	4866	7733	2125	4121	7742	2125	4415	1431	1854	3285	9236	22961
JUN	8081	3746	5684	7723	3349	4844	8081	3349	5203	1751	1996	3746	10307	23472
JUL	8596	4231	6726	8859	4084	6068	8859	4084	6353	2166	2561	4727	10460	23472
AUG	9640	4641	7009	8969	3671	6361	9640	3671	6617	2061	2862	4923	10868	23472
SEP	8150	2832	5509	7371	2749	4832	8150	2749	5122	1697	1991	3688	9236	20920
OCT	7815	3194	5916	7642	2876	5481	7815	2876	5661	1822	2390	4212	9644	20920
NOV	8976	4822	7381	9011	3925	7313	9011	3925	7340	2067	3218	5285	9389	20920
DEC	9781	7416	8676	9678	7306	8535	9781	7306	8593	2672	3721	6393	9236	20920
TOTAL	10154	2428	6677	10190	2008	6332	10190	2008	6474	24022	32688	56710	113431	23472
OCT-MAR	10154	3194	7592	10190	2876	7517	10190	2876	7548	13495	19469	32968	54344	20920
APR-SEP	9640	2428	5782	8969	2008	5140	9640	2008	5406	10523	13219	23742	59087	23472
NOV-APR	10154	2428	7424	10190	2008	7378	10190	2008	7396	13095	19034	32130	53680	20920
MAY-OCT	9640	2558	5958	8969	2125	5288	9640	2125	5566	10927	13654	24580	59751	23472

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 3

YEAR-MONTH	KILOWATT PRODUCTION: ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION: ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER: KWHRS (X1000)	DEMAND (KW)
1983														
JAN	10161	7665	8811	10197	7669	8736	10197	7665	8766	2590	3931	6522	9236	20920
FEB	8837	4981	7692	8824	5326	7775	8837	4981	7740	2154	3048	5202	7603	20410
MAR	8278	3395	7149	8361	3727	7276	8361	3395	7224	2202	3172	5374	9236	20410
APR	7587	2456	4850	7793	2035	4611	7793	2035	4708	1426	1964	3390	8980	20920
MAY	7742	2586	4885	7737	2152	4140	7742	2152	4434	1436	1863	3299	9236	22961
JUN	8084	3746	5706	7751	3376	4859	8084	3376	5221	1756	2002	3759	10307	23472
JUL	8599	4258	6747	8863	4084	6080	8863	4084	6369	2172	2566	4738	10460	23472
AUG	9643	4669	7025	8972	3698	6381	9643	3698	6636	2065	2872	4937	10868	23472
SEP	8154	2832	5529	7398	2777	4849	8154	2777	5140	1703	1998	3701	9236	20920
OCT	7822	3222	5938	7649	2876	5502	7822	2876	5682	1829	2399	4228	9644	20920
NOV	8983	4849	7396	9018	3953	7325	9018	3953	7353	2071	3223	5294	9389	20920
DEC	9788	7420	8682	9688	7334	8541	9788	7334	8599	2674	3724	6398	9236	20920
TOTAL	10161	2456	6693	10197	2035	6347	10197	2035	6489	24081	32761	56842	113431	23472
OCT-MAR	10161	3222	7604	10197	2876	7528	10197	2876	7559	13520	19497	33017	54344	20920
APR-SEP	9643	2456	5803	8972	2035	5157	9643	2035	5425	10561	13264	23825	59087	23472
NOV-APR	10161	2456	7436	10197	2035	7389	10197	2035	7408	13117	19063	32180	53680	20920
MAY-OCT	9643	2586	5978	8972	2152	5306	9643	2152	5585	10964	13699	24662	59751	23472
1984														
JAN	10161	7665	8811	10197	7669	8736	10197	7665	8766	2590	3931	6522	9236	20920
FEB	8837	4981	7692	8824	5326	7786	8837	4981	7748	2154	3239	5393	7603	20410
MAR	8361	3395	7248	8245	3727	7205	8361	3395	7224	2334	3041	5374	9236	20410
APR	7793	2456	5018	7646	2035	4494	7793	2035	4708	1475	1915	3390	8980	20920
MAY	7742	2751	5106	7112	2152	4029	7742	2152	4434	1430	1869	3299	9236	22961
JUN	8084	3746	5826	7751	3376	4770	8084	3376	5221	1794	1965	3759	10307	23472
JUL	8599	4258	6898	8863	4084	6023	8863	4084	6369	2028	2710	4738	10460	23472
AUG	9643	4669	7177	8923	3698	6254	9643	3698	6636	2211	2727	4937	10868	23472
SEP	8154	2832	5774	7189	2777	4703	8154	2777	5140	1697	2003	3701	9236	20920
OCT	7822	3810	6002	7649	2876	5490	7822	2876	5682	1681	2547	4228	9644	20920
NOV	9018	4315	7387	8701	3953	7329	9018	3953	7353	2172	3122	5294	9389	20920
DEC	9788	7481	8837	9528	7334	8432	9788	7334	8599	2722	3676	6398	9236	20920
TOTAL	10161	2456	6830	10197	2035	6264	10197	2035	6493	24287	32746	57033	113431	23472
OCT-MAR	10161	3395	7678	10197	2876	7481	10197	2876	7561	13652	19556	33209	54344	20920
APR-SEP	9643	2456	5982	8923	2035	5046	9643	2035	5425	10635	13189	23825	59087	23472
NOV-APR	10161	2456	7504	10197	2035	7346	10197	2035	7411	13447	18924	32371	53680	20920
MAY-OCT	9643	2751	6145	8923	2152	5212	9643	2152	5585	10840	13822	24662	59751	23472

78/02/20.

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION 3

YEAR-MONTH	KILOWATT PRODUCTION ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER KWHRS (X1000)	DEMAND (KW)
1985														
JAN	10161	7665	8811	10197	7669	8736	10197	7665	8766	2598	3931	6522	9236	20920
FEB	8837	4981	7692	8824	5326	7775	8837	4981	7740	2154	3048	5202	7603	20410
MAR	8278	3395	7149	8361	3727	7276	8361	3395	7224	2202	3172	5374	9236	20410
APR	7587	2456	4850	7793	2035	4611	7793	2035	4708	1426	1964	3390	8980	20920
MAY	7742	2586	4885	7737	2152	4140	7742	2152	4434	1436	1863	3299	9236	22961
JUN	8084	3746	5706	7751	3376	4859	8084	3376	5221	1758	2002	3759	10307	23472
JUL	8599	4258	6747	8863	4084	6080	8863	4084	6369	2172	2566	4738	10460	23472
AUG	9643	4669	7025	8972	3698	6381	9643	3698	6636	2065	2872	4937	10868	23472
SEP	8154	2832	5529	7398	2777	4849	8154	2777	5140	1703	1998	3701	9236	20920
OCT	7822	3222	5938	7649	2876	5502	7822	2876	5682	1829	2399	4228	9644	20920
NOV	8983	4849	7396	9018	3953	7325	9018	3953	7353	2071	3223	5294	9389	20920
DEC	9788	7420	8682	9688	7334	8541	9788	7334	8599	2674	3724	6398	9236	20920
TOTAL	10161	2456	6693	10197	2035	6347	10197	2035	6489	24081	32761	56842	113431	23472
OCT-MAR	10161	3222	7604	10197	2876	7528	10197	2876	7559	13520	19497	33017	54344	20920
APR-SEP	9643	2456	5803	8972	2035	5157	9643	2035	5425	10561	13264	23825	59087	23472
NOV-APR	10161	2456	7436	10197	2035	7389	10197	2035	7408	13117	19063	32180	53680	20920
MAY-OCT	9643	2586	5978	8972	2152	5306	9643	2152	5585	10964	13699	24662	59751	23472

ELECTRIC PRODUCTION - S.E. STEAM PLANT
ANNUAL SUMMARY

YEAR	KILOWATT PRODUCTION: ON PEAK PEAK (KW)	ON PEAK MIN. (KW)	ON PEAK AVG. (KW)	OFF PEAK PEAK (KW)	OFF PEAK MIN. (KW)	OFF PEAK AVG. (KW)	TOTAL PEAK (KW)	TOTAL MIN. (KW)	TOTAL AVG. (KW)	KILOWATTHOUR PRODUCTION: ON PEAK (X1000)	OFF PEAK (X1000)	TOTAL (X1000)	EAST BANK PURCHASED POWER: KWHRS (X1000)	DEMAND (KW)
BASIC PLAN														
1981	7332	1177	4783	7332	960	4525	7332	960	4631	17209	23356	40566	106779	22096
1982	7502	1332	5026	7502	1115	4756	7502	1115	4867	18083	24553	42636	113431	23472
1983	7502	1332	5026	7502	1115	4756	7502	1115	4867	18083	24553	42636	113431	23472
1984	7502	1581	5144	7502	1115	4685	7502	1115	4871	18291	24495	42786	113431	23472
1985	7502	1332	5026	7502	1115	4756	7502	1115	4867	18083	26553	42636	113431	23472
OPTION 1														
1981	7494	2022	5272	7523	1649	4999	7523	1649	5111	18969	25806	44775	106779	22096
1982	7674	2242	5488	7700	1832	5213	7700	1832	5326	19746	26907	46653	113431	23472
1983	7680	2263	5500	7706	1860	5223	7706	1860	5337	19789	26963	46752	113431	23472
1984	7680	2263	5595	7706	1860	5166	7706	1860	5340	19897	27007	46904	113431	23472
1985	7680	2263	5500	7706	1860	5223	7706	1860	5337	19789	26963	46752	113431	23472
OPTION 2														
1981	8462	2022	5670	8491	1649	5392	8491	1649	5506	20401	27832	48233	106779	22096
1982	8642	2242	5942	8668	1832	5647	8668	1832	5768	21379	29152	50531	113431	23472
1983	8647	2263	5958	8673	1860	5661	8673	1860	5783	21436	29223	50659	113431	23472
1984	8647	2263	6079	8673	1860	5589	8673	1860	5787	21618	29217	50835	113431	23472
1985	8647	2263	5958	8673	1860	5661	8673	1860	5783	21436	29223	50659	113431	23472
OPTION 3														
1981	9876	2207	6360	9915	1819	6035	9915	1819	6168	22884	31151	54035	106779	22096
1982	10154	2428	6677	10190	2008	6332	10190	2008	6474	24022	32688	56710	113431	23472
1983	10161	2456	6693	10197	2035	6347	10197	2035	6489	24081	32761	56842	113431	23472
1984	10161	2456	6830	10197	2035	6264	10197	2035	6493	24287	32746	57033	113431	23472
1985	10161	2456	6693	10197	2035	6347	10197	2035	6489	24081	32761	56842	113431	23472

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION SUMMARY BY MONTH

MONTH	PEAK KILOWATTS BASIC PLAN	PEAK KILOWATTS OPTION 1	PEAK KILOWATTS OPTION 2	PEAK KILOWATTS OPTION 3	MINIMUM KILOWATTS BASIC PLAN	MINIMUM KILOWATTS OPTION 1	MINIMUM KILOWATTS OPTION 2	MINIMUM KILOWATTS OPTION 3	AVERAGE KILOWATTS BASIC PLAN	AVERAGE KILOWATTS OPTION 1	AVERAGE KILOWATTS OPTION 2	AVERAGE KILOWATTS OPTION 3	KILOWATTHOURS(X1000) BASIC PLAN	KILOWATTHOURS(X1000) OPTION 1	KILOWATTHOURS(X1000) OPTION 2	KILOWATTHOURS(X1000) OPTION 3
1981																
JAN	7332	7523	8491	9915	5858	5970	6938	7515	6500	6646	7613	8559	4836	4944	5664	6368
FEB	6654	6815	7783	8618	3257	4305	4305	4602	5883	6132	6989	7533	3953	4121	4697	5062
MAR	6502	6663	7631	8173	1953	2973	2973	3114	5502	5911	6665	6989	4093	4398	4959	5200
APR	6145	6265	7232	7643	1022	1711	1711	1819	3257	4068	4172	4372	2345	2929	3004	3148
MAY	5835	5887	6467	7270	960	1649	1649	1925	2930	3592	3598	4087	2180	2673	2677	3041
JUN	5876	5940	6850	7914	2015	2567	2567	3073	3545	4101	4107	4829	2552	2953	2957	3477
JUL	6080	6138	7105	8649	2512	3008	3008	3762	4273	4765	4851	5931	3179	3545	3609	4413
AUG	6390	6466	7434	9389	2077	2684	2684	3384	4316	4908	5084	6219	3211	3651	3783	4627
SEP	5739	5865	6374	7616	1581	1967	1967	2504	3338	3908	3915	4751	2403	2813	2819	3420
OCT	6045	6165	7133	7671	1829	2408	2408	2618	4092	4799	4953	5301	3045	3570	3685	3944
NOV	6771	6933	7900	8791	2605	3377	3377	3634	5498	5911	6585	7066	3958	4256	4742	5088
DEC	7186	7364	8331	9521	5274	5819	6349	6820	6463	6615	7579	8398	4809	4922	5639	6248
TOTAL	7332	7523	8491	9915	960	1649	1649	1819	4631	5111	5506	6168	40566	44775	48233	54035
1982																
JAN	7502	7700	8668	10190	5946	6066	7033	7662	6623	6776	7744	8760	4928	5041	5761	6517
FEB	6788	6960	7928	8830	3536	4639	4639	4953	6033	6247	7146	7732	4054	4190	4802	5196
MAR	6625	6797	7764	8354	2170	3216	3218	3367	5694	6032	6858	7210	4237	4488	5103	5364
APR	6244	6369	7337	7786	1177	1894	1894	2008	3519	4323	4473	4686	2534	3113	3221	3374
MAY	5917	5971	6929	7742	1115	1832	1832	2125	3197	3875	3897	4415	2378	2883	2900	3285
JUN	5963	6030	6998	8081	2232	2812	2812	3349	3846	4420	4439	5203	2769	3182	3196	3746
JUL	6180	6240	7207	8859	2760	3284	3284	4084	4581	5059	5212	6353	3408	3764	3877	4727
AUG	6507	6586	7553	9640	2294	2929	2929	3671	4606	5164	5418	6617	3427	3842	4031	4923
SEP	5887	5950	6836	8150	1767	2181	2181	2749	3625	4216	4237	5122	2610	3035	3051	3688
OCT	6139	6264	7232	7815	2046	2653	2653	2876	4396	5036	5292	5661	3271	3747	3938	4212
NOV	6911	7083	8051	9011	2853	3653	3653	3925	5721	6032	6826	7340	4119	4343	4915	5285
DEC	7350	7538	8506	9781	5677	5901	6808	7306	6589	6744	7711	8593	4902	5017	5737	6393
TOTAL	7502	7700	8668	10190	1115	1832	1832	2008	4867	5326	5768	6474	42636	46653	50531	56710
1983																
JAN	7502	7706	8673	10197	5946	6068	7036	7665	6623	6780	7748	8766	4928	5045	5764	6522
FEB	6788	6965	7933	8837	3536	4667	4667	4981	6033	6252	7153	7740	4054	4201	4807	5202
MAR	6625	6802	7770	8361	2170	3246	3246	3395	5694	6038	6871	7226	4237	4492	5112	5374
APR	6244	6375	7342	7793	1177	1922	1922	2035	3519	4342	4495	4708	2534	3126	3237	3390
MAY	5917	5971	6938	7742	1115	1860	1860	2152	3197	3892	3916	4434	2378	2896	2914	3299
JUN	5963	6032	7000	8084	2232	2839	2839	3376	3846	4437	4457	5221	2769	3194	3209	3759
JUL	6180	6242	7210	8863	2760	3284	3284	4084	4581	5071	5228	6369	3408	3773	3889	4738
AUG	6507	6588	7556	9643	2294	2956	2956	3698	4606	5178	5438	6636	3427	3852	4046	4937
SEP	5887	5952	6863	8154	1767	2208	2208	2777	3625	4233	4256	5140	2610	3040	3064	3701
OCT	6139	6269	7237	7822	2046	2653	2653	2876	4396	5049	5313	5682	3271	3757	3953	4228
NOV	6911	7089	8056	9018	2853	3680	3680	3953	5721	6037	6838	7353	4119	4347	4923	5294
DEC	7350	7543	8511	9788	5677	5903	6836	7334	6589	6748	7716	8599	4902	5021	5741	6398
TOTAL	7502	7706	8673	10197	1115	1860	1860	2035	4867	5337	5783	6489	42636	46752	50659	56842

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION SUMMARY BY MONTH

MONTH	PEAK KILOWATTS BASIC PLAN	PEAK KILOWATTS OPTION 1	PEAK KILOWATTS OPTION 2	PEAK KILOWATTS OPTION 3	MINIMUM KILOWATTS BASIC PLAN	MINIMUM KILOWATTS OPTION 1	MINIMUM KILOWATTS OPTION 2	MINIMUM KILOWATTS OPTION 3	AVERAGE KILOWATTS BASIC PLAN	AVERAGE KILOWATTS OPTION 1	AVERAGE KILOWATTS OPTION 2	AVERAGE KILOWATTS OPTION 3	KILOWATTHOURS(X1000) BASIC PLAN	KILOWATTHOURS(X1000) OPTION 1	KILOWATTHOURS(X1000) OPTION 2	KILOWATTHOURS(X1000) OPTION 3
1984																
JAN	7502	7706	8673	10197	5946	6068	7036	7665	6623	6780	7748	8766	4928	5045	5764	6522
FEB	6788	6965	7933	8837	3536	4667	4667	4981	6040	6256	7159	7748	4204	4354	4983	5393
MAR	6625	6802	7770	8361	2170	3246	3246	3395	5694	6038	6871	7224	4237	4492	5112	5374
APR	6244	6375	7342	7793	1177	1922	1922	2035	3519	4342	4495	4708	2534	3126	3237	3390
MAY	5917	5971	6938	7742	1115	1860	1860	2152	3197	3892	3916	4434	2378	2896	2914	3299
JUN	5963	6032	7000	8084	2232	2839	2839	3376	3846	4437	4457	5221	2769	3194	3209	3759
JUL	6180	6242	7210	8863	2760	3284	3284	4084	4581	5071	5228	6369	3408	3773	3889	4738
AUG	6507	6588	7556	9643	2294	2956	2956	3698	4606	5178	5438	6636	3427	3852	4046	4937
SEP	5887	5952	6863	8154	1767	2208	2208	2777	3625	4233	4256	5140	2610	3048	3064	3701
OCT	6139	6269	7237	7822	2046	2653	2653	2876	4396	5049	5313	5682	3271	3757	3953	4228
NOV	6911	7089	8056	9018	2853	3680	3680	3953	5721	6037	6838	7353	4119	4347	4923	5294
DEC	7350	7543	8511	9788	5677	5903	6836	7334	6589	6748	7716	8599	4902	5021	5741	6398
TOTAL	7502	7706	8673	10197	1115	1860	1860	2035	4871	5340	5787	6493	42786	46904	50835	57033
1985																
JAN	7502	7706	8673	10197	5946	6068	7036	7665	6623	6780	7748	8766	4928	5045	5764	6522
FEB	6788	6965	7933	8837	3536	4667	4667	4981	6033	6252	7153	7740	4054	4201	4807	5202
MAR	6625	6802	7770	8361	2170	3246	3246	3395	5694	6038	6871	7224	4237	4492	5112	5374
APR	6244	6375	7342	7793	1177	1922	1922	2035	3519	4342	4495	4708	2534	3126	3237	3390
MAY	5917	5971	6938	7742	1115	1860	1860	2152	3197	3892	3916	4434	2378	2896	2914	3299
JUN	5963	6032	7000	8084	2232	2839	2839	3376	3846	4437	4457	5221	2769	3194	3209	3759
JUL	6180	6242	7210	8863	2760	3284	3284	4084	4581	5071	5228	6369	3408	3773	3889	4738
AUG	6507	6588	7556	9643	2294	2956	2956	3698	4606	5178	5438	6636	3427	3852	4046	4937
SEP	5887	5952	6863	8154	1767	2208	2208	2777	3625	4233	4256	5140	2610	3048	3064	3701
OCT	6139	6269	7237	7822	2046	2653	2653	2876	4396	5049	5313	5682	3271	3757	3953	4228
NOV	6911	7089	8056	9018	2853	3680	3680	3953	5721	6037	6838	7353	4119	4347	4923	5294
DEC	7350	7543	8511	9788	5677	5903	6836	7334	6589	6748	7716	8599	4902	5021	5741	6398
TOTAL	7502	7706	8673	10197	1115	1860	1860	2035	4867	5337	5783	6489	42636	46752	50659	56842

78/02/20.

ELECTRIC PRODUCTION - S.E. STEAM PLANT
OPTION SUMMARY BY YEAR

YEAR	PEAK KILOWATTS BASIC PLAN	PEAK KILOWATTS OPTION 1	PEAK KILOWATTS OPTION 2	PEAK KILOWATTS OPTION 3	MINIMUM KILOWATTS BASIC PLAN	MINIMUM KILOWATTS OPTION 1	MINIMUM KILOWATTS OPTION 2	MINIMUM KILOWATTS OPTION 3	AVERAGE KILOWATTS BASIC PLAN	AVERAGE KILOWATTS OPTION 1	AVERAGE KILOWATTS OPTION 2	AVERAGE KILOWATTS OPTION 3	KILOWATTHOURS(X1000) BASIC PLAN	KILOWATTHOURS(X1000) OPTION 1	KILOWATTHOURS(X1000) OPTION 2	KILOWATTHOURS(X1000) OPTION 3
1981	7332	7523	8491	9915	960	1649	1649	1819	4631	5111	5506	6168	40566	44775	48233	54035
1982	7502	7703	8668	10190	1115	1832	1832	2008	4867	5326	5768	6474	42636	46653	50531	56710
1983	7502	7706	8673	10197	1115	1860	1860	2035	4867	5337	5783	6489	42636	46752	50659	56842
1984	7502	7706	8673	10197	1115	1860	1860	2035	4871	5340	5787	6493	42786	46904	50835	57033
1985	7502	7706	8673	10197	1115	1860	1860	2035	4867	5337	5783	6489	42636	46752	50659	56842

ORID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
BASIC PLAN

MONTH	IN-PLANT CONSUMPTION SE STEAM (TONS)	U - PLANT (TONS)	NET TOTAL (TONS)	FUEL ALLOCATED TO COMMUNITY ELECT GEN (TONS)	UNIVERSITY (TONS)	ST. MARYS (TONS)	FAIRVIEW (TONS)	AUGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
				1981					
JAN	14463	6598	21061	1203	19858	0	0	0	0
FEB	12742	2143	14886	1004	13882	0	0	0	0
MAR	13554	1423	14977	1054	13923	0	0	0	0
APR	9140	56	9196	697	8499	0	0	0	0
MAY	8818	0	8818	672	8147	0	0	0	0
JUN	9694	2	9696	739	8957	0	0	0	0
JUL	11429	54	11483	872	10611	0	0	0	0
AUG	11692	164	11656	878	10778	0	0	0	0
SEP	9304	0	9304	709	8596	0	0	0	0
OCT	11078	48	11126	845	10281	0	0	0	0
NOV	13124	1300	14424	1020	13405	0	0	0	0
DEC	14451	6299	20750	1197	19552	0	0	0	0
TOTAL	139290	18087	157377	10888	146489	0	0	0	0
				1982					
JAN	14463	7792	22255	1221	21034	0	0	0	0
FEB	12861	2868	15729	1024	14706	0	0	0	0
MAR	13810	2018	15828	1083	14745	0	0	0	0
APR	9624	114	9737	735	9002	0	0	0	0
MAY	9337	4	9341	711	8630	0	0	0	0
JUN	10263	7	10270	782	9488	0	0	0	0
JUL	12013	146	12159	917	11242	0	0	0	0
AUG	12028	313	12341	921	11420	0	0	0	0
SEP	9845	9	9854	750	9104	0	0	0	0
OCT	11656	125	11781	890	10891	0	0	0	0
NOV	13443	1808	15252	1052	14200	0	0	0	0
DEC	14462	7463	21925	1216	20709	0	0	0	0
TOTAL	143805	22668	166473	11302	155170	0	0	0	0
				1983					
JAN	14463	7792	22255	1221	21034	0	0	0	0
FEB	12861	2868	15729	1024	14706	0	0	0	0
MAR	13810	2018	15828	1083	14745	0	0	0	0
APR	9624	114	9737	735	9002	0	0	0	0
MAY	9337	4	9341	711	8630	0	0	0	0
JUN	10263	7	10270	782	9488	0	0	0	0
JUL	12013	146	12159	917	11242	0	0	0	0
AUG	12028	313	12341	921	11420	0	0	0	0
SEP	9845	9	9854	750	9104	0	0	0	0
OCT	11656	125	11781	890	10891	0	0	0	0
NOV	13443	1808	15252	1052	14200	0	0	0	0
DEC	14462	7463	21925	1216	20709	0	0	0	0
TOTAL	143805	22668	166473	11302	155170	0	0	0	0

78/02/20.

GRID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
BASIC PLAN

MONTH	IN-PLANT CONSUMPTION SE STEAM (TONS)	U - PLANT (TONS)	NET TOTAL (TONS)	FUEL ALLOCATED TO COMMUNITY: ELECT GEN (TONS)	UNIVERSITY (TONS)	ST. MARYS (TONS)	FAIRVIEW (TONS)	AUGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
				1984					
JAN	14463	7792	22255	1221	21034	0	0	0	0
FEB	13528	3000	16328	1061	15266	0	0	0	0
MAR	13810	2018	15828	1083	14745	0	0	0	0
APR	9624	114	9737	735	9002	0	0	0	0
MAY	9337	4	9341	711	8630	0	0	0	0
JUN	10263	7	10270	782	9488	0	0	0	0
JUL	12013	146	12159	917	11242	0	0	0	0
AUG	12028	313	12341	921	11420	0	0	0	0
SEP	9845	9	9854	750	9104	0	0	0	0
OCT	11656	125	11781	890	10891	0	0	0	0
NOV	13443	1808	15252	1052	14200	0	0	0	0
DEC	14462	7463	21925	1216	20709	0	0	0	0
TOTAL	144271	22800	167071	11340	155731	0	0	0	0
				1985					
JAN	14463	7792	22255	1221	21034	0	0	0	0
FEB	12861	2868	15729	1024	14706	0	0	0	0
MAR	13810	2018	15828	1083	14745	0	0	0	0
APR	9624	114	9737	735	9002	0	0	0	0
MAY	9337	4	9341	711	8630	0	0	0	0
JUN	10263	7	10270	782	9488	0	0	0	0
JUL	12013	146	12159	917	11242	0	0	0	0
AUG	12028	313	12341	921	11420	0	0	0	0
SEP	9845	9	9854	750	9104	0	0	0	0
OCT	11656	125	11781	890	10891	0	0	0	0
NOV	13443	1808	15252	1052	14200	0	0	0	0
DEC	14462	7463	21925	1216	20709	0	0	0	0
TOTAL	143805	22668	166473	11302	155170	0	0	0	0

GRID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION 1

MONTH	---IN-PLANT CONSUMPTION--- SE STEAM (TONS)	U - PLANT (TONS)	NET TOTAL (TONS)	----------FUEL ALLOCATED TO COMMUNITY---------- ELECT GEN (TONS)	UNIVERSITY (TONS)	ST. MARYS (TONS)	FAIRVIEW (TONS)	AUGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
1981									
JAN	14463	9740	24203	1224	19856	1653	793	677	0
FEB	13006	4384	17390	1037	13880	1283	611	573	0
MAR	14226	3592	17818	1115	13921	1405	676	701	0
APR	10826	296	11123	814	8498	937	443	430	0
MAY	10259	13	10272	770	8146	710	348	298	0
JUN	10867	13	10880	819	8957	593	291	219	0
JUL	12486	207	12692	945	10611	607	302	228	0
AUG	12747	503	13249	966	10778	785	382	339	0
SEP	10504	17	10521	791	8595	619	301	215	0
OCT	12582	398	12981	950	10281	902	432	416	0
NOV	13819	3056	16875	1079	13403	1236	584	572	0
DEC	14463	9459	23922	1220	19551	1635	779	739	0
TOTAL	150247	31678	181926	11730	146478	12364	5947	5407	0
1982									
JAN	14463	11090	25553	1244	21033	1784	816	677	0
FEB	13035	5315	18351	1052	14704	1385	636	573	0
MAR	14296	4493	18789	1133	14744	1518	693	701	0
APR	11283	469	11752	851	9002	1011	459	430	0
MAY	10810	51	10861	812	8629	772	349	298	0
JUN	11469	44	11513	865	9488	648	293	219	0
JUL	13029	395	13424	989	11241	663	303	228	0
AUG	13194	802	13996	1006	11420	850	384	338	0
SEP	11086	47	11133	835	9103	672	308	215	0
OCT	12990	725	13714	985	10890	971	452	416	0
NOV	13886	3932	17818	1097	14198	1336	615	572	0
DEC	14463	10803	25266	1239	20707	1770	812	739	0
TOTAL	154005	38166	192171	12105	155159	13379	6121	5406	0
1983									
JAN	14463	11185	25648	1244	21032	1878	816	677	0
FEB	13037	5393	18430	1053	14704	1464	636	573	0
MAR	14301	4577	18878	1134	14744	1606	693	701	0
APR	11320	485	11806	853	9002	1061	459	430	0
MAY	10848	54	10903	815	8629	811	349	298	0
JUN	11504	47	11551	867	9488	684	293	219	0
JUL	13054	408	13462	990	11241	699	303	228	0
AUG	13223	822	14044	1006	11420	896	384	338	0
SEP	11123	49	11172	838	9103	708	308	215	0
OCT	13015	753	13768	987	10890	1023	452	416	0
NOV	13890	4004	17894	1097	14198	1411	615	572	0
DEC	14463	10900	25363	1239	20707	1866	812	739	0
TOTAL	154242	38676	192918	12125	155158	14107	6121	5406	0

GRID ICLS FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION 1

MONTH	---IN-PLANT CONSUMPTION---- SE STEAM (TONS)	U - PLANT (TONS)	NET TOTAL (TONS)	----------FUEL ALLOCATED TO COMMUNITY---------- ELECT GEN (TONS)	UNIVERSITY (TONS)	ST. MARYS (TONS)	FAIRVIEW (TONS)	AUGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
				1984					
JAN	14463	11185	25648	1244	21032	1878	816	677	0
FEB	13504	5611	19115	1091	15255	1509	656	595	0
MAR	14301	4577	18878	1134	14744	1606	693	701	0
APR	11320	485	11806	853	9002	1061	459	430	0
MAY	10848	54	10903	815	8629	811	349	298	0
JUN	11504	47	11551	867	9488	684	293	219	0
JUL	13054	408	13462	990	11241	699	303	228	0
AUG	13223	822	14044	1006	11420	896	384	338	0
SEP	11123	49	11172	838	9103	708	308	215	0
OCT	13015	753	13768	987	10890	1023	452	416	0
NOV	13890	4004	17894	1097	14198	1411	615	572	0
DEC	14463	10900	25363	1239	20707	1866	812	739	0
TOTAL	154708	38895	193603	12163	155719	14152	6141	5428	0
				1985					
JAN	14463	11185	25648	1244	21032	1878	816	677	0
FEB	13037	5393	18430	1053	14704	1464	636	573	0
MAR	14301	4577	18878	1134	14744	1606	693	701	0
APR	11320	485	11806	853	9002	1061	459	430	0
MAY	10848	54	10903	815	8629	811	349	298	0
JUN	11504	47	11551	867	9488	684	293	219	0
JUL	13054	408	13462	990	11241	699	303	228	0
AUG	13223	822	14044	1006	11420	896	384	338	0
SEP	11123	49	11172	838	9103	708	308	215	0
OCT	13015	753	13768	987	10890	1023	452	416	0
NOV	13890	4004	17894	1097	14198	1411	615	572	0
DEC	14463	10900	25363	1239	20707	1866	812	739	0
TOTAL	154242	38676	192918	12125	155158	14107	6121	5406	0

78/02/20.

GRID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION 2

MONTH	---IN-PLANT CONSUMPTION--- SE STEAM (TONS)	U - PLANT (TONS)	NET TOTAL (TONS)	----------FUEL ALLOCATED TO COMMUNITY---------- ELECT GEN (TONS)	UNIVERSITY (TONS)	ST. MARYS (TONS)	FAIRVIEW (TONS)	ALGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
				1981					
JAN	14463	7557	22020	1368	17849	1484	712	607	-2316
FEB	12766	2637	15403	1152	12098	1118	537	498	-2091
MAR	13712	1891	15603	1227	11988	1207	581	600	-2316
APR	8814	70	8884	829	6652	728	344	331	-2241
MAY	9071	0	9071	771	7103	594	291	253	-1195
JUN	8627	0	8627	820	6955	459	225	169	-2241
JUL	10364	13	10377	958	8511	485	241	182	-2316
AUG	10843	105	10947	992	8741	633	308	273	-2316
SEP	8268	0	8268	792	6607	474	230	164	-2241
OCT	10623	52	10675	973	8292	729	349	332	-2316
NOV	13136	1583	14719	1176	11495	1059	501	488	-2241
DEC	14455	7284	21739	1363	17549	1467	699	661	-2316
TOTAL	135142	21192	156334	12422	123900	10436	5018	4557	-26144
				1982					
JAN	14463	8907	23370	1388	19022	1612	737	611	-2316
FEB	12885	3485	16370	1173	12920	1217	558	502	-2091
MAR	13957	2628	16585	1256	12807	1315	601	605	-2316
APR	9380	141	9521	872	7152	798	363	336	-2241
MAY	9663	0	9663	816	7643	653	296	255	-1195
JUN	9259	2	9262	867	7483	509	230	172	-2241
JUL	11067	51	11118	1011	9140	537	246	184	-2316
AUG	11478	228	11706	1042	9380	694	314	276	-2316
SEP	8883	0	8883	838	7114	523	240	167	-2241
OCT	11278	147	11424	1023	8899	795	370	337	-2316
NOV	13481	2199	15680	1211	12289	1156	532	492	-2241
DEC	14462	8621	23083	1383	18704	1598	733	666	-2316
TOTAL	140256	26408	166664	12881	132554	11406	5219	4604	-26144
				1983					
JAN	14463	9002	23465	1388	19030	1698	737	611	-2316
FEB	12892	3558	16449	1174	12928	1287	559	502	-2091
MAR	13976	2699	16675	1258	12817	1393	601	606	-2316
APR	9425	149	9574	876	7161	839	363	336	-2241
MAY	9704	0	9704	819	7648	686	296	255	-1195
JUN	9297	3	9300	870	7490	538	230	172	-2241
JUL	11102	54	11157	1014	9146	566	246	185	-2316
AUG	11519	236	11755	1045	9387	732	314	277	-2316
SEP	8922	0	8922	841	7121	552	240	167	-2241
OCT	11323	156	11479	1026	8907	838	371	337	-2316
NOV	13501	2256	15757	1213	12297	1221	532	493	-2241
DEC	14463	8718	23180	1384	18712	1686	733	666	-2316
TOTAL	140587	26830	167417	12907	132644	12036	5223	4607	-26144

78/02/20.

GRID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION 2

MONTH	IN-PLANT CONSUMPTION: SE STEAM (TONS)	IN-PLANT CONSUMPTION: U - PLANT (TONS)	IN-PLANT CONSUMPTION: NET TOTAL (TONS)	FUEL ALLOCATED TO COMMUNITY: ELECT GEN (TONS)	FUEL ALLOCATED TO COMMUNITY: UNIVERSITY (TONS)	FUEL ALLOCATED TO COMMUNITY: ST. MARYS (TONS)	FUEL ALLOCATED TO COMMUNITY: FAIRVIEW (TONS)	FUEL ALLOCATED TO COMMUNITY: AUGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
1984									
JAN	14463	9002	23465	1388	19030	1698	737	611	-2316
FEB	13358	3706	17064	1217	13423	1326	576	521	-2166
MAR	13976	2699	16675	1258	12817	1393	601	606	-2316
APR	9425	149	9574	876	7161	839	363	336	-2241
MAY	9704	0	9704	819	7648	686	296	255	-1195
JUN	9297	3	9300	870	7490	538	230	172	-2241
JUL	11102	54	11157	1014	9146	566	246	185	-2316
AUG	11519	236	11755	1045	9387	732	314	277	-2316
SEP	8922	0	8922	841	7121	552	240	167	-2241
OCT	11323	156	11479	1026	8907	838	371	337	-2316
NOV	13501	2256	15757	1213	12297	1221	532	493	-2241
DEC	14463	8718	23180	1384	18712	1686	733	666	-2316
TOTAL	141054	26978	168031	12950	133139	12076	5240	4626	-26218
1985									
JAN	14463	9002	23465	1388	19030	1698	737	611	-2316
FEB	12892	3558	16449	1174	12928	1287	559	502	-2091
MAR	13976	2699	16675	1258	12817	1393	601	606	-2316
APR	9425	149	9574	876	7161	839	363	336	-2241
MAY	9704	0	9704	819	7648	686	296	255	-1195
JUN	9297	3	9300	870	7490	538	230	172	-2241
JUL	11102	54	11157	1014	9146	566	246	185	-2316
AUG	11519	236	11755	1045	9387	732	314	277	-2316
SEP	8922	0	8922	841	7121	552	240	167	-2241
OCT	11323	156	11479	1026	8907	838	371	337	-2316
NOV	13501	2256	15757	1213	12297	1221	532	493	-2241
DEC	14463	8718	23180	1384	18712	1686	733	666	-2316
TOTAL	140587	26830	167417	12907	132644	12036	5223	4607	-26144

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OHIO ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION 3

MONTH	IN-PLANT CONSUMPTION: SE STEAM (TONS)	IN-PLANT CONSUMPTION: U - PLANT (TONS)	IN-PLANT CONSUMPTION: NET TOTAL (TONS)	FUEL ALLOCATED TO COMMUNITY: ELECT GEN (TONS)	FUEL ALLOCATED TO COMMUNITY: UNIVERSITY (TONS)	FUEL ALLOCATED TO COMMUNITY: ST. MARYS (TONS)	FUEL ALLOCATED TO COMMUNITY: FAIRVIEW (TONS)	FUEL ALLOCATED TO COMMUNITY: AUGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
1981									
JAN	14463	7865	22328	1509	17994	1496	718	612	-2316
FEB	12777	2759	15536	1225	12145	1122	539	500	-2091
MAR	13725	1969	15694	1276	12024	1210	583	601	-2316
APR	8840	75	8915	858	6654	728	344	331	-2241
MAY	9146	0	9146	844	7164	594	291	253	-1195
JUN	8733	0	8733	923	6957	459	225	169	-2241
JUL	10522	19	10541	1118	8515	485	241	182	-2316
AUG	10991	131	11122	1101	8747	634	308	273	-2316
SEP	8391	0	8391	912	6610	474	231	164	-2241
OCT	10672	58	10729	1024	8294	729	349	333	-2316
NOV	13164	1661	14825	1245	11526	1062	502	489	-2241
DEC	14456	7565	22021	1485	17688	1478	704	666	-2316
TOTAL	135880	22102	157982	13579	124324	10472	5036	4572	-26144
1982									
JAN	14463	9255	23718	1538	19193	1627	744	616	-2316
FEB	12891	3635	16526	1252	12986	1223	561	504	-2091
MAR	13966	2730	16695	1308	12857	1320	603	607	-2316
APR	9406	149	9555	963	7155	798	363	336	-2241
MAY	9742	0	9742	893	7645	653	296	255	-1195
JUN	9371	3	9374	977	7486	509	230	172	-2241
JUL	11225	68	11293	1181	9145	537	246	185	-2316
AUG	11621	272	11894	1220	9388	695	314	277	-2316
SEP	9013	0	9013	965	7117	523	240	167	-2241
OCT	11324	159	11484	1078	8903	795	371	337	-2316
NOV	13500	2304	15804	1285	12332	1160	534	494	-2241
DEC	14463	8941	23404	1514	18868	1612	739	671	-2316
TOTAL	140986	27516	168502	14113	133076	11452	5240	4621	-26144
1983									
JAN	14463	9352	23815	1539	19202	1713	744	616	-2316
FEB	12898	3710	16608	1253	12995	1293	562	505	-2091
MAR	13985	2802	16787	1310	12868	1398	603	608	-2316
APR	9452	157	9609	906	7164	839	363	336	-2241
MAY	9783	0	9783	895	7650	686	296	255	-1195
JUN	9409	3	9413	980	7493	538	230	172	-2241
JUL	11259	73	11331	1183	9151	567	246	185	-2316
AUG	11662	281	11943	1223	9396	733	314	277	-2316
SEP	9052	0	9052	968	7124	552	240	167	-2241
OCT	11369	170	11539	1081	8911	838	371	337	-2316
NOV	13520	2362	15882	1287	12341	1226	534	494	-2241
DEC	14463	9041	23504	1515	18877	1701	740	671	-2316
TOTAL	141314	27951	169265	14140	133172	12085	5244	4625	-26144

78/02/20.

OHIO ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION 3

MONTH	IN-PLANT CONSUMPTION: SE STEAM (TONS)	IN-PLANT CONSUMPTION: U - PLANT (TONS)	IN-PLANT CONSUMPTION: NET TOTAL (TONS)	FUEL ALLOCATED TO COMMUNITY: ELECT GEN (TONS)	FUEL ALLOCATED TO COMMUNITY: UNIVERSITY (TONS)	FUEL ALLOCATED TO COMMUNITY: ST. MARYS (TONS)	FUEL ALLOCATED TO COMMUNITY: FAIRVIEW (TONS)	FUEL ALLOCATED TO COMMUNITY: AUGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
1984									
JAN	14463	9352	23815	1539	19202	1713	744	616	-2316
FEB	13364	3864	17228	1299	13494	1333	579	526	-2316
MAR	13985	2802	16787	1310	12868	1398	603	608	-2316
APR	9452	157	9609	906	7164	839	363	336	-2241
MAY	9783	0	9783	895	7650	686	296	255	-1195
JUN	9409	3	9413	980	7493	538	230	172	-2241
JUL	11259	73	11331	1183	9151	567	246	185	-2316
AUG	11662	281	11943	1223	9396	733	314	277	-2316
SEP	9052	0	9052	968	7124	552	240	167	-2241
OCT	11369	170	11539	1081	8911	838	371	337	-2316
NOV	13520	2362	15882	1287	12341	1226	534	494	-2241
DEC	14463	9041	23504	1515	18877	1701	740	671	-2316
TOTAL	141781	28105	169886	14185	133671	12125	5261	4644	-26218
1985									
JAN	14463	9352	23815	1539	19202	1713	744	616	-2316
FEB	12898	3710	16608	1253	12995	1293	562	505	-2091
MAR	13985	2802	16787	1310	12868	1398	603	608	-2316
APR	9452	157	9609	906	7164	839	363	336	-2241
MAY	9783	0	9783	895	7650	686	296	255	-1195
JUN	9409	3	9413	980	7493	538	230	172	-2241
JUL	11259	73	11331	1183	9151	567	246	185	-2316
AUG	11662	281	11943	1223	9396	733	314	277	-2316
SEP	9052	0	9052	968	7124	552	240	167	-2241
OCT	11369	170	11539	1081	8911	838	371	337	-2316
NOV	13520	2362	15882	1287	12341	1226	534	494	-2241
DEC	14463	9041	23504	1515	18877	1701	740	671	-2316
TOTAL	141314	27951	169265	14140	133172	12085	5244	4625	-26164

78/02/20.

GRID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
ANNUAL SUMMARY

YEAR	---IN-PLANT CONSUMPTION--- SE STEAM (TONS)	U - PLANT (TONS)	NET TOTAL (TONS)	----------FUEL ALLOCATED TO COMMUNITY---------- ELECT GEN (TONS)	UNIVERSITY (TONS)	ST. MARYS (TONS)	FAIRVIEW (TONS)	AUGSBURG (TONS)	REDUCTION FROM PYROLYSIS (TONS)
				BASIC PLAN					
1981	139290	18087	157377	10888	146489	0	0	0	0
1982	143805	22668	166473	11302	155170	0	0	0	0
1983	143805	22668	166473	11302	155170	0	0	0	0
1984	144271	22800	167071	11340	155731	0	0	0	0
1985	143805	22668	166473	11302	155170	0	0	0	0
				OPTION 1					
1981	150247	31678	181926	11730	146478	12364	5947	5407	0
1982	154005	38166	192171	12105	155159	13379	6121	5406	0
1983	154242	38676	192918	12125	155158	14107	6121	5406	0
1984	154708	38895	193603	12163	155719	14152	6141	5428	0
1985	154242	38676	192918	12125	155158	14107	6121	5406	0
				OPTION 2					
1981	135142	21192	156334	12422	123900	10436	5018	4557	-26144
1982	140256	26408	166664	12881	132554	11406	5219	4604	-26144
1983	140587	26830	167417	12907	132644	12036	5223	4607	-26144
1984	141054	26978	168031	12950	133139	12076	5240	4626	-26218
1985	140587	26830	167417	12907	132644	12036	5223	4607	-26144
				OPTION 3					
1981	135880	22102	157982	13579	124324	10472	5036	4572	-26144
1982	140986	27516	168502	14113	133076	11452	5240	4621	-26144
1983	141314	27951	169265	14140	133172	12085	5244	4625	-26144
1984	141781	28105	169886	14185	133671	12125	5261	4644	-26218
1985	141314	27951	169265	14140	133172	12085	5244	4625	-26144

GRID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION SUMMARY BY MONTH

MONTH	---IN-PLANT CONSUMPTION(TONS)--- BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	---FUEL ALLOCATED TO ELECT GEN-- BASIC PLAN	OPTION 1	OPTION 2	OPTION 3
1981								
JAN	21061	24203	22020	22328	1203	1224	1368	1509
FEB	14886	17390	15403	15536	1004	1037	1152	1225
MAR	14977	17818	15603	15694	1054	1115	1227	1276
APR	9196	11123	8884	8915	697	814	829	858
MAY	8818	10272	9071	9146	672	770	771	844
JUN	9696	10880	8627	8733	739	819	820	923
JUL	11483	12692	10377	10541	872	945	958	1118
AUG	11656	13249	10947	11122	878	966	992	1161
SEP	9304	10521	8268	8391	709	791	792	912
OCT	11126	12981	10675	10729	845	950	973	1024
NOV	14424	16875	14719	14825	1020	1079	1176	1245
DEC	20750	23922	21739	22021	1197	1220	1363	1485
TOTAL	157377	181926	156334	157982	10888	11730	12422	13579
1982								
JAN	22255	25553	23370	23718	1221	1244	1388	1538
FEB	15729	18351	16370	16526	1024	1052	1173	1252
MAR	15828	18789	16585	16695	1083	1133	1256	1308
APR	9737	11752	9521	9555	735	851	872	903
MAY	9341	10861	9663	9742	711	812	816	893
JUN	10270	11513	9262	9374	782	865	867	977
JUL	12159	13424	11118	11293	917	989	1011	1181
AUG	12341	13996	11706	11894	921	1004	1042	1220
SEP	9854	11133	8883	9013	750	835	838	965
OCT	11781	13714	11424	11484	890	985	1023	1078
NOV	15252	17818	15680	15804	1052	1097	1211	1285
DEC	21925	25266	23083	23404	1216	1239	1383	1514
TOTAL	166473	192171	166664	168502	11302	12105	12881	14113
1983								
JAN	22255	25648	23465	23815	1221	1244	1388	1539
FEB	15729	18430	16449	16608	1024	1053	1174	1253
MAR	15828	18878	16675	16787	1083	1134	1258	1310
APR	9737	11806	9574	9609	735	853	876	906
MAY	9341	10903	9704	9783	711	815	819	895
JUN	10270	11551	9300	9413	782	867	870	980
JUL	12159	13462	11157	11331	917	990	1014	1183
AUG	12341	14044	11755	11943	921	1006	1045	1223
SEP	9854	11172	8922	9052	750	838	841	968
OCT	11781	13768	11479	11539	890	987	1026	1081
NOV	15252	17894	15757	15882	1052	1097	1213	1287
DEC	21925	25363	23180	23504	1216	1239	1384	1515
TOTAL	166473	192918	167417	169265	11302	12125	12907	14140

GRID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION SUMMARY BY MONTH

78/02/20.

MONTH	---IN-PLANT CONSUMPTION(TONS)--- BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	---FUEL ALLOCATED TO ELECT GEN-- BASIC PLAN	OPTION 1	OPTION 2	OPTION 3
				1984				
JAN	22255	25648	23465	23815	1221	1244	1388	1539
FEB	16328	19115	17064	17228	1061	1091	1217	1299
MAR	15828	18878	16675	16787	1083	1134	1258	1310
APR	9737	11806	9574	9609	735	853	876	906
MAY	9341	10903	9704	9783	711	815	819	895
JUN	10270	11551	9300	9413	782	867	870	980
JUL	12159	13462	11157	11331	917	990	1014	1183
AUG	12341	14044	11755	11943	921	1006	1045	1223
SEP	9854	11172	8922	9052	750	838	841	968
OCT	11781	13768	11479	11539	890	987	1026	1081
NOV	15252	17894	15757	15882	1052	1097	1213	1287
DEC	21925	25363	23180	23504	1216	1239	1384	1515
TOTAL	167071	193603	168031	169886	11340	12163	12950	14185
				1985				
JAN	22255	25648	23465	23815	1221	1244	1388	1539
FEB	15729	18430	16449	16608	1024	1053	1174	1253
MAR	15828	18878	16675	16787	1083	1134	1258	1310
APR	9737	11806	9574	9609	735	853	876	906
MAY	9341	10903	9704	9783	711	815	819	895
JUN	10270	11551	9300	9413	782	867	870	980
JUL	12159	13462	11157	11331	917	990	1014	1183
AUG	12341	14044	11755	11943	921	1006	1045	1223
SEP	9854	11172	8922	9052	750	838	841	968
OCT	11781	13768	11479	11539	890	987	1026	1081
NOV	15252	17894	15757	15882	1052	1097	1213	1287
DEC	21925	25363	23180	23504	1216	1239	1384	1515
TOTAL	166473	192918	167417	169265	11302	12125	12907	14140

78/02/20.

GRID ICES FUEL CONSUMPTION
WESTERN COAL EQUIVALENT - (8890 BTU/LB)
OPTION SUMMARY BY YEAR

YEAR	---IN-PLANT CONSUMPTION(TONS)--- BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	---FUEL ALLOCATED TO ELECT GEN-- BASIC PLAN	OPTION 1	OPTION 2	OPTION 3
1981	157377	181926	156334	157982	10888	11730	12922	13579
1982	166473	192171	166664	168502	11302	12105	12881	14113
1983	166473	192918	167417	169265	11302	12125	12907	14140
1984	167071	193603	168031	169886	11340	12163	12950	14185
1985	166473	192918	167417	169262	11302	12125	12907	14140

GRID ICES TRANSPORTATION SCENARIO
BASIC PLAN

MONTH	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS. MC (7 TON)	SOLID WASTE TO MPLS. MUN (20 TON)	SOLID WASTE TO MPLS. TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)
1981											
JAN	11	332	211	150	67	48	0	0	0	0	0
FEB	6	244	149	106	49	35	0	0	0	0	0
MAR	5	240	150	107	48	34	0	0	0	0	0
APR	4	145	92	65	29	21	0	0	0	0	0
MAY	3	151	88	63	30	21	0	0	0	0	0
JUN	4	190	97	69	38	27	0	0	0	0	0
JUL	4	201	115	82	40	29	0	0	0	0	0
AUG	5	204	117	83	41	29	0	0	0	0	0
SEP	3	142	93	66	28	20	0	0	0	0	0
OCT	5	189	111	79	38	27	0	0	0	0	0
NOV	5	259	144	103	52	37	0	0	0	0	0
DEC	8	343	207	148	69	49	0	0	0	0	0
TOTAL	63	2639	1574	1122	529	377	0	0	0	0	0
1982											
JAN	8	333	223	159	67	48	0	0	0	0	0
FEB	6	244	157	112	49	35	0	0	0	0	0
MAR	6	239	158	113	48	34	0	0	0	0	0
APR	4	145	97	70	29	21	0	0	0	0	0
MAY	3	151	93	67	30	21	0	0	0	0	0
JUN	4	190	103	73	38	27	0	0	0	0	0
JUL	5	201	122	87	40	29	0	0	0	0	0
AUG	5	204	123	88	41	29	0	0	0	0	0
SEP	3	141	99	70	28	20	0	0	0	0	0
OCT	5	190	118	84	38	27	0	0	0	0	0
NOV	6	259	153	109	52	37	0	0	0	0	0
DEC	8	343	219	157	69	49	0	0	0	0	0
TOTAL	63	2640	1665	1189	529	377	0	0	0	0	0
1983											
JAN	8	333	223	159	67	48	0	0	0	0	0
FEB	6	244	157	112	49	35	0	0	0	0	0
MAR	6	239	158	113	48	34	0	0	0	0	0
APR	3	145	97	70	29	21	0	0	0	0	0
MAY	4	151	93	67	30	21	0	0	0	0	0
JUN	4	190	103	73	38	27	0	0	0	0	0
JUL	5	200	122	87	40	29	0	0	0	0	0
AUG	4	205	123	88	41	29	0	0	0	0	0
SEP	4	141	99	70	28	20	0	0	0	0	0
OCT	4	190	118	84	38	27	0	0	0	0	0
NOV	6	259	153	109	52	37	0	0	0	0	0
DEC	8	343	219	157	69	49	0	0	0	0	0
TOTAL	62	2640	1665	1189	529	377	0	0	0	0	0

78/02/20.

GRID ICES TRANSPORTATION SCENARIO
BASIC PLAN

MONTH	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS MC (7 TON)	SOLID WASTE TO MPLS MUN (20 TON)	SOLID WASTE TO MPLS TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)
1984											
JAN	9	333	223	159	67	48	0	0	0	0	0
FEB	6	253	163	117	51	36	0	0	0	0	0
MAR	6	239	158	113	48	34	0	0	0	0	0
APR	3	145	97	70	29	21	0	0	0	0	0
MAY	4	151	93	67	30	21	0	0	0	0	0
JUN	4	190	103	73	38	27	0	0	0	0	0
JUL	4	200	122	87	40	29	0	0	0	0	0
AUG	5	205	123	88	41	29	0	0	0	0	0
SEP	4	141	99	70	28	20	0	0	0	0	0
OCT	4	190	118	84	38	27	0	0	0	0	0
NOV	6	259	153	109	52	37	0	0	0	0	0
DEC	8	343	219	157	69	49	0	0	0	0	0
TOTAL	63	2649	1671	1194	531	378	0	0	0	0	0
1985											
JAN	9	333	223	159	67	48	0	0	0	0	0
FEB	5	244	157	112	49	35	0	0	0	0	0
MAR	6	239	158	113	48	34	0	0	0	0	0
APR	4	145	97	70	29	21	0	0	0	0	0
MAY	3	150	93	67	30	21	0	0	0	0	0
JUN	5	190	103	73	38	27	0	0	0	0	0
JUL	4	201	122	87	40	29	0	0	0	0	0
AUG	5	205	123	88	41	29	0	0	0	0	0
SEP	3	141	99	70	28	20	0	0	0	0	0
OCT	5	190	118	84	38	27	0	0	0	0	0
NOV	6	259	153	109	52	37	0	0	0	0	0
DEC	8	343	219	157	69	49	0	0	0	0	0
TOTAL	63	2640	1665	1189	529	377	0	0	0	0	0

78/02/20.

GRID ICES TRANSPORTATION SCENARIO
OPTION 1

MONTH	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS MC (7 TON)	SOLID WASTE TO MPLS MUN (20 TON)	SOLID WASTE TO MPLS TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)
1981											
JAN	12	335	242	173	67	48	0	0	0	0	0
FEB	6	247	174	124	49	35	0	0	0	0	0
MAR	7	241	178	127	48	35	0	0	0	0	0
APR	4	147	111	79	29	21	0	0	0	0	0
MAY	4	152	103	73	30	22	0	0	0	0	0
JUN	4	191	109	78	38	27	0	0	0	0	0
JUL	5	203	127	91	41	29	0	0	0	0	0
AUG	5	206	132	95	41	29	0	0	0	0	0
SEP	3	143	105	75	29	20	0	0	0	0	0
OCT	5	191	130	93	38	27	0	0	0	0	0
NOV	6	261	169	121	52	37	0	0	0	0	0
DEC	9	346	239	171	69	49	0	0	0	0	0
TOTAL	70	2663	1819	1300	531	379	0	0	0	0	0
1982											
JAN	10	336	256	183	67	48	0	0	0	0	0
FEB	6	246	184	131	49	35	0	0	0	0	0
MAR	7	242	188	134	48	35	0	0	0	0	0
APR	4	147	118	84	29	21	0	0	0	0	0
MAY	4	151	109	78	30	22	0	0	0	0	0
JUN	4	192	115	82	38	27	0	0	0	0	0
JUL	5	203	134	96	41	29	0	0	0	0	0
AUG	6	206	140	100	41	29	0	0	0	0	0
SEP	4	143	111	80	29	20	0	0	0	0	0
OCT	5	191	137	98	38	27	0	0	0	0	0
NOV	6	261	178	127	52	37	0	0	0	0	0
DEC	9	346	253	180	69	49	0	0	0	0	0
TOTAL	70	2664	1923	1373	531	379	0	0	0	0	0
1983											
JAN	10	335	256	183	67	48	0	0	0	0	0
FEB	6	247	184	132	49	35	0	0	0	0	0
MAR	7	242	189	135	48	35	0	0	0	0	0
APR	4	146	118	84	29	21	0	0	0	0	0
MAY	4	152	109	78	30	22	0	0	0	0	0
JUN	5	192	116	83	38	27	0	0	0	0	0
JUL	5	202	135	96	41	29	0	0	0	0	0
AUG	5	206	140	100	41	29	0	0	0	0	0
SEP	4	143	112	80	29	20	0	0	0	0	0
OCT	5	191	138	98	38	27	0	0	0	0	0
NOV	7	261	179	128	52	37	0	0	0	0	0
DEC	9	346	254	181	69	49	0	0	0	0	0
TOTAL	71	2663	1930	1378	531	379	0	0	0	0	0

78/02/20.

GRID ICES TRANSPORTATION SCENARIO
OPTION 1

MONTH	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS MC (7 TON)	SOLID WASTE TO MPLS MUN (20 TON)	SOLID WASTE TO MPLS TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)
1984											
JAN	9	336	256	183	67	48	0	0	0	0	0
FEB	7	256	191	137	51	37	0	0	0	0	0
MAR	7	241	189	135	48	35	0	0	0	0	0
APR	4	147	118	84	29	21	0	0	0	0	0
MAY	4	152	109	78	30	22	0	0	0	0	0
JUN	4	191	116	83	38	27	0	0	0	0	0
JUL	5	203	135	96	41	29	0	0	0	0	0
AUG	5	206	140	100	41	29	0	0	0	0	0
SEP	4	143	112	80	29	20	0	0	0	0	0
OCT	6	191	138	98	38	27	0	0	0	0	0
NOV	6	261	179	128	52	37	0	0	0	0	0
DEC	9	346	254	181	69	49	0	0	0	0	0
TOTAL	70	2673	1937	1383	533	381	0	0	0	0	0
1985											
JAN	10	336	256	183	67	48	0	0	0	0	0
FEB	6	246	184	132	49	35	0	0	0	0	0
MAR	7	242	189	135	48	35	0	0	0	0	0
APR	4	146	118	84	29	21	0	0	0	0	0
MAY	4	152	109	78	30	22	0	0	0	0	0
JUN	5	192	116	83	38	27	0	0	0	0	0
JUL	5	203	135	96	41	29	0	0	0	0	0
AUG	5	206	140	100	41	29	0	0	0	0	0
SEP	4	143	112	80	29	20	0	0	0	0	0
OCT	5	191	138	98	38	27	0	0	0	0	0
NOV	6	261	179	128	52	37	0	0	0	0	0
DEC	10	346	254	181	69	49	0	0	0	0	0
TOTAL	71	2664	1930	1378	531	379	0	0	0	0	0

GRID ICES TRANSPORTATION SCENARIO
OPTION 2

MONTH	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS MC (7 TON)	SOLID WASTE TO MPLS MUN (20 TON)	SOLID WASTE TO MPLS TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)	STORED COAL-TONS LAST DAY OF MONTH MPLS.	STORED COAL-TONS LAST DAY OF MONTH ST. PAUL
1981													
JAN	11	338	220	157	68	48	354	81	435	82	58	22319	39994
FEB	6	249	154	110	50	36	320	73	393	74	53	22936	39991
MAR	6	244	156	111	49	35	354	81	435	82	58	23453	39988
APR	3	149	89	63	30	21	343	78	421	79	57	22089	39999
MAY	4	153	91	65	31	22	354	81	435	82	58	23958	39996
JUN	3	193	86	62	39	28	343	78	421	79	57	21971	39989
JUL	5	204	104	74	41	29	354	81	435	82	58	25014	39980
AUG	4	208	109	78	42	30	354	81	435	82	58	23907	39980
SEP	3	145	83	59	29	21	343	78	421	79	57	23239	39994
OCT	4	192	107	76	38	27	354	81	435	82	58	22724	39985
NOV	6	263	147	105	53	38	343	78	421	79	57	23745	39989
DEC	8	349	217	155	70	50	354	81	435	82	58	23026	39993
TOTAL	63	2687	1563	1115	540	385	4170	952	5122	964	687	23026	39993
1982													
JAN	9	338	234	167	68	48	354	81	435	82	58	24396	39987
FEB	6	249	164	117	50	36	320	73	393	74	53	24046	39984
MAR	6	244	166	118	49	35	354	81	435	82	58	23581	39981
APR	4	149	95	68	30	21	343	78	421	79	57	25081	39992
MAY	3	153	97	69	31	22	354	81	435	82	58	22858	39989
JUN	4	193	93	66	39	28	343	78	421	79	57	23736	39982
JUL	4	205	111	79	41	29	354	81	435	82	58	22518	39993
AUG	5	208	117	84	42	30	354	81	435	82	58	24152	39993
SEP	3	144	89	63	29	21	343	78	421	79	57	22889	39987
OCT	5	193	114	82	38	27	354	81	435	82	58	25105	39998
NOV	6	262	157	112	53	38	343	78	421	79	57	25185	39982
DEC	8	349	231	165	70	50	354	81	435	82	58	23122	39986
TOTAL	63	2687	1668	1190	540	385	4170	952	5122	964	687	23122	39986
1983													
JAN	9	338	235	168	68	48	354	81	435	82	58	24397	39980
FEB	6	250	164	117	50	36	320	73	393	74	53	23948	39997
MAR	6	244	167	119	49	35	354	81	435	82	58	23393	39995
APR	4	148	96	68	30	21	343	78	421	79	57	24858	39985
MAY	3	153	97	69	31	22	354	81	435	82	58	22594	39983
JUN	4	194	93	66	39	28	343	78	421	79	57	23414	39995
JUL	4	204	112	80	41	29	354	81	435	82	58	22178	39986
AUG	5	208	118	84	42	30	354	81	435	82	58	23763	39986
SEP	3	144	89	64	29	21	343	78	421	79	57	22461	39980
OCT	5	193	115	82	38	27	354	81	435	82	58	24622	39991
NOV	6	263	158	113	53	38	343	78	421	79	57	24605	39996
DEC	8	349	232	166	70	50	354	81	435	82	58	22445	39999
TOTAL	63	2688	1676	1196	540	385	4170	952	5122	964	687	22445	39999

GRID ICES TRANSPORTATION SCENARIO
OPTION 2

MONTH	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS MC (7 TON)	SOLID WASTE TO MPLS MUN (20 TON)	SOLID WASTE TO MPLS TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)	STORED COAL-TONS LAST DAY OF MONTH MPLS.	STORED COAL-TONS LAST DAY OF MONTH ST. PAUL
					1984								
JAN	9	338	235	168	68	48	354	81	435	82	58	23720	39994
FEB	6	258	171	122	52	37	332	75	407	77	55	22496	39989
MAR	6	244	167	119	49	35	354	81	435	82	58	21941	39986
APR	4	149	96	68	30	21	343	78	421	79	57	23387	39997
MAY	4	153	97	69	31	22	354	81	435	82	58	24623	39994
JUN	3	193	93	66	39	28	343	78	421	79	57	21963	39987
JUL	5	205	112	80	41	29	354	81	435	82	58	24206	39998
AUG	4	208	118	84	42	30	354	81	435	82	58	22291	39998
SEP	4	144	89	64	29	21	343	78	421	79	57	24489	39992
OCT	4	192	115	82	38	27	354	81	435	82	58	23171	39983
NOV	6	263	158	113	53	38	343	78	421	79	57	23154	39987
DEC	9	349	232	166	70	50	354	81	435	82	58	24493	39991
TOTAL	64	2696	1683	1201	542	386	4182	954	5136	967	689	24493	39991
					1985								
JAN	8	338	235	168	68	48	354	81	435	82	58	22269	39985
FEB	6	249	164	117	50	36	320	73	393	74	53	21839	39982
MAR	7	245	167	119	49	35	354	81	435	82	58	24764	39999
APR	3	148	96	68	30	21	343	78	421	79	57	22730	39990
MAY	4	153	97	69	31	22	354	81	435	82	58	23966	39987
JUN	4	193	93	66	39	28	343	78	421	79	57	24806	39980
JUL	4	205	112	80	41	29	354	81	435	82	58	23549	39991
AUG	5	208	118	84	42	30	354	81	435	82	58	25134	39991
SEP	3	144	89	64	29	21	343	78	421	79	57	23832	39985
OCT	4	193	115	82	38	27	354	81	435	82	58	22493	39996
NOV	6	262	158	113	53	38	343	78	421	79	57	22497	39980
DEC	9	349	232	166	70	50	354	81	435	82	58	23836	39984
TOTAL	63	2687	1676	1196	540	385	4170	952	5122	964	687	23836	39984

GRID ICES TRANSPORTATION SCENARIO
OPTION 3

MONTH	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS MC (7 TON)	SOLID WASTE TO MPLS MUN (20 TON)	SOLID WASTE TO MPLS TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)	STORED COAL-TONS LAST DAY OF MONTH MPLS.	STORED COAL-TONS LAST DAY OF MONTH ST. PAUL
1981													
JAN	11	341	223	159	68	49	354	81	435	82	58	21951	39959
FEB	6	251	155	111	50	36	320	73	393	74	53	22396	39986
MAR	8	247	157	112	49	35	354	81	435	82	58	22762	39994
APR	4	150	89	64	30	21	343	78	421	79	57	24847	39988
MAY	3	155	91	65	31	22	354	81	435	82	58	23101	39998
JUN	4	195	87	62	39	28	343	78	421	79	57	24468	39997
JUL	4	206	105	75	41	29	354	81	435	82	58	23807	39992
AUG	4	210	111	79	42	30	354	81	435	82	58	22484	39996
SEP	4	145	84	60	29	21	343	78	421	79	57	25193	39982
OCT	4	194	107	77	39	28	354	81	435	82	58	24584	39985
NOV	5	265	148	106	53	38	343	78	421	79	57	21959	39991
DEC	9	352	220	157	70	50	354	81	435	82	58	24398	39998
TOTAL	64	2711	1577	1127	541	387	4170	952	5122	964	687	24398	39998
1982													
JAN	8	341	237	169	68	49	354	81	435	82	58	21860	39997
FEB	7	251	165	118	50	36	320	73	393	74	53	24814	39985
MAR	6	247	167	119	49	35	354	81	435	82	58	24178	39992
APR	3	150	96	68	30	21	343	78	421	79	57	22123	39986
MAY	4	155	97	70	31	22	354	81	435	82	58	23282	39997
JUN	4	195	94	67	39	28	343	78	421	79	57	24007	39996
JUL	4	206	113	81	41	29	354	81	435	82	58	22594	39991
AUG	5	210	119	85	42	30	354	81	435	82	58	24000	39994
SEP	3	145	90	64	29	21	343	78	421	79	57	22587	39980
OCT	5	194	115	82	39	28	354	81	435	82	58	24723	39983
NOV	6	265	158	113	53	38	343	78	421	79	57	24619	39989
DEC	8	352	234	167	70	50	354	81	435	82	58	22176	39997
TOTAL	63	2711	1685	1203	541	387	4170	952	5122	964	687	22176	39997
1983													
JAN	9	341	238	170	68	49	354	81	435	82	58	23041	39996
FEB	6	251	166	119	50	36	320	73	393	74	53	22413	39983
MAR	7	247	168	120	49	35	354	81	435	82	58	25186	39991
APR	3	150	96	69	30	21	343	78	421	79	57	23077	39985
MAY	4	155	98	70	31	22	354	81	435	82	58	24194	39995
JUN	4	195	94	67	39	28	343	78	421	79	57	24881	39995
JUL	4	206	113	81	41	29	354	81	435	82	58	23429	39989
AUG	5	210	119	85	42	30	354	81	435	82	58	24787	39993
SEP	3	146	91	65	29	21	343	78	421	79	57	23315	39999
OCT	4	193	115	82	39	28	354	81	435	82	58	21916	39982
NOV	6	265	159	113	53	38	343	78	421	79	57	21734	39988
DEC	9	352	235	168	70	50	354	81	435	82	58	22690	39995
TOTAL	64	2711	1692	1209	541	387	4170	952	5122	964	687	22690	39995

GRID ICES TRANSPORTATION SCENARIO
OPTION 3

MONTH	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS MC (7 TON)	SOLID WASTE TO MPLS MUN (20 TON)	SOLID WASTE TO MPLS TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)	STORED COAL-TONS LAST DAY OF MONTH MPLS.	STORED COAL-TONS LAST DAY OF MONTH ST. PAUL
1984													
JAN	9	341	238	170	68	49	354	81	435	82	58	23556	39994
FEB	6	260	172	123	52	37	332	75	407	77	55	22127	39980
MAR	7	247	168	120	49	35	354	81	435	82	58	24900	39988
APR	3	150	96	69	30	21	343	78	421	79	57	22791	39981
MAY	4	155	98	70	31	22	354	81	435	82	58	23908	39992
JUN	4	195	94	67	39	28	343	78	421	79	57	24595	39991
JUL	4	206	113	81	41	29	354	81	435	82	58	23144	39986
AUG	5	210	119	85	42	30	354	81	435	82	58	24501	39990
SEP	3	146	91	65	29	21	343	78	421	79	57	23029	39996
OCT	5	194	115	82	39	28	354	81	435	82	58	25110	39998
NOV	6	264	159	113	53	38	343	78	421	79	57	24948	39985
DEC	8	352	235	168	70	50	354	81	435	82	58	22405	39992
TOTAL	64	2720	1698	1213	543	388	4182	954	5136	967	689	22405	39992
1985													
JAN	9	341	238	170	68	49	354	81	435	82	58	23270	39991
FEB	6	252	166	119	50	36	320	73	393	74	53	22622	39998
MAR	6	246	168	120	49	35	354	81	435	82	58	21915	39986
APR	4	150	96	69	30	21	343	78	421	79	57	23306	39980
MAY	4	155	98	70	31	22	354	81	435	82	58	24423	39991
JUN	4	195	94	67	39	28	343	78	421	79	57	25110	39990
JUL	4	206	113	81	41	29	354	81	435	82	58	23658	39985
AUG	5	210	119	85	42	30	354	81	435	82	58	25016	39988
SEP	3	146	91	65	29	21	343	78	421	79	57	23544	39994
OCT	4	194	115	82	39	28	354	81	435	82	58	22125	39997
NOV	6	264	159	113	53	38	343	78	421	79	57	21963	39983
DEC	9	352	235	168	70	50	354	81	435	82	58	22919	39991
TOTAL	64	2711	1692	1209	541	387	4170	952	5122	964	687	22919	39991

GRID ICES TRANSPORTATION SCENARIO
ANNUAL SUMMARY

YEAR	UNIT TRAINS TO MPLS. (3500 TON)	COAL TRUCKS TO ST. PAUL (20 TON)	ASH TRUCKS FROM MPLS. (10 TON)	ASH TRUCKS FROM MPLS. (14 TON)	ASH TRUCKS FROM ST. PAUL (10 TON)	ASH TRUCKS FROM ST. PAUL (14 TON)	SOLID WASTE TO MPLS MC (7 TON)	SOLID WASTE TO MPLS MUN (20 TON)	SOLID WASTE TO MPLS TOTAL	SLAG TRUCKS FROM MPLS (10 TON)	SLAG TRUCKS FROM MPLS (14 TON)
BASIC PLAN											
1981	63	2639	1574	1122	529	377	0	0	0	0	0
1982	63	2640	1668	1189	529	377	0	0	0	0	0
1983	62	2646	1665	1189	529	377	0	0	0	0	0
1984	63	2649	1671	1194	531	378	0	0	0	0	0
1985	63	2640	1665	1189	529	377	0	0	0	0	0
OPTION 1											
1981	70	2663	1819	1300	531	379	0	0	0	0	0
1982	70	2664	1923	1373	531	379	0	0	0	0	0
1983	71	2663	1930	1378	531	379	0	0	0	0	0
1984	70	2673	1937	1383	533	381	0	0	0	0	0
1985	71	2664	1930	1378	531	379	0	0	0	0	0
OPTION 2											
1981	63	2687	1563	1115	540	385	4170	952	5122	964	687
1982	63	2687	1668	1190	540	385	4170	952	5122	964	687
1983	63	2688	1676	1196	540	385	4170	952	5122	964	687
1984	64	2696	1683	1201	542	386	4182	954	5136	967	689
1985	63	2687	1676	1196	540	385	4170	952	5122	964	687
OPTION 3											
1981	64	2711	1577	1127	541	387	4170	952	5122	964	687
1982	63	2711	1685	1203	541	387	4170	952	5122	964	687
1983	64	2711	1692	1209	541	387	4170	952	5122	964	687
1984	64	2720	1698	1213	543	388	4182	954	5136	967	689
1985	64	2711	1692	1209	541	387	4170	952	5122	964	687

OHID ICES TRANSPORTATION SCENARIO
OPTION SUMMARY BY MONTH

MONTH	UNIT TRAINS TO MPLS(3500 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	ASH TRUCKS FROM MPLS(10 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	ASH TRUCKS FROM MPLS(14 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3
1981												
JAN	11	12	11	11	211	242	220	223	150	173	157	159
FEB	6	6	6	6	149	174	154	155	106	124	110	111
MAR	5	7	6	6	150	178	156	157	107	127	111	112
APR	4	4	3	4	92	111	89	89	66	79	63	64
MAY	3	4	4	3	88	103	91	91	63	73	65	65
JUN	4	4	3	4	97	109	86	87	69	78	62	62
JUL	4	5	5	4	115	127	104	105	82	91	74	75
AUG	5	5	4	4	117	132	109	111	83	95	78	79
SEP	3	3	3	4	93	105	83	84	66	75	59	60
OCT	5	5	4	4	111	130	107	107	79	93	76	77
NOV	5	6	6	5	144	169	147	148	103	121	105	106
DEC	8	9	8	9	207	239	217	220	148	171	155	157
OTAL	63	70	63	64	1574	1819	1563	1577	1122	1300	1115	1127
1982												
JAN	8	10	9	8	223	256	234	237	159	183	167	169
FEB	6	6	6	7	157	184	164	165	112	131	117	118
MAR	6	7	6	6	158	188	166	167	113	134	118	119
APR	4	4	4	3	97	118	95	96	70	84	68	68
MAY	3	4	3	4	93	109	97	97	67	78	69	70
JUN	4	4	4	4	103	115	93	94	73	82	66	67
JUL	5	5	4	4	122	134	111	113	87	96	79	81
AUG	5	6	5	5	123	140	117	119	88	100	84	85
SEP	3	4	3	3	99	111	89	90	70	80	63	64
OCT	5	5	5	5	118	137	114	115	84	98	82	82
NOV	6	6	6	6	153	178	157	158	109	127	112	113
DEC	8	9	8	8	219	253	231	234	157	180	165	167
OTAL	63	70	63	63	1665	1923	1668	1685	1189	1373	1190	1203
1983												
JAN	8	10	9	9	223	256	235	238	159	183	168	170
FEB	6	6	6	6	157	184	164	166	112	132	117	119
MAR	6	7	6	7	158	189	167	168	113	135	119	120
APR	3	4	4	3	97	118	96	96	70	84	68	69
MAY	4	4	3	4	93	109	97	98	67	78	69	70
JUN	4	5	4	4	103	116	93	94	73	83	66	67
JUL	5	5	4	4	122	135	112	113	87	96	80	81
AUG	4	5	5	5	123	140	118	119	88	100	84	85
SEP	4	4	3	3	99	112	89	91	70	80	64	65
OCT	4	5	5	4	118	138	115	115	84	98	82	82
NOV	6	7	6	6	153	179	158	159	109	128	113	113
DEC	8	9	8	9	219	254	232	235	157	181	166	168
OTAL	62	71	63	64	1665	1930	1676	1692	1189	1378	1196	1209

GRID ICES TRANSPORTATION SCENARIO
OPTION SUMMARY BY MONTH

MONTH	UNIT TRAINS TO MPLS(3500 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	ASH TRUCKS FROM MPLS(10 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	ASH TRUCKS FROM MPLS(14 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3
1984												
JAN	9	9	9	9	223	256	235	238	159	183	168	170
FEB	6	7	6	6	163	191	171	172	117	137	122	123
MAR	6	7	6	7	158	189	167	168	113	135	119	120
APR	3	4	4	3	97	118	96	96	70	84	68	69
MAY	4	4	4	4	93	109	97	98	67	78	69	70
JUN	4	4	3	4	103	116	93	94	73	83	66	67
JUL	4	5	5	4	122	135	112	113	87	96	80	81
AUG	5	5	4	5	123	140	116	119	88	100	84	85
SEP	4	4	4	3	99	112	89	91	70	80	64	65
OCT	4	6	4	5	118	138	115	115	84	98	82	82
NOV	6	6	6	6	153	179	158	159	109	128	113	113
DEC	8	9	9	8	219	254	232	235	157	181	166	168
OTAL	63	70	64	64	1671	1937	1683	1698	1194	1383	1201	1213
1985												
JAN	9	10	8	9	223	256	235	238	159	183	168	170
FEB	5	6	6	6	157	184	164	166	112	132	117	119
MAR	6	7	7	6	158	189	167	168	113	135	119	120
APR	4	4	3	4	97	118	96	96	70	84	68	69
MAY	3	4	4	4	93	109	97	98	67	78	69	70
JUN	5	5	4	4	103	116	93	94	73	83	66	67
JUL	4	5	4	4	122	135	112	113	87	96	80	81
AUG	5	5	5	5	123	140	116	119	88	100	84	85
SEP	3	4	3	3	99	112	89	91	70	80	64	65
OCT	5	5	4	4	118	138	115	115	84	98	82	82
NOV	6	6	6	6	153	179	158	159	109	128	113	113
DEC	8	10	9	9	219	254	232	235	157	181	166	168
OTAL	63	71	63	64	1665	1930	1676	1692	1189	1378	1196	1209

78/02/20.

GRID ICES TRANSPORTATION SCENARIO
OPTION SUMMARY BY YEAR

YEAR	UNIT TRAINS TO MPLS(3500 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	ASH TRUCKS FROM MPLS(10 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3	ASH TRUCKS FROM MPLS(14 TON) BASIC PLAN	OPTION 1	OPTION 2	OPTION 3
1981	63	70	63	64	1574	1819	1563	1577	1122	1300	1115	1127
1982	63	70	63	63	1665	1923	1668	1685	1189	1373	1190	1203
1983	62	71	63	64	1665	1930	1676	1692	1189	1378	1196	1205
1984	63	70	64	64	1671	1937	1683	1698	1194	1383	1201	1213
1985	63	71	63	64	1665	1930	1676	1692	1189	1378	1196	1209

3.6 SENSITIVITY ANALYSIS

From the cost benefit comparisons general algebraic equations were developed for each of the plans considered. These equations were then inputed with 1981 costs and sensitivity generated allowing one cost to escalate with the others constant. The equations were put in a general computer form so that any variable can be inputed to generate sensitivity.

This section analyzes the various cost benefit studies of their sensitivity to eastern coal cost, western coal cost, energy production and energy credits. Payback on the turbine generator is shown.

Also generated using sensitivity analysis is cost benefit versus electric generation credit and the optimum capital cost for ICES if the turbine-generator is to be paid back at the end of 1981.

3.6.1 SENSITIVITY OF EASTERN COAL

The folowing plots present the sensitivity of the cost benefit comparisons to escalating costs of Eastern coal and changing electric generation credits.

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 2.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	24	10	8	5	5	2	P
1978	40.19	NONE	26	10	8	5	5	2	A
1979	40.99	NONE	28	10	8	5	5	2	Y
1980	41.81	NONE	30	11	8	5	5	2	B
1981	42.65	NONE	32	11	8	6	5	2	A
1982	43.50	NONE	35	11	8	6	5	2	C
1983	44.37	NONE	39	11	9	6	5	2	K
1984	45.26	NONE	44	12	9	6	5	2	
1985	46.16	NONE	51	12	9	6	5	2	Y
1986	47.09	NONE	64	12	9	6	5	2	E
1987	48.03	NONE	102	13	9	6	5	2	A
1988	48.99	NONE	NONE	13	10	6	5	2	R
1989	49.97	NONE	NONE	14	10	6	5	2	S
1990	50.97	NONE	NONE	14	10	6	5	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

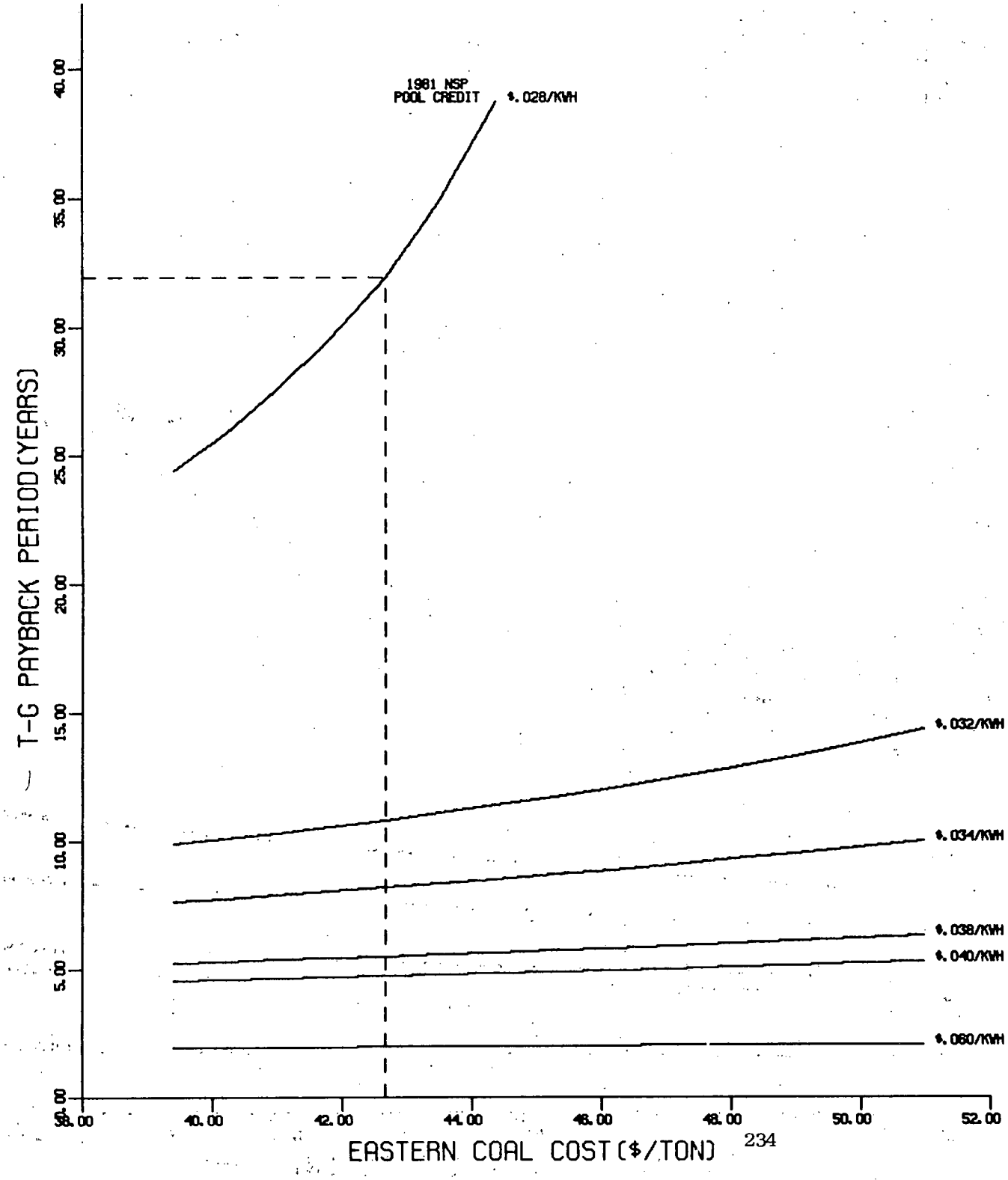
COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 2.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	12	7	6	4	4	2	P
1978	40.19	NONE	13	7	6	4	4	2	A
1979	40.99	NONE	13	7	6	4	4	2	Y
1980	41.81	NONE	14	7	6	4	4	2	B
1981	42.65	NONE	14	8	6	4	4	2	A
1982	43.50	NONE	14	8	6	5	4	2	C
1983	44.37	NONE	15	8	6	5	4	2	K
1984	45.26	NONE	16	8	6	5	4	2	
1985	46.16	NONE	16	8	7	5	4	2	Y
1986	47.09	NONE	17	8	7	5	4	2	E
1987	48.03	NONE	18	8	7	5	4	2	A
1988	48.99	NONE	19	9	7	5	4	2	R
1989	49.97	NONE	20	9	7	5	4	2	S
1990	50.97	NONE	21	9	7	5	4	2	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

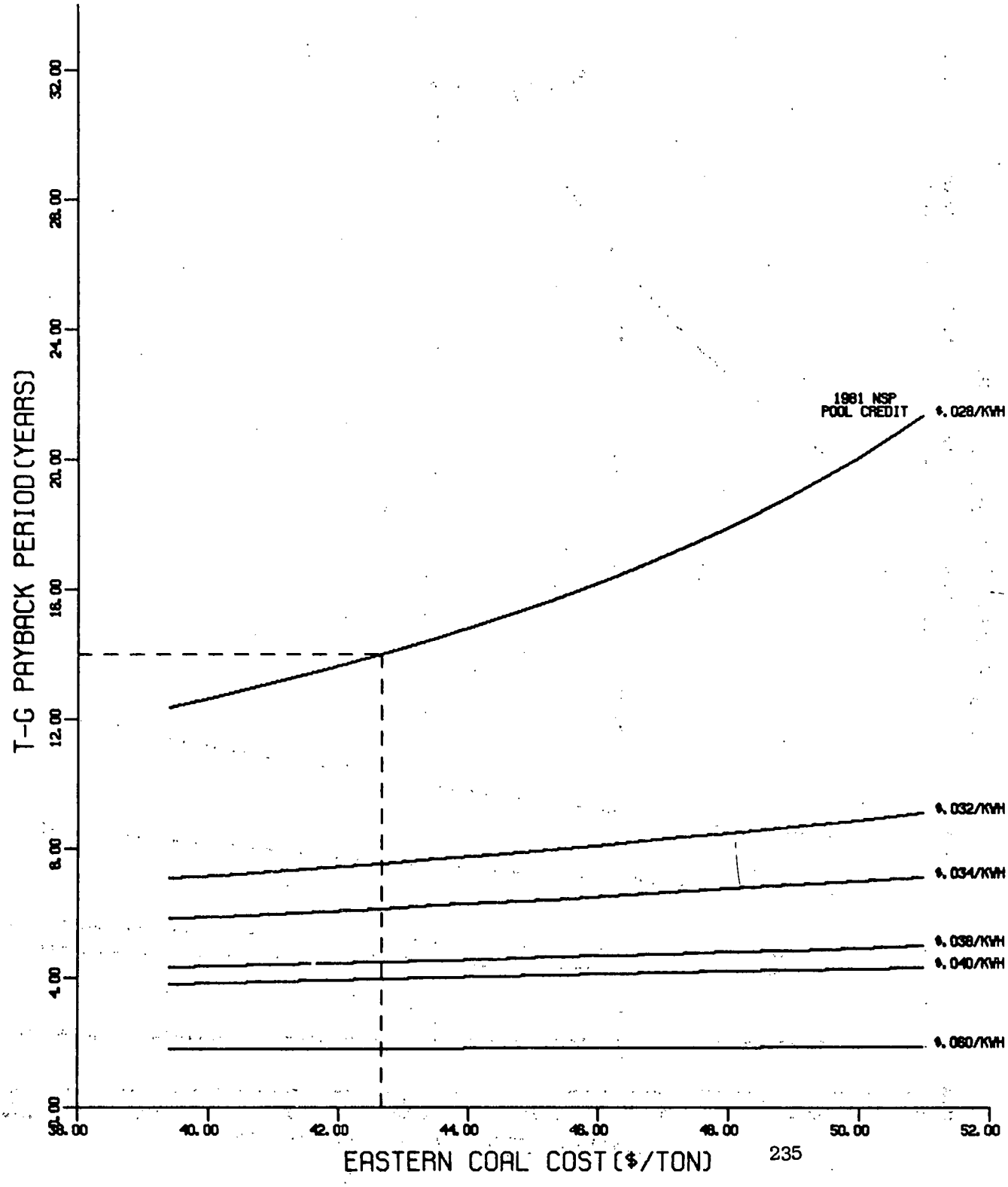
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 2.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 2.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 4.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	24	10	8	5	5	2	P
1978	40.98	NONE	28	10	8	5	5	2	A
1979	42.62	NONE	32	11	8	6	5	2	Y
1980	44.32	NONE	38	11	8	6	5	2	B
1981	46.09	NONE	51	12	9	6	5	2	A
1982	47.94	NONE	94	13	9	6	5	2	C
1983	49.85	NONE	NONE	14	10	6	5	2	K
1984	51.85	NONE	NONE	15	10	6	5	2	
1985	53.92	NONE	NONE	16	11	7	6	2	Y
1986	56.08	NONE	NONE	18	12	7	6	2	E
1987	58.32	NONE	NONE	20	13	7	6	2	A
1988	60.65	NONE	NONE	23	14	8	6	2	R
1989	63.08	NONE	NONE	28	15	8	6	2	S
1990	65.60	NONE	NONE	36	17	8	7	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

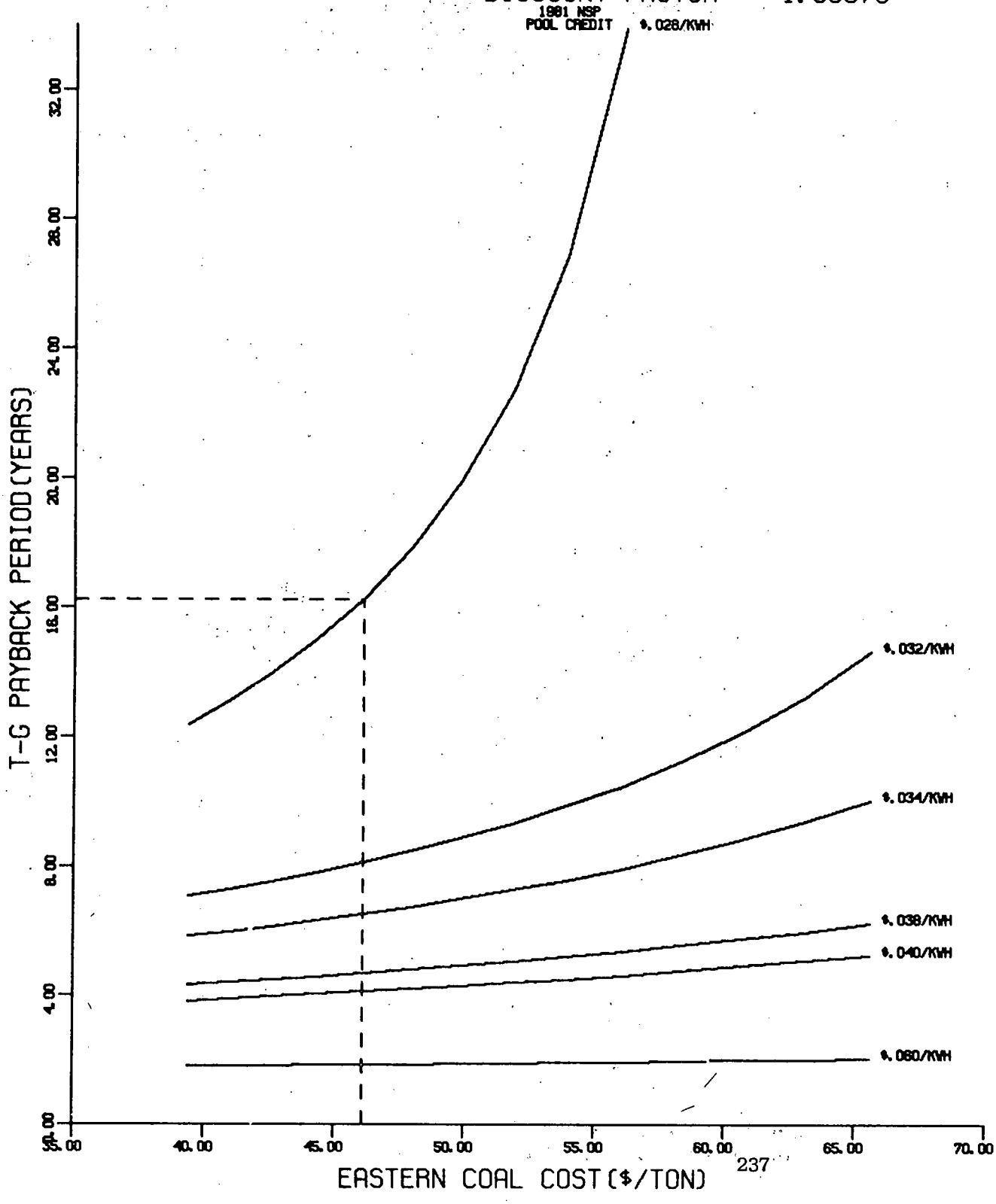
COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 4.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	12	7	6	4	4	2	P
1978	40.98	NONE	13	7	6	4	4	2	A
1979	42.62	NONE	14	8	6	4	4	2	Y
1980	44.32	NONE	15	8	6	5	4	2	B
1981	46.09	NONE	16	8	7	5	4	2	A
1982	47.94	NONE	18	8	7	5	4	2	C
1983	49.85	NONE	20	9	7	5	4	2	K
1984	51.85	NONE	23	9	7	5	4	2	
1985	53.92	NONE	27	10	8	5	4	2	Y
1986	56.08	NONE	34	10	8	5	5	2	E
1987	58.32	NONE	52	11	8	6	5	2	A
1988	60.65	NONE	NONE	12	9	6	5	2	R
1989	63.08	NONE	NONE	13	9	6	5	2	S
1990	65.60	NONE	NONE	15	10	6	5	2	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

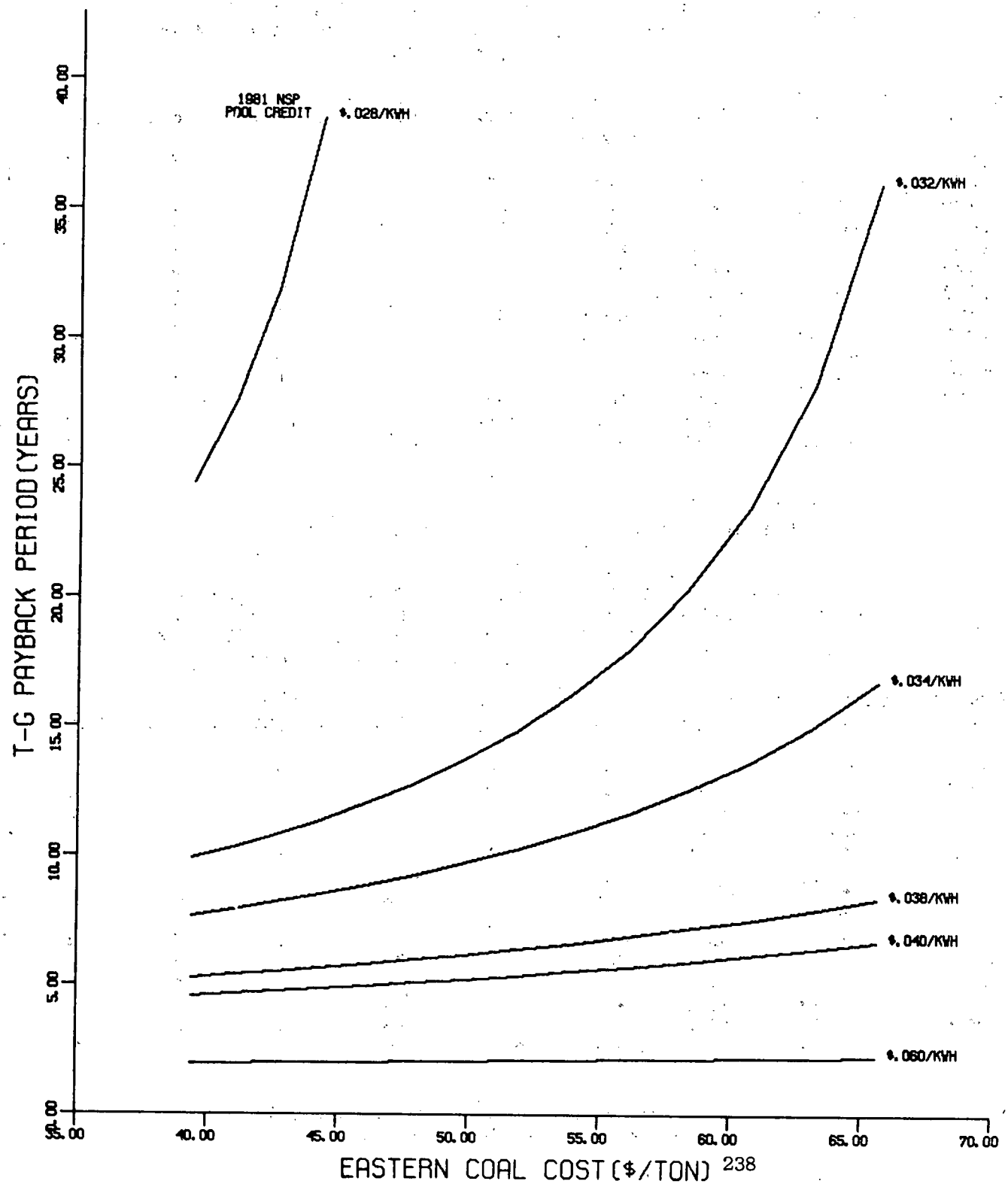
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 4.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 4.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 5.75 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	24	10	8	5	5	2	P
1978	41.67	NONE	29	11	8	5	5	2	A
1979	44.06	NONE	37	11	8	6	5	2	Y
1980	46.59	NONE	56	12	9	6	5	2	B
1981	49.27	NONE	NONE	13	10	6	5	2	A
1982	52.11	NONE	NONE	15	10	6	5	2	C
1983	55.10	NONE	NONE	17	11	7	6	2	K
1984	58.27	NONE	NONE	20	13	7	6	2	
1985	61.62	NONE	NONE	25	14	8	6	2	Y
1986	65.17	NONE	NONE	34	16	8	7	2	E
1987	68.91	NONE	NONE	64	20	9	7	2	A
1988	72.88	NONE	NONE	NONE	26	10	8	2	R
1989	77.07	NONE	NONE	NONE	38	11	8	2	S
1990	81.50	NONE	NONE	NONE	NONE	13	9	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

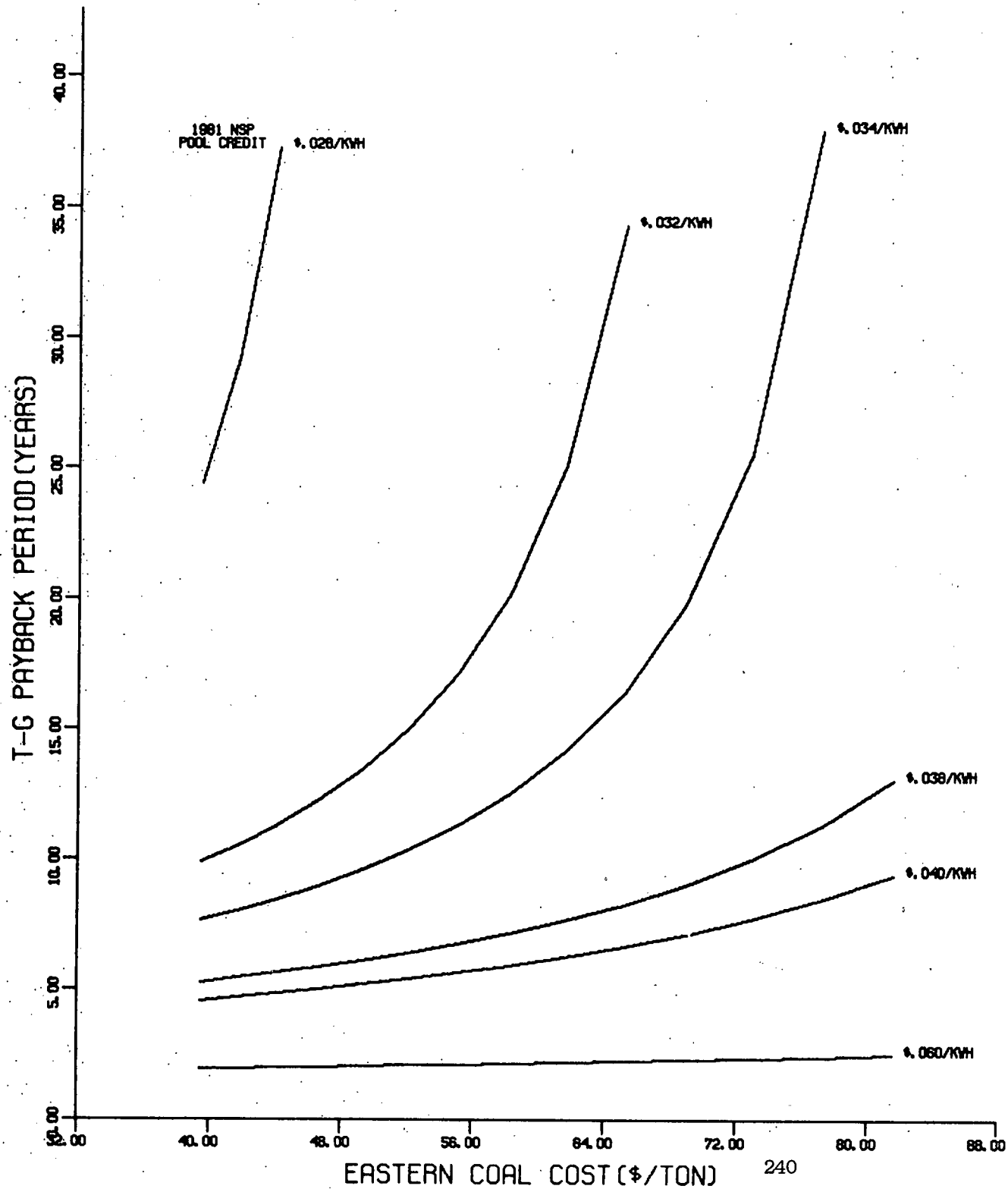
COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 5.75 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	12	7	6	4	4	2	P
1978	41.67	NONE	13	7	6	4	4	2	A
1979	44.06	NONE	15	8	6	5	4	2	Y
1980	46.59	NONE	17	8	7	5	4	2	B
1981	49.27	NONE	19	9	7	5	4	2	A
1982	52.11	NONE	23	9	7	5	4	2	C
1983	55.10	NONE	30	10	8	5	5	2	K
1984	58.27	NONE	51	11	8	6	5	2	
1985	61.62	NONE	NONE	13	9	6	5	2	Y
1986	65.17	NONE	NONE	14	10	6	5	2	E
1987	68.91	NONE	NONE	17	11	7	6	2	A
1988	72.88	NONE	NONE	21	13	7	6	2	R
1989	77.07	NONE	NONE	31	15	8	6	2	S
1990	81.50	NONE	NONE	NONE	19	9	7	2	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

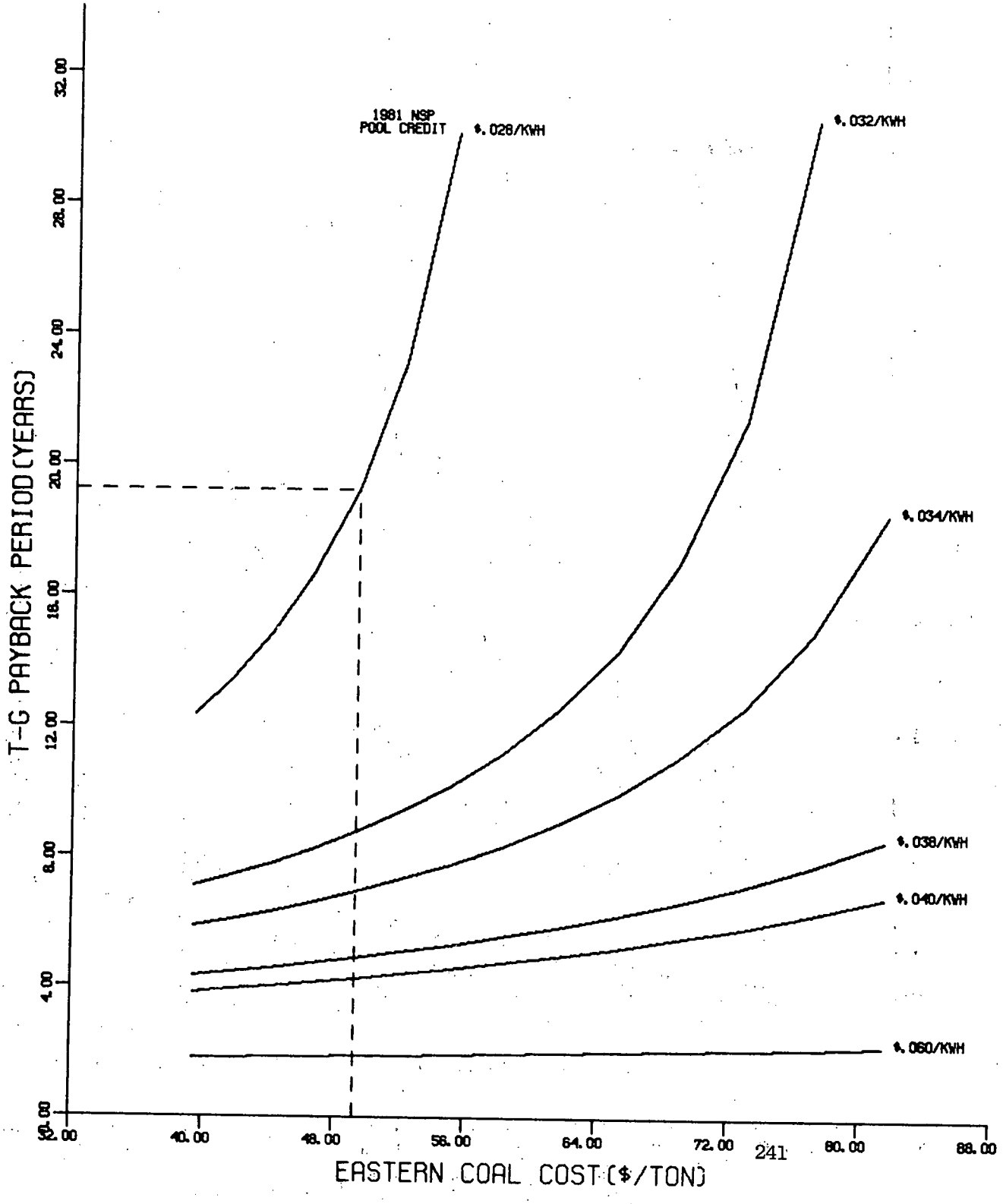
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 5.75 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 5.75 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 6.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	24	10	8	5	5	2	P
1978	41.76	NONE	29	11	8	5	5	2	A
1979	44.27	NONE	38	11	8	6	5	2	Y
1980	46.93	NONE	61	12	9	6	5	2	B
1981	49.74	NONE	NONE	14	10	6	5	2	A
1982	52.73	NONE	NONE	15	11	6	5	2	C
1983	55.89	NONE	NONE	18	12	7	6	2	K
1984	59.24	NONE	NONE	21	13	7	6	2	
1985	62.80	NONE	NONE	27	15	8	6	2	Y
1986	66.57	NONE	NONE	41	18	9	7	2	E
1987	70.56	NONE	NONE	NONE	22	9	7	2	A
1988	74.79	NONE	NONE	NONE	30	11	8	2	R
1989	79.28	NONE	NONE	NONE	54	12	9	2	S
1990	84.04	NONE	NONE	NONE	NONE	14	10	3	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

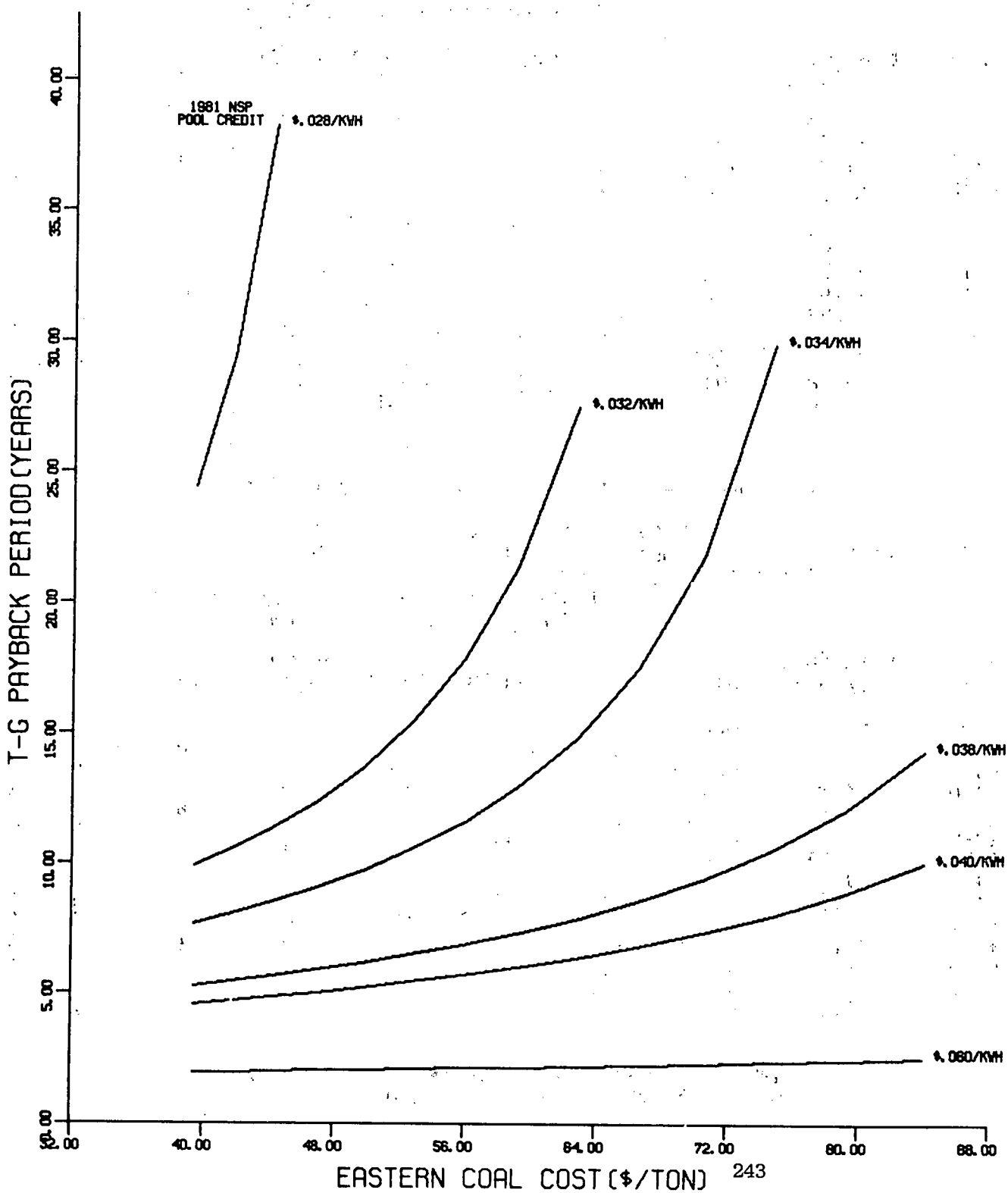
COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 6.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	12	7	6	4	4	2	P
1978	41.76	NONE	14	7	6	4	4	2	A
1979	44.27	NONE	15	8	6	5	4	2	Y
1980	46.93	NONE	17	8	7	5	4	2	B
1981	49.74	NONE	20	9	7	5	4	2	A
1982	52.73	NONE	24	10	7	5	4	2	C
1983	55.89	NONE	33	10	8	5	5	2	K
1984	59.24	NONE	104	12	9	6	5	2	
1985	62.80	NONE	NONE	13	9	6	5	2	Y
1986	66.57	NONE	NONE	15	10	6	5	2	E
1987	70.56	NONE	NONE	19	12	7	6	2	A
1988	74.79	NONE	NONE	25	14	7	6	2	R
1989	79.28	NONE	NONE	42	17	8	7	2	S
1990	84.04	NONE	NONE	NONE	22	9	7	2	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

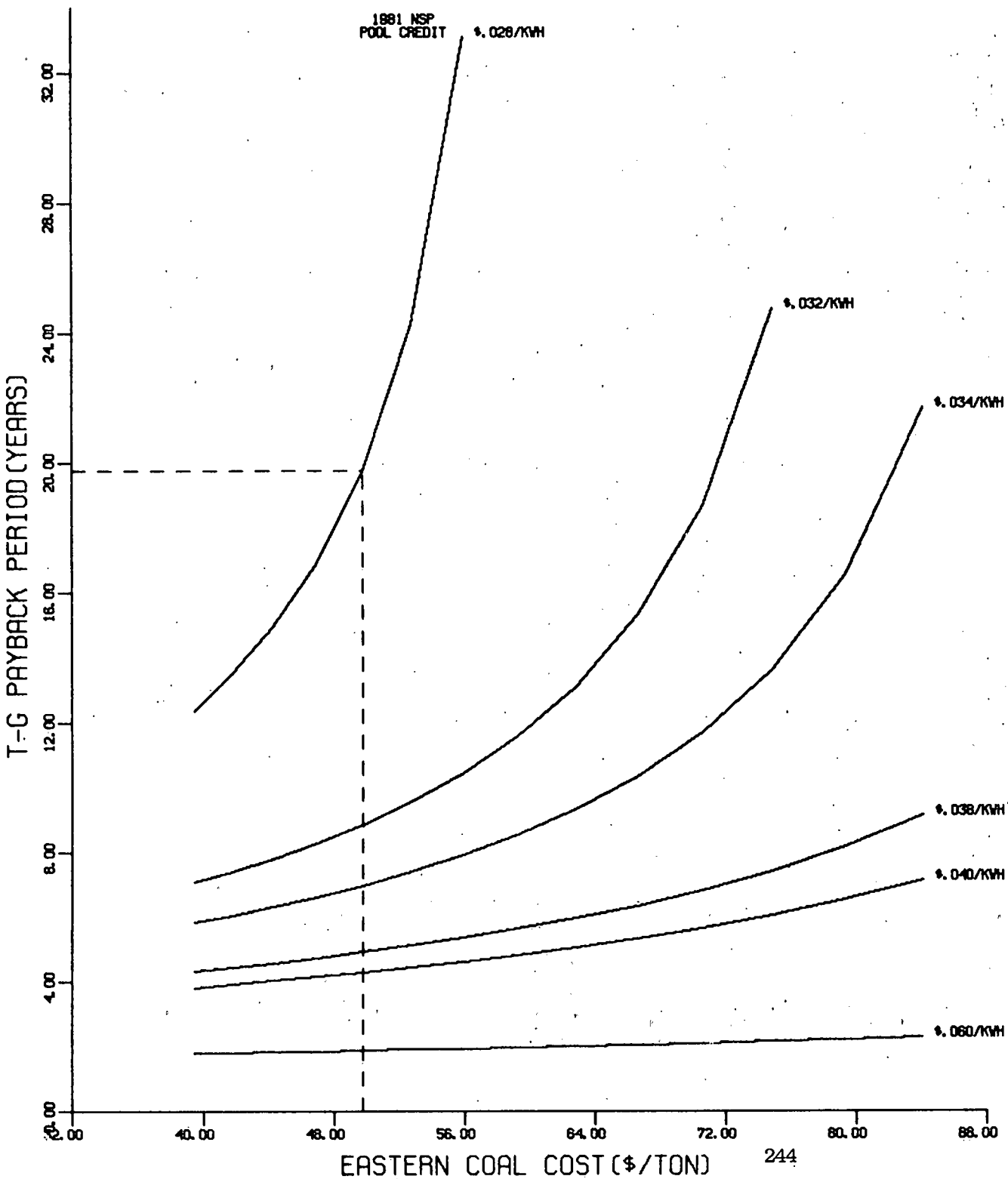
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 6.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 6.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 7.40 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	24	10	8	5	5	2	P
1978	42.32	NONE	31	11	8	5	5	2	A
1979	45.45	NONE	45	12	9	6	5	2	Y
1980	48.81	NONE	NONE	13	9	6	5	2	B
1981	52.42	NONE	NONE	15	10	6	5	2	A
1982	56.30	NONE	NONE	18	12	7	6	2	C
1983	60.46	NONE	NONE	23	14	7	6	2	K
1984	64.94	NONE	NONE	33	16	8	7	2	
1985	69.74	NONE	NONE	92	21	9	7	2	Y
1986	74.90	NONE	NONE	NONE	30	11	8	2	E
1987	80.44	NONE	NONE	NONE	77	13	9	2	A
1988	86.40	NONE	NONE	NONE	NONE	16	11	3	R
1989	92.79	NONE	NONE	NONE	NONE	22	13	3	S
1990	99.66	NONE	NONE	NONE	NONE	41	18	3	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

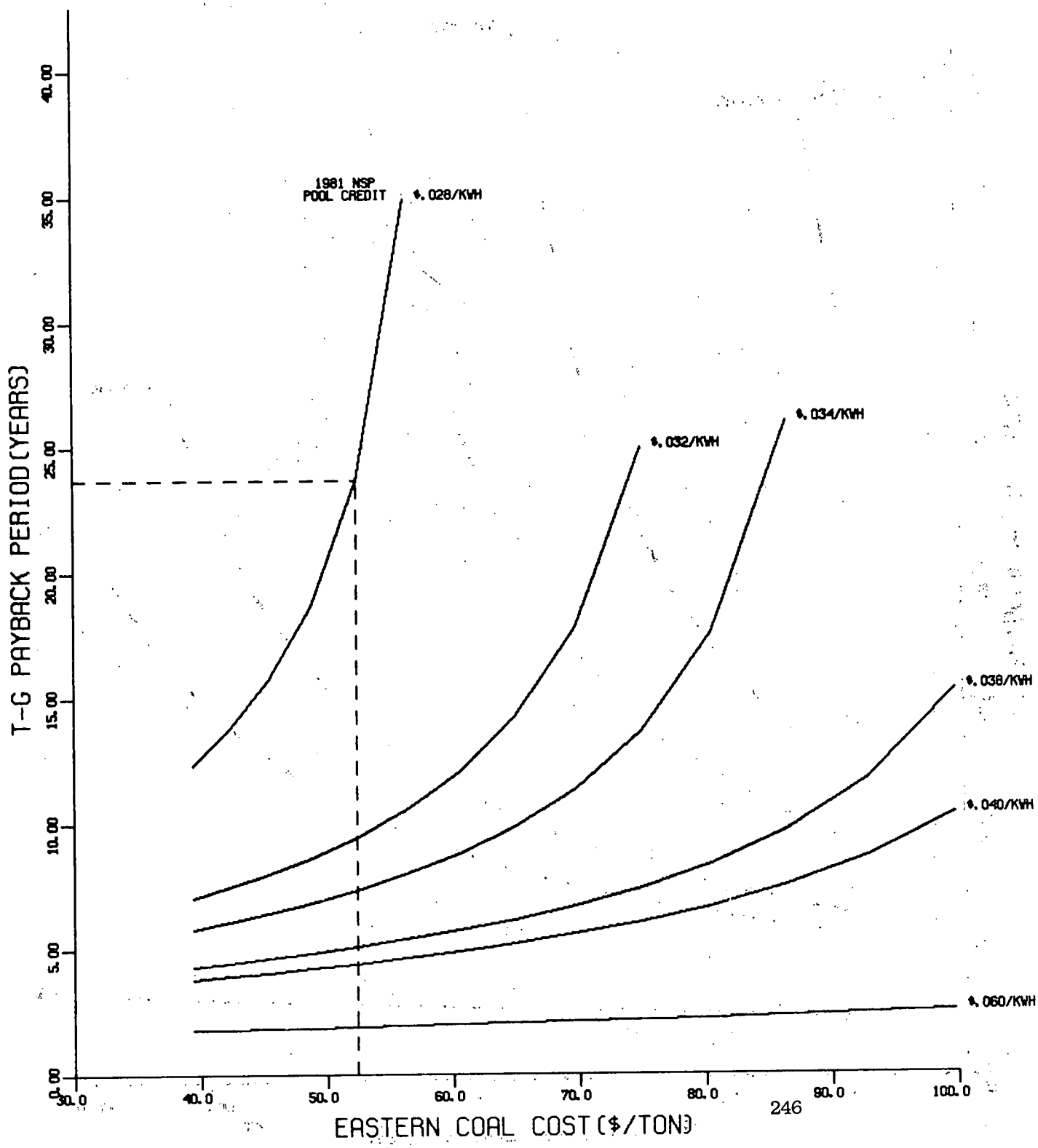
COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 7.40 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	12	7	6	4	4	2	P
1978	42.32	NONE	14	7	6	4	4	2	A
1979	45.45	NONE	16	8	6	5	4	2	Y
1980	48.81	NONE	19	9	7	5	4	2	B
1981	52.42	NONE	24	9	7	5	4	2	A
1982	56.30	NONE	35	11	8	5	5	2	C
1983	60.46	NONE	NONE	12	9	6	5	2	K
1984	64.94	NONE	NONE	14	10	6	5	2	
1985	69.74	NONE	NONE	18	11	7	6	2	Y
1986	74.90	NONE	NONE	25	14	7	6	2	E
1987	80.44	NONE	NONE	58	18	8	7	2	A
1988	86.40	NONE	NONE	NONE	26	10	7	2	R
1989	92.79	NONE	NONE	NONE	NONE	12	9	2	S
1990	99.66	NONE	NONE	NONE	NONE	15	10	3	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

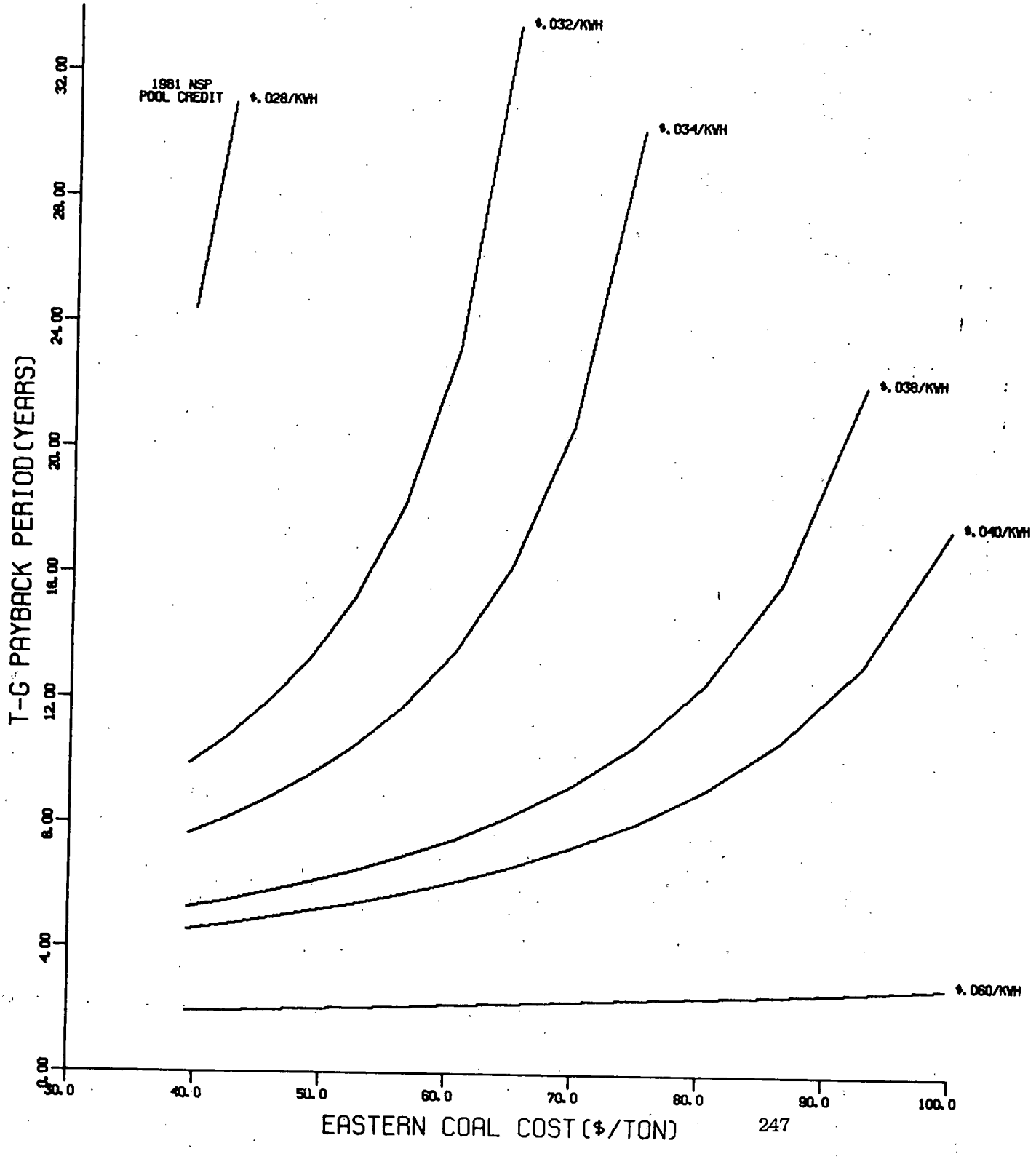
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 7.40 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 7.40 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 8.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	24	10	8	5	5	2	P
1978	42.55	NONE	32	11	8	6	5	2	A
1979	45.96	NONE	49	12	9	6	5	2	Y
1980	49.63	NONE	NONE	14	10	6	5	2	B
1981	53.60	NONE	NONE	16	11	7	6	2	A
1982	57.89	NONE	NONE	20	12	7	6	2	C
1983	62.52	NONE	NONE	27	15	8	6	2	K
1984	67.52	NONE	NONE	47	18	9	7	2	
1985	72.93	NONE	NONE	NONE	26	10	8	2	Y
1986	78.76	NONE	NONE	NONE	49	12	9	2	E
1987	85.06	NONE	NONE	NONE	NONE	15	10	3	A
1988	91.87	NONE	NONE	NONE	NONE	21	13	3	R
1989	99.22	NONE	NONE	NONE	NONE	38	17	3	S
1990	107.15	NONE	NONE	NONE	NONE	NONE	28	3	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

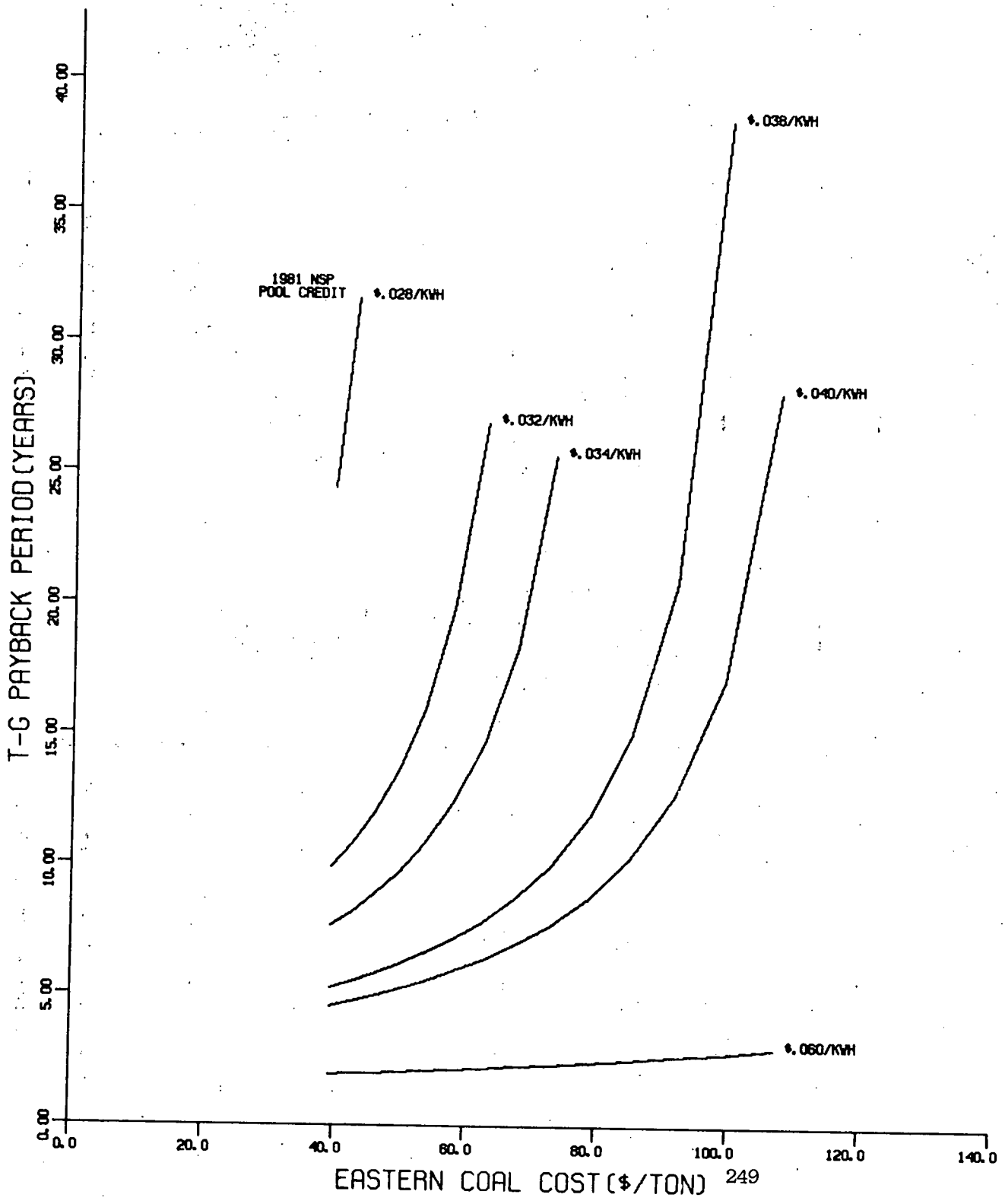
COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 8.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	12	7	6	4	4	2	P
1978	42.55	NONE	14	8	6	4	4	2	A
1979	45.96	NONE	16	8	6	5	4	2	Y
1980	49.63	NONE	20	9	7	5	4	2	B
1981	53.60	NONE	26	10	8	5	4	2	A
1982	57.89	NONE	46	11	8	6	5	2	C
1983	62.52	NONE	NONE	13	9	6	5	2	K
1984	67.52	NONE	NONE	16	11	6	5	2	
1985	72.93	NONE	NONE	22	13	7	6	2	Y
1986	78.76	NONE	NONE	38	16	8	6	2	E
1987	85.06	NONE	NONE	NONE	23	9	7	2	A
1988	91.87	NONE	NONE	NONE	72	11	8	2	R
1989	99.22	NONE	NONE	NONE	NONE	15	10	3	S
1990	107.15	NONE	NONE	NONE	NONE	23	13	3	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

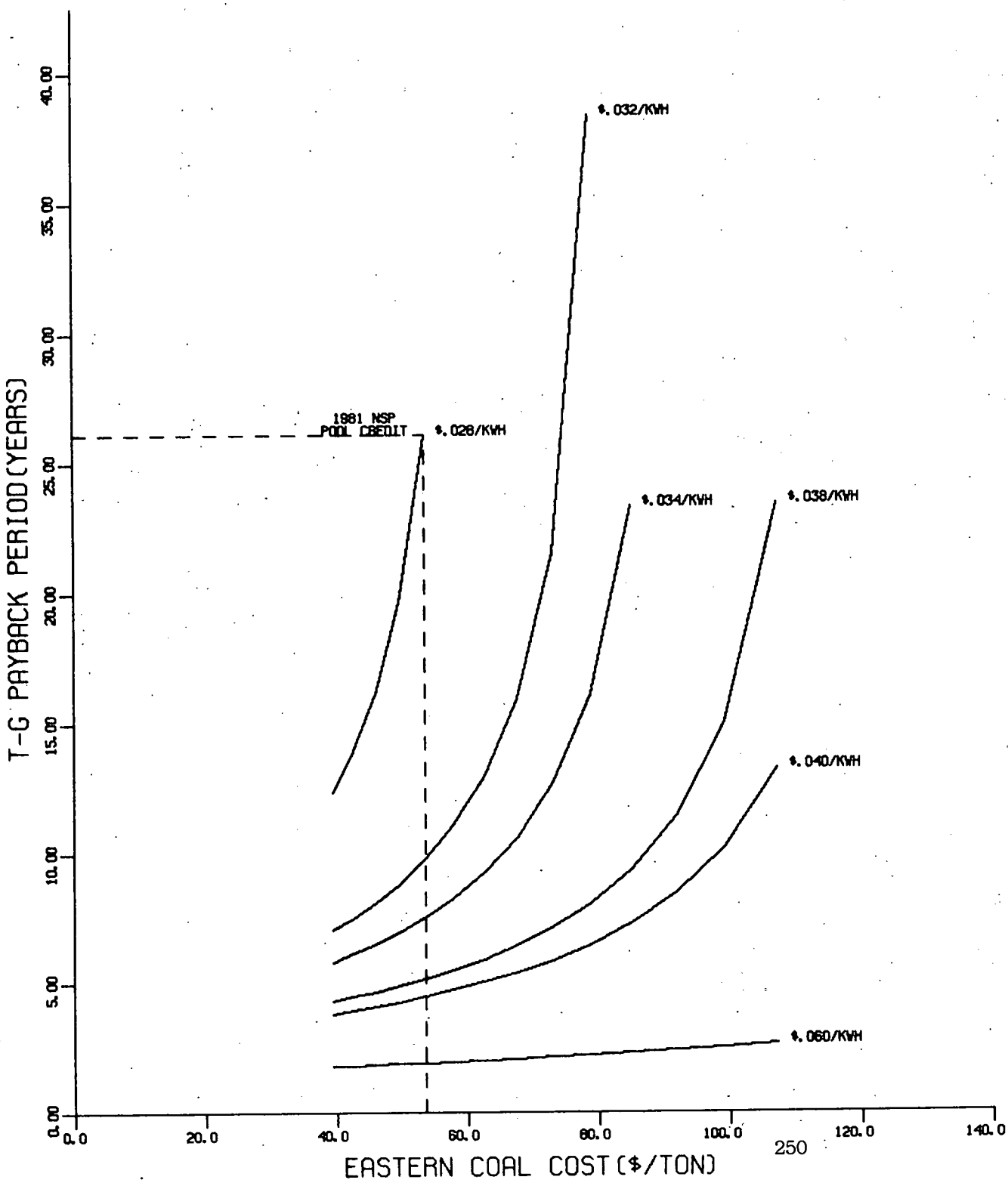
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 8.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 8.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 10.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	24	10	8	5	5	2	P
1978	43.34	NONE	34	11	8	6	5	2	A
1979	47.67	NONE	80	13	9	6	5	2	Y
1980	52.44	NONE	NONE	15	10	6	5	2	B
1981	57.69	NONE	NONE	20	12	7	6	2	A
1982	63.45	NONE	NONE	29	15	8	6	2	C
1983	69.80	NONE	NONE	97	21	9	7	2	K
1984	76.78	NONE	NONE	NONE	37	11	8	2	
1985	84.46	NONE	NONE	NONE	NONE	15	10	3	Y
1986	92.90	NONE	NONE	NONE	NONE	22	13	3	E
1987	102.19	NONE	NONE	NONE	NONE	69	20	3	A
1988	112.41	NONE	NONE	NONE	NONE	NONE	55	3	R
1989	123.65	NONE	NONE	NONE	NONE	NONE	NONE	3	S
1990	136.02	NONE	NONE	NONE	NONE	NONE	NONE	4	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

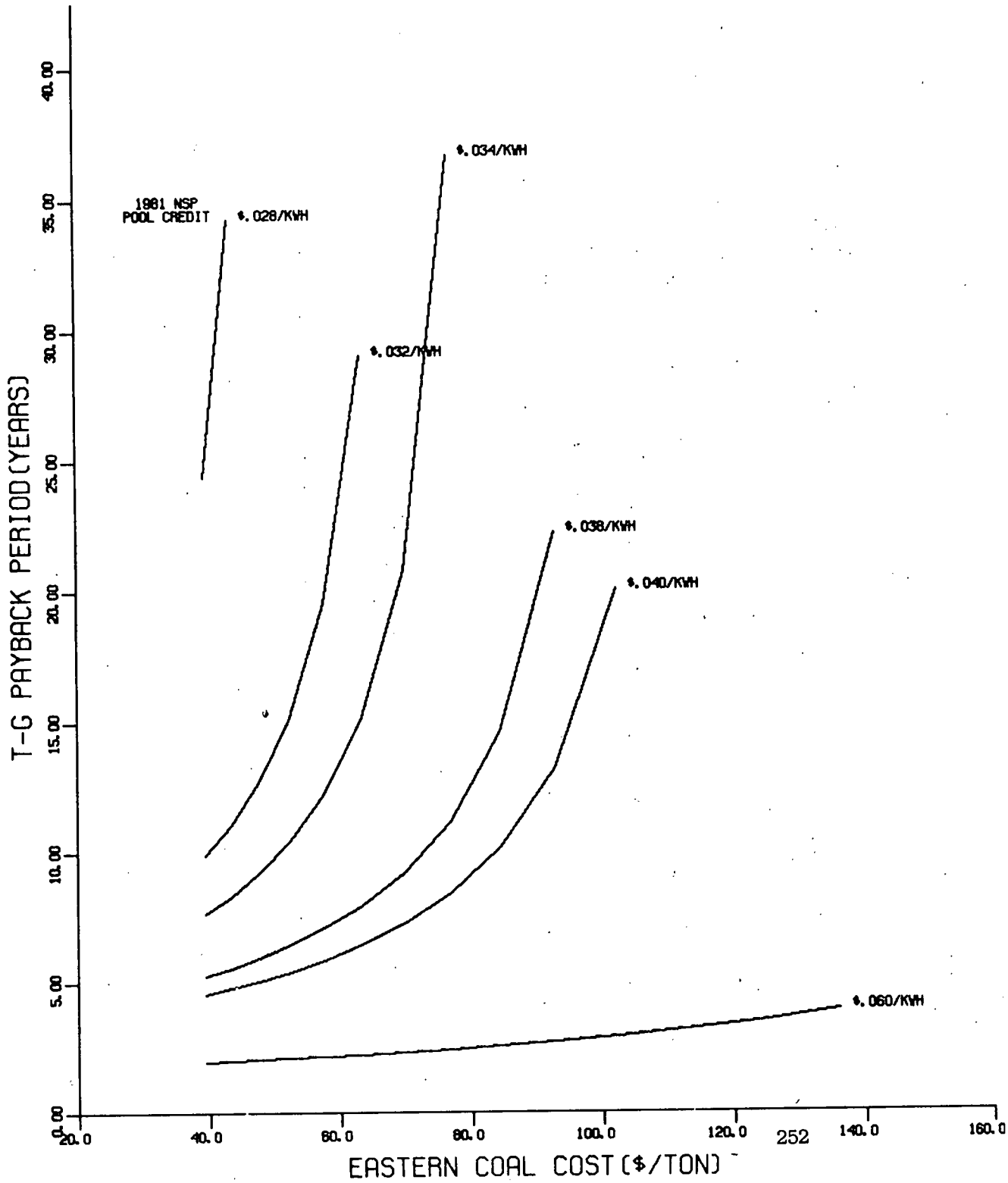
COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 10.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	39.40	NONE	12	7	6	4	4	2	P
1978	43.34	NONE	14	8	6	5	4	2	A
1979	47.67	NONE	18	8	7	5	4	2	Y
1980	52.44	NONE	24	9	7	5	4	2	B
1981	57.69	NONE	44	11	8	5	5	2	A
1982	63.45	NONE	NONE	13	9	6	5	2	C
1983	69.80	NONE	NONE	18	11	7	6	2	K
1984	76.78	NONE	NONE	30	15	8	6	2	
1985	84.46	NONE	NONE	NONE	22	9	7	2	Y
1986	92.90	NONE	NONE	NONE	NONE	12	9	2	E
1987	102.19	NONE	NONE	NONE	NONE	17	11	3	A
1988	112.41	NONE	NONE	NONE	NONE	43	17	3	R
1989	123.65	NONE	NONE	NONE	NONE	NONE	45	3	S
1990	136.02	NONE	NONE	NONE	NONE	NONE	NONE	3	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

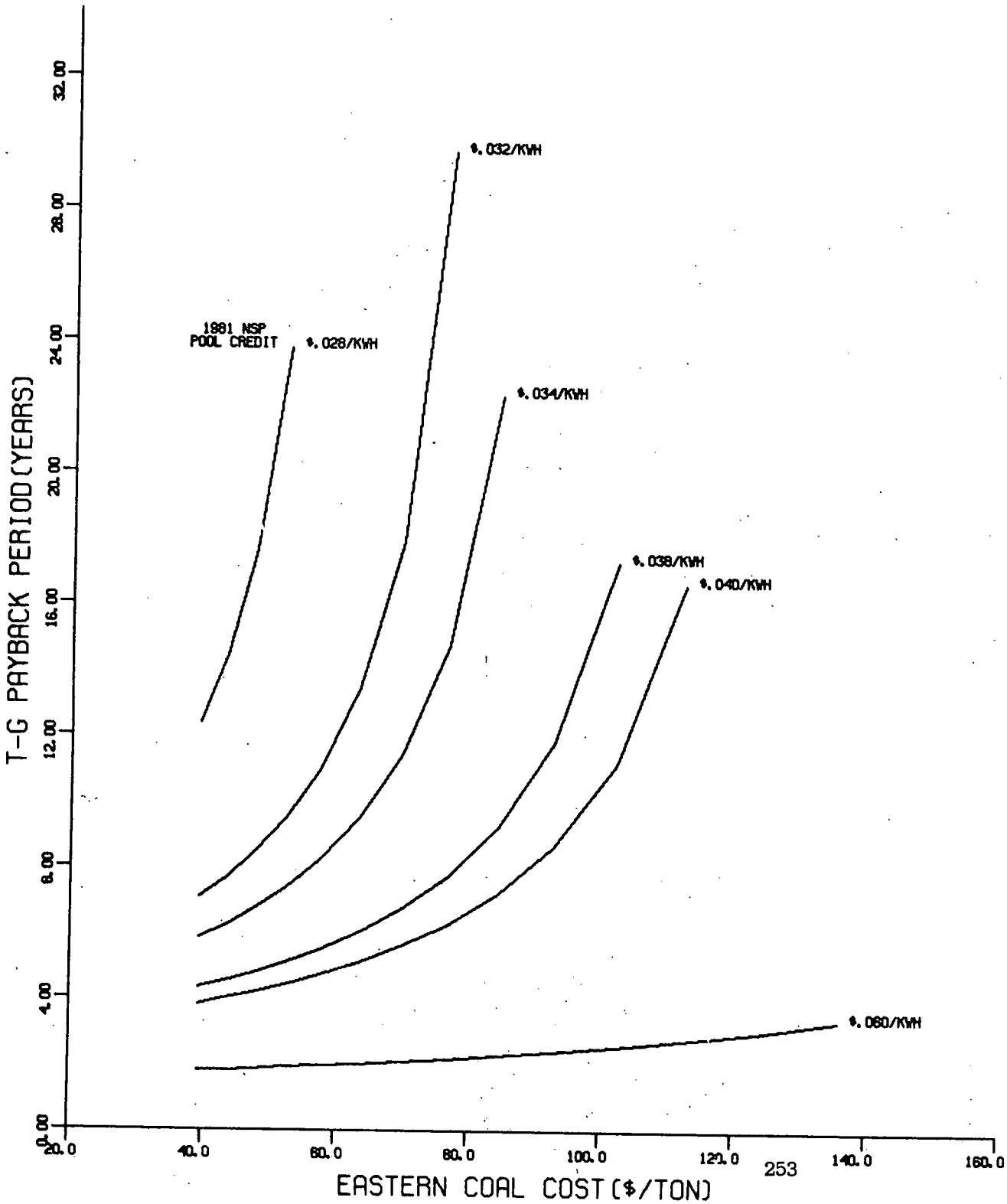
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 10.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.04260



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 10.00 PERCENT
EASTERN COAL BASE COST = 39.40 $/TON(1977)
DISCOUNT FACTOR = 1.06370



3.6.2 SENSITIVITY OF WESTERN COAL

The following plots present the sensitivity of the cost benefit comparisons to changing western coal costs and changing electric generation credits.

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 2.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	33	10	6	5	4	4	2	P
1978	15.93	35	10	6	5	4	4	2	A
1979	16.25	37	11	6	5	4	4	2	Y
1980	16.58	40	11	7	5	4	4	2	B
1981	16.91	43	11	7	5	4	4	2	A
1982	17.25	49	11	7	6	4	4	2	C
1983	17.59	57	11	7	6	4	4	2	K
1984	17.94	76	11	7	6	4	4	2	
1985	18.30	NONE	12	7	6	4	4	2	Y
1986	18.67	NONE	12	7	6	4	4	2	E
1987	19.04	NONE	12	7	6	4	4	2	A
1988	19.42	NONE	12	7	6	4	4	2	R
1989	19.81	NONE	12	7	6	4	4	2	S
1990	20.21	NONE	13	7	6	4	4	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 2.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	8	5	4	3	3	2	1	P
1978	15.93	8	5	4	3	3	2	1	A
1979	16.25	8	5	4	3	3	2	1	Y
1980	16.58	8	5	4	3	3	2	1	B
1981	16.91	8	5	4	3	3	2	1	A
1982	17.25	8	5	4	3	3	2	1	C
1983	17.59	9	5	4	3	3	2	1	K
1984	17.94	9	5	4	3	3	2	1	
1985	18.30	9	5	4	3	3	2	1	Y
1986	18.67	9	5	4	3	3	3	1	E
1987	19.04	9	5	4	3	3	3	1	A
1988	19.42	10	5	4	3	3	3	1	R
1989	19.81	10	5	4	3	3	3	1	S
1990	20.21	10	5	4	3	3	3	1	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

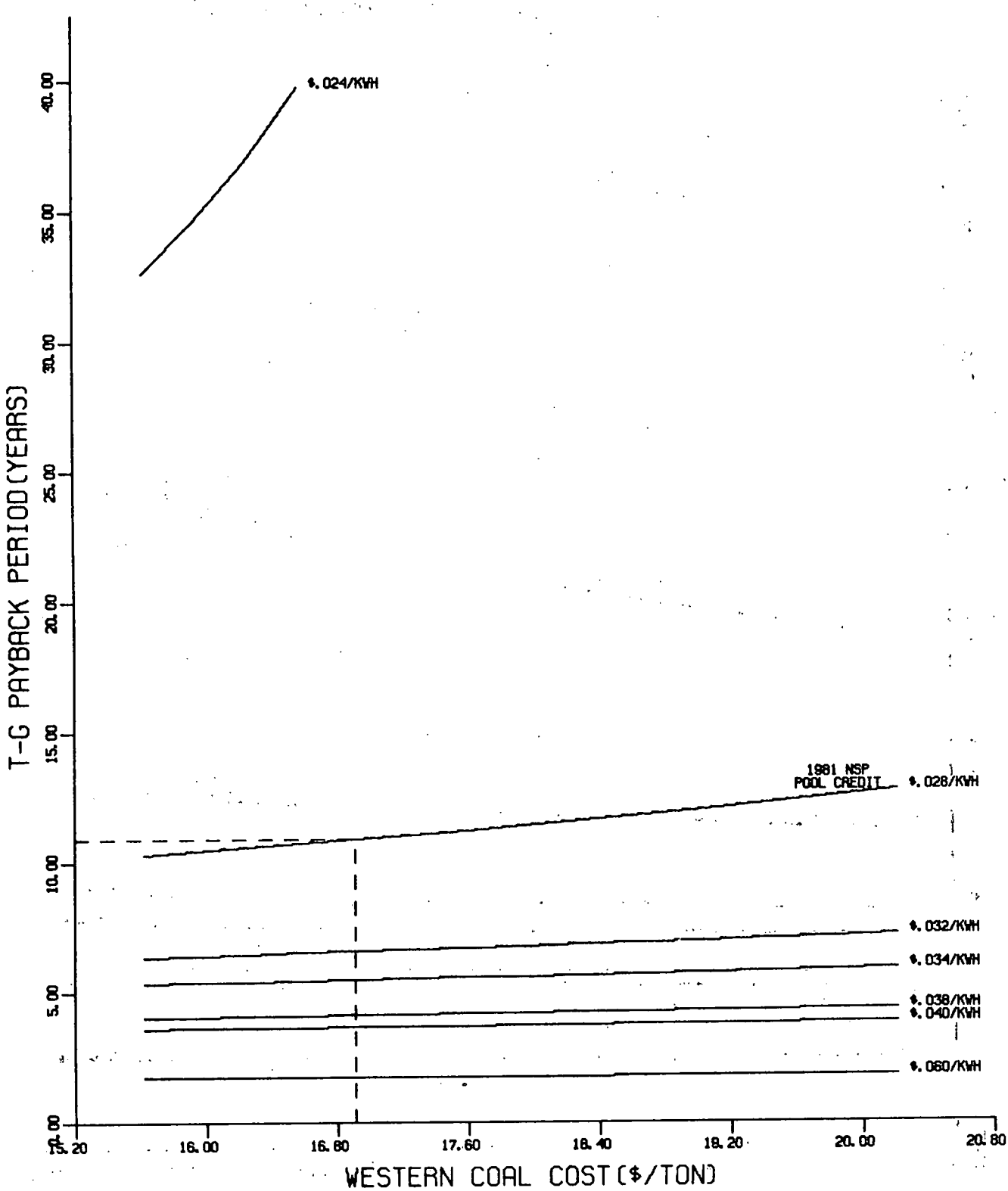
COST BENEFIT COMPARISON - I.A.1(C)

CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING

ESCALATION OF BASE COAL COST PER ANNUM = 2.00 PERCENT

WESTERN COAL BASE COST = 15.62 $/TON(1977)

DISCOUNT FACTOR = 1.06345



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

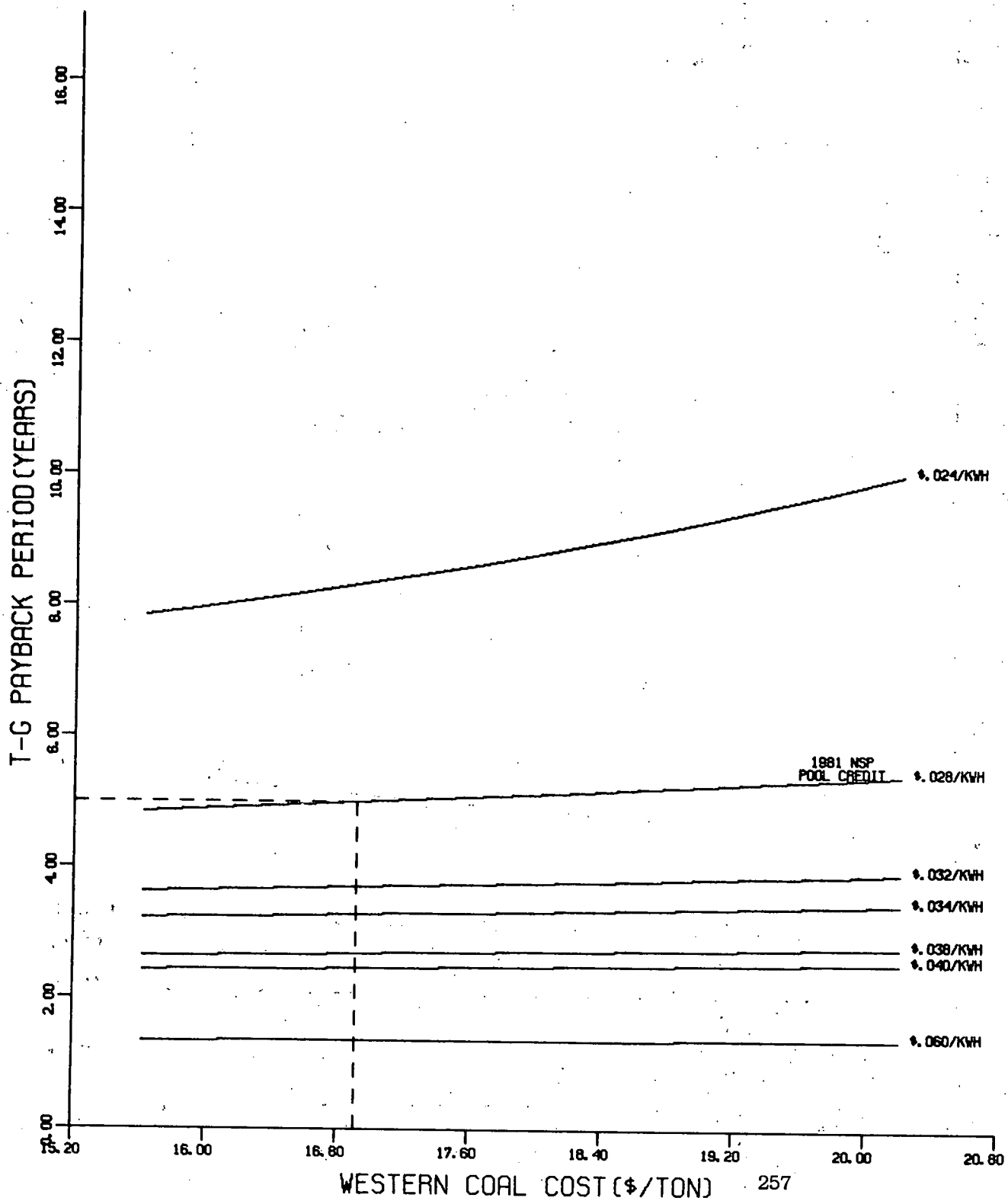
COST BENEFIT COMPARISON - I.A.2(B)

CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING

ESCALATION OF BASE COAL COST PER ANNUM = 2.00 PERCENT

WESTERN COAL BASE COST = 15.62 $/TON(1977)

DISCOUNT FACTOR = 1.27250



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 4.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	33	10	6	5	4	4	2	P
1978	16.24	37	11	6	5	4	4	2	A
1979	16.89	43	11	7	5	4	4	2	Y
1980	17.57	56	11	7	6	4	4	2	B
1981	18.27	NONE	12	7	6	4	4	2	A
1982	19.00	NONE	12	7	6	4	4	2	C
1983	19.76	NONE	12	7	6	4	4	2	K
1984	20.55	NONE	13	7	6	4	4	2	
1985	21.38	NONE	14	7	6	4	4	2	Y
1986	22.23	NONE	14	8	6	5	4	2	E
1987	23.12	NONE	15	8	6	5	4	2	A
1988	24.05	NONE	16	8	6	5	4	2	R
1989	25.01	NONE	17	8	7	5	4	2	S
1990	26.01	NONE	18	9	7	5	4	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

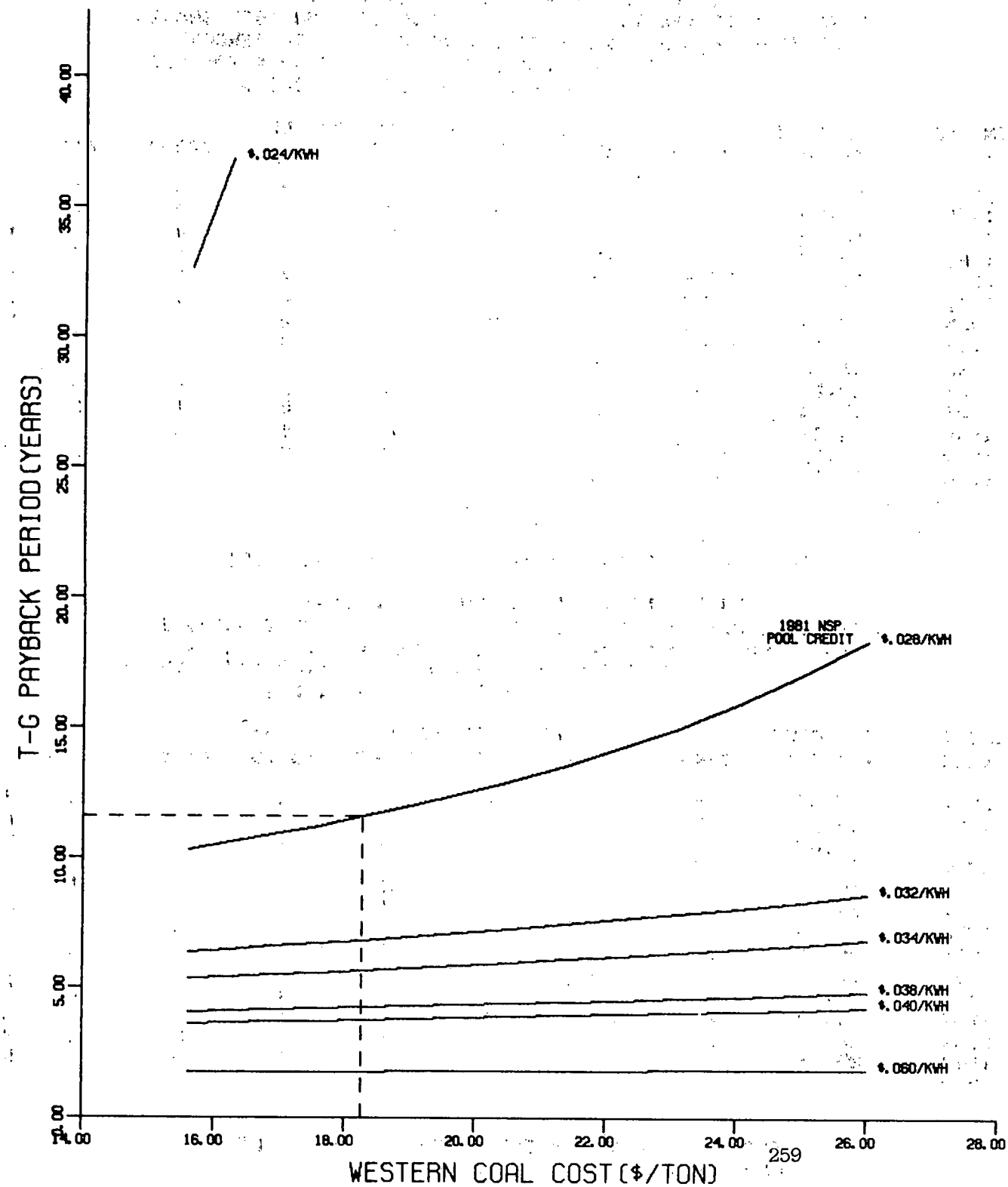
COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 4.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	8	5	4	3	3	2	1	P
1978	16.24	8	5	4	3	3	2	1	A
1979	16.89	8	5	4	3	3	2	1	Y
1980	17.57	9	5	4	3	3	2	1	B
1981	18.27	9	5	4	3	3	2	1	A
1982	19.00	9	5	4	3	3	3	1	C
1983	19.76	10	5	4	3	3	3	1	K
1984	20.55	10	5	4	3	3	3	1	
1985	21.38	11	6	4	4	3	3	1	Y
1986	22.23	12	6	4	4	3	3	1	E
1987	23.12	13	6	4	4	3	3	1	A
1988	24.05	15	6	4	4	3	3	1	R
1989	25.01	18	6	4	4	3	3	1	S
1990	26.01	NONE	6	4	4	3	3	1	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

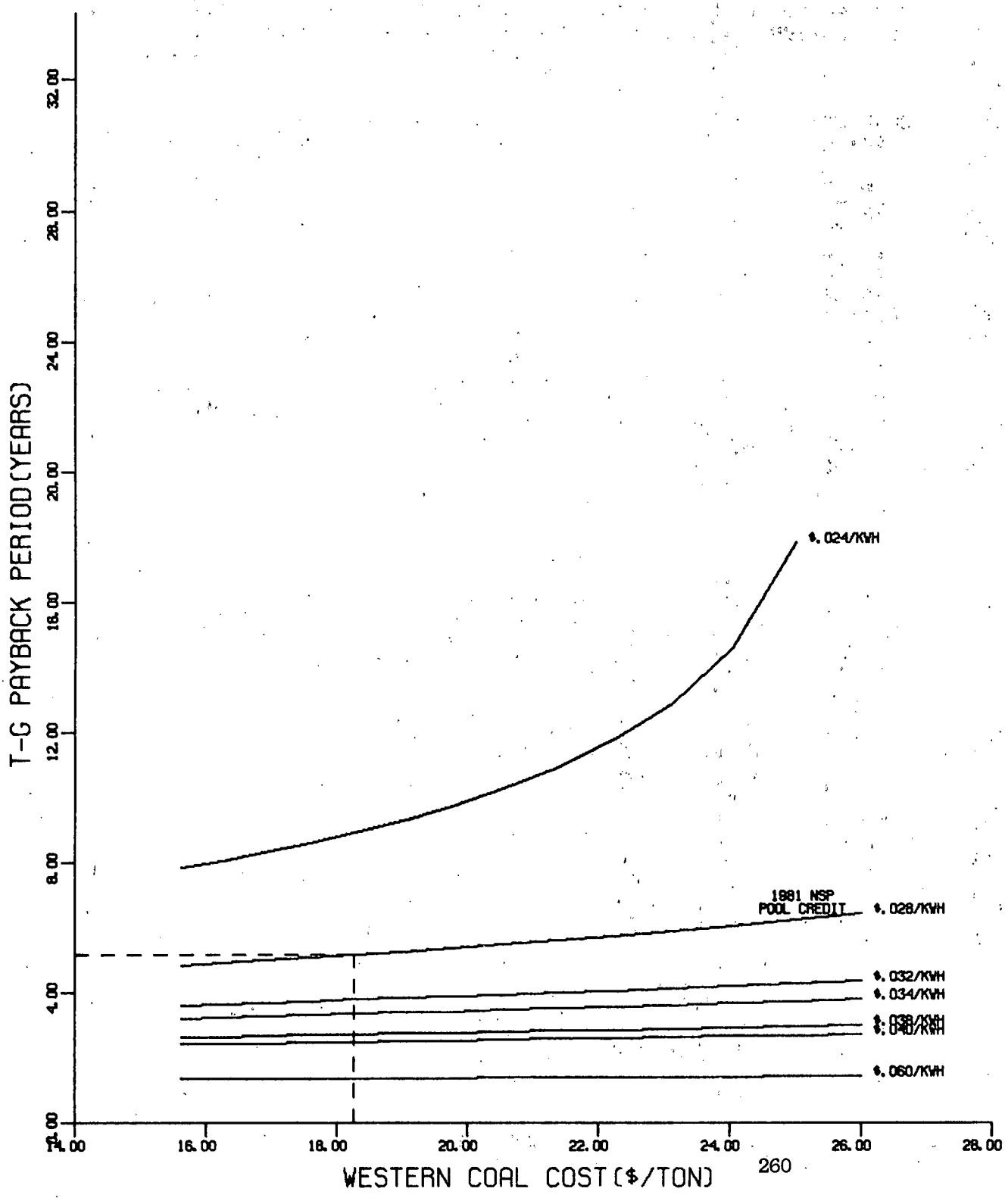
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 4.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 4.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 6.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	33	10	6	5	4	4	2	P
1978	16.56	40	11	7	5	4	4	2	A
1979	17.55	56	11	7	6	4	4	2	Y
1980	18.60	NONE	12	7	6	4	4	2	B
1981	19.72	NONE	12	7	6	4	4	2	A
1982	20.90	NONE	13	7	6	4	4	2	C
1983	22.16	NONE	14	8	6	5	4	2	K
1984	23.49	NONE	15	8	6	5	4	2	
1985	24.90	NONE	17	8	7	5	4	2	Y
1986	26.39	NONE	19	9	7	5	4	2	E
1987	27.97	NONE	22	9	7	5	4	2	A
1988	29.65	NONE	26	10	8	5	5	2	R
1989	31.43	NONE	34	11	8	5	5	2	S
1990	33.32	NONE	64	11	8	6	5	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

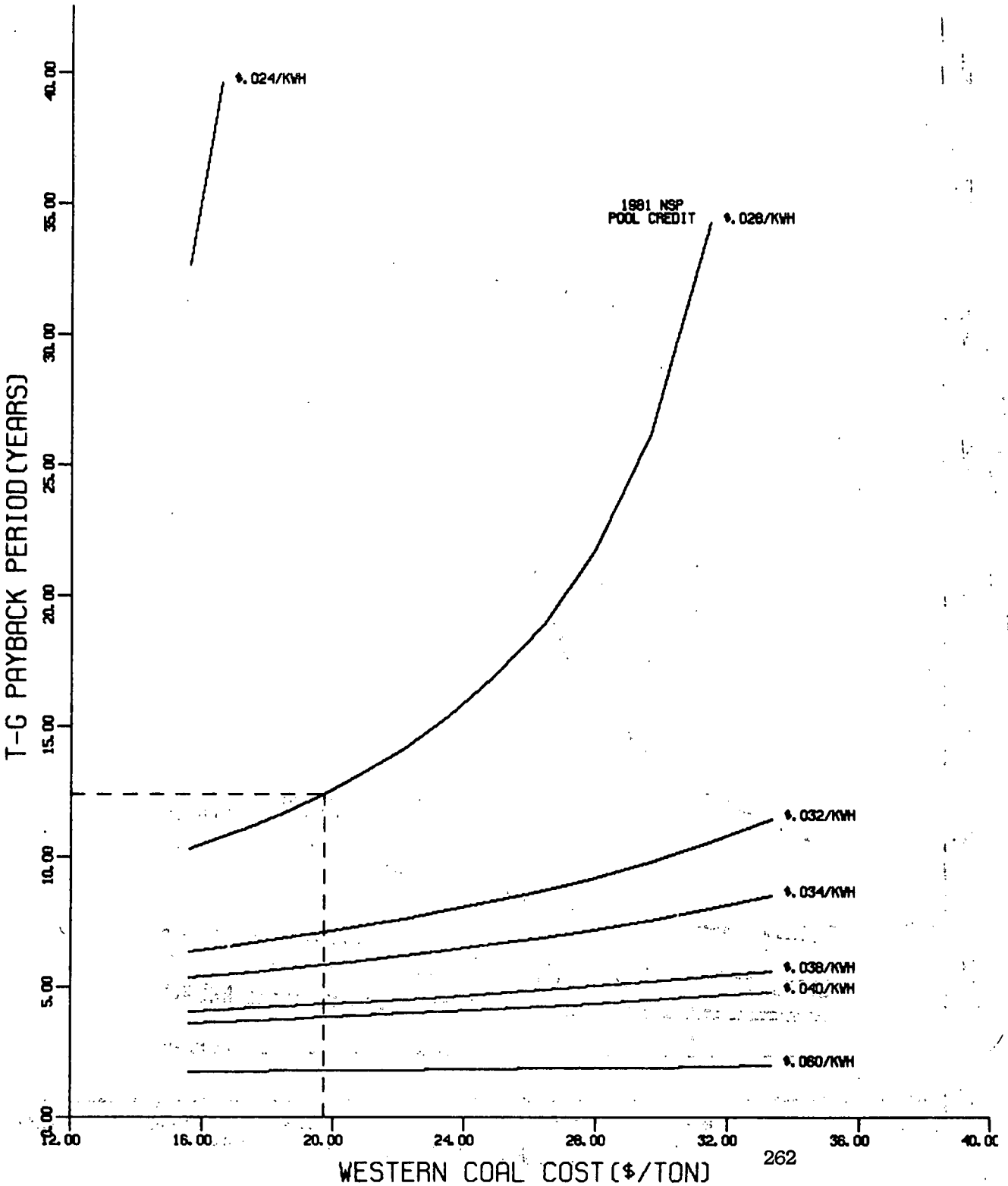
COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 6.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	8	5	4	3	3	2	1	P
1978	16.56	8	5	4	3	3	2	1	A
1979	17.55	9	5	4	3	3	2	1	Y
1980	18.60	9	5	4	3	3	3	1	B
1981	19.72	10	5	4	3	3	3	1	A
1982	20.90	11	6	4	3	3	3	1	C
1983	22.16	12	6	4	4	3	3	1	K
1984	23.49	13	6	4	4	3	3	1	
1985	24.90	17	6	4	4	3	3	1	Y
1986	26.39	NONE	7	4	4	3	3	1	E
1987	27.97	NONE	7	5	4	3	3	1	A
1988	29.65	NONE	7	5	4	3	3	1	R
1989	31.43	NONE	8	5	4	3	3	1	S
1990	33.32	NONE	9	5	4	3	3	1	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

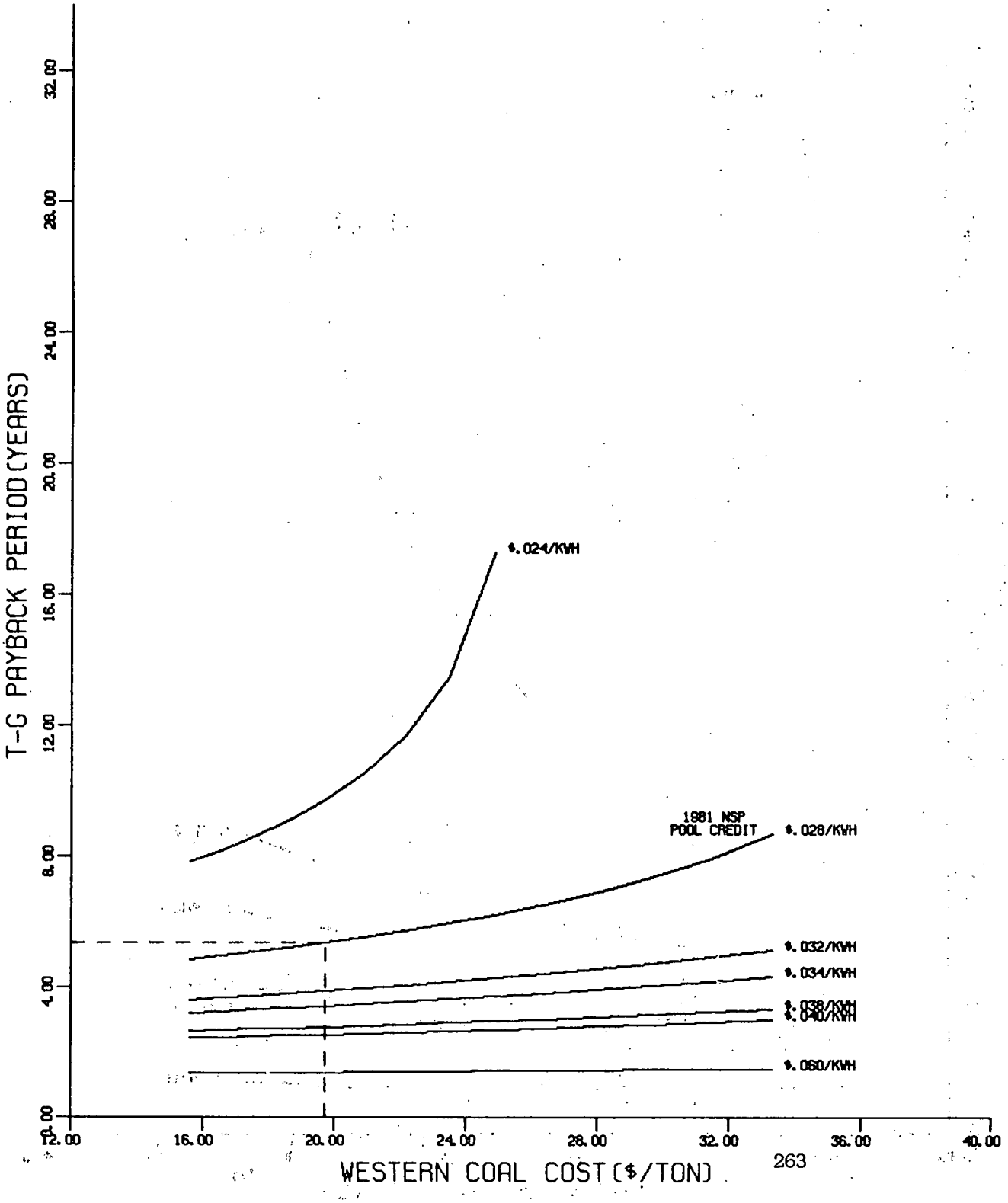
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 6.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 6.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 5.75 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	33	10	6	5	4	4	2	P
1978	16.52	39	11	7	5	4	4	2	A
1979	17.47	53	11	7	6	4	4	2	Y
1980	18.47	NONE	12	7	6	4	4	2	B
1981	19.53	NONE	12	7	6	4	4	2	A
1982	20.66	NONE	13	7	6	4	4	2	C
1983	21.85	NONE	14	8	6	4	4	2	K
1984	23.10	NONE	15	8	6	5	4	2	
1985	24.43	NONE	16	8	7	5	4	2	Y
1986	25.83	NONE	18	9	7	5	4	2	E
1987	27.32	NONE	20	9	7	5	4	2	A
1988	28.89	NONE	24	10	7	5	4	2	R
1989	30.55	NONE	30	10	8	5	5	2	S
1990	32.31	NONE	42	11	8	5	5	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 5.75 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	8	5	4	3	3	2	1	P
1978	16.52	8	5	4	3	3	2	1	A
1979	17.47	9	5	4	3	3	2	1	Y
1980	18.47	9	5	4	3	3	3	1	B
1981	19.53	10	5	4	3	3	3	1	A
1982	20.66	10	5	4	3	3	3	1	C
1983	21.85	11	6	4	4	3	3	1	K
1984	23.10	13	6	4	4	3	3	1	
1985	24.43	16	6	4	4	3	3	1	Y
1986	25.83	NONE	6	4	4	3	3	1	E
1987	27.32	NONE	7	4	4	3	3	1	A
1988	28.89	NONE	7	5	4	3	3	1	R
1989	30.55	NONE	8	5	4	3	3	1	S
1990	32.31	NONE	8	5	4	3	3	1	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

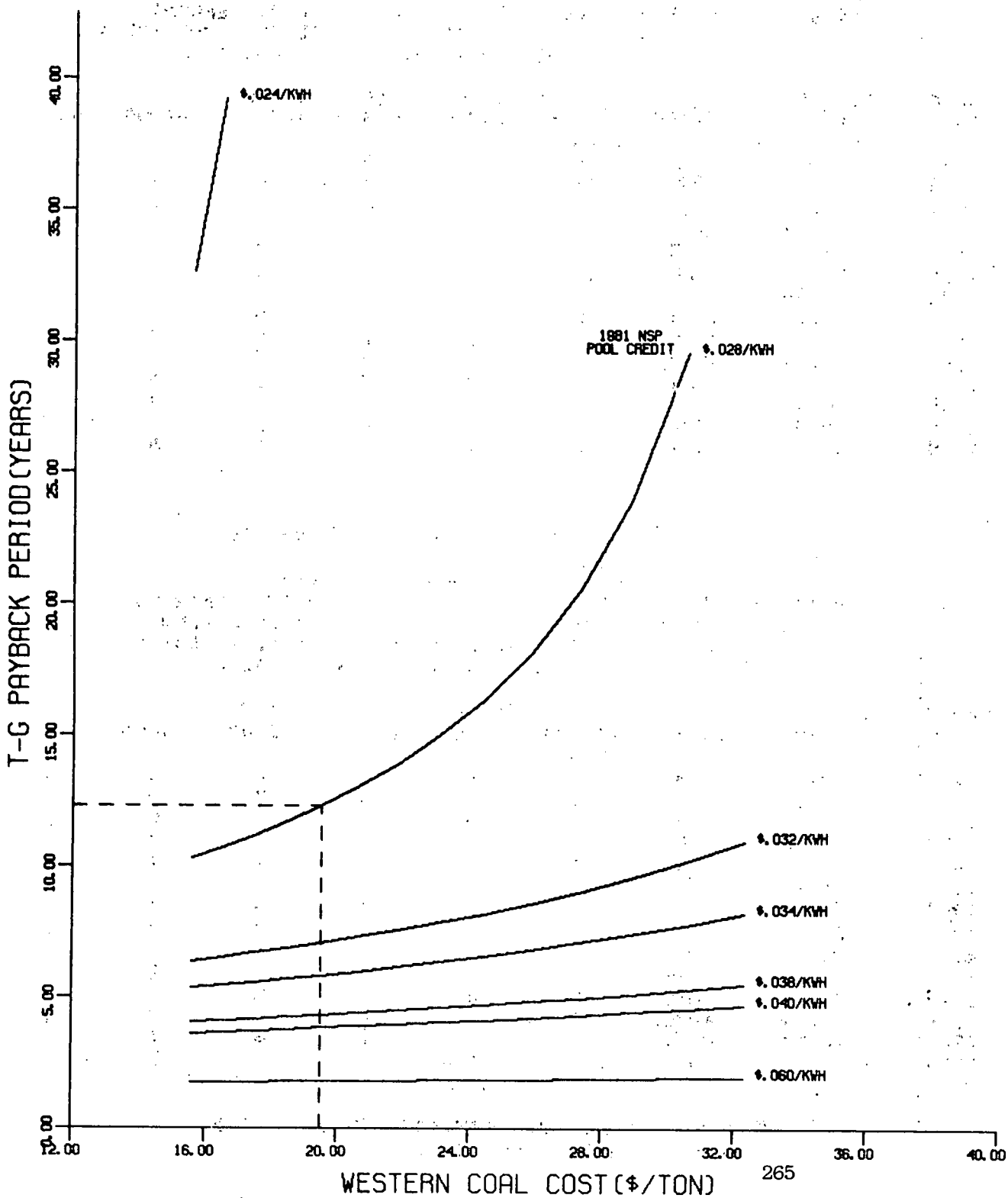
COST BENEFIT COMPARISON - I.A.1(C)

CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING

ESCALATION OF BASE COAL COST PER ANNUM = 5.75 PERCENT

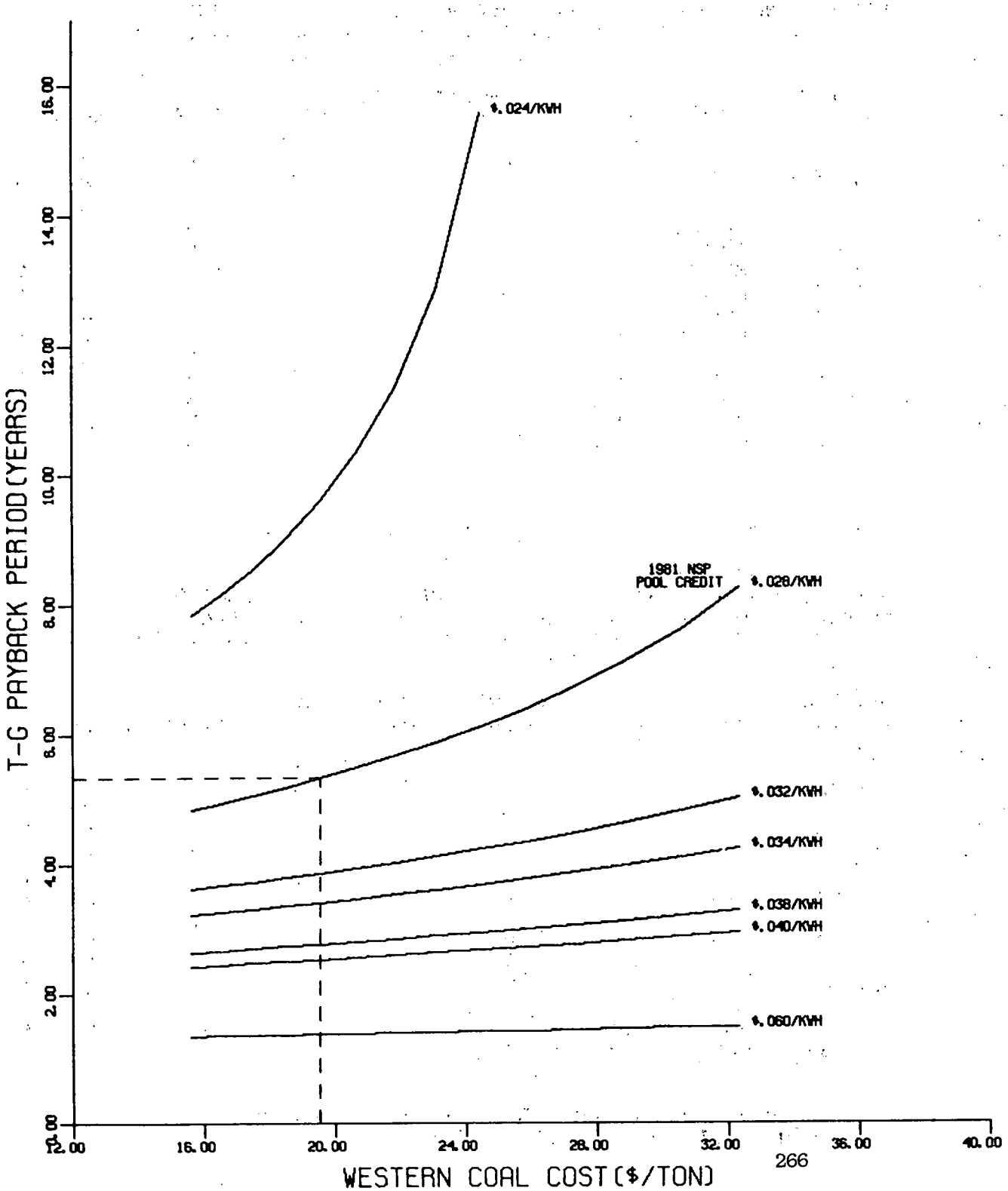
WESTERN COAL BASE COST = 15.62 $/TON(1977)

DISCOUNT FACTOR = 1.06345



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 5.75 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 7.40 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	33	10	6	5	4	4	2	P
1978	16.78	42	11	7	5	4	4	2	A
1979	18.02	88	11	7	6	4	4	2	Y
1980	19.35	NONE	12	7	6	4	4	2	B
1981	20.78	NONE	13	7	6	4	4	2	A
1982	22.32	NONE	14	8	6	5	4	2	C
1983	23.97	NONE	16	8	6	5	4	2	K
1984	25.74	NONE	18	9	7	5	4	2	
1985	27.65	NONE	21	9	7	5	4	2	Y
1986	29.69	NONE	26	10	8	5	5	2	E
1987	31.89	NONE	38	11	8	5	5	2	A
1988	34.25	NONE	NONE	12	9	6	5	2	R
1989	36.79	NONE	NONE	14	10	6	5	2	S
1990	39.51	NONE	NONE	16	11	6	5	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

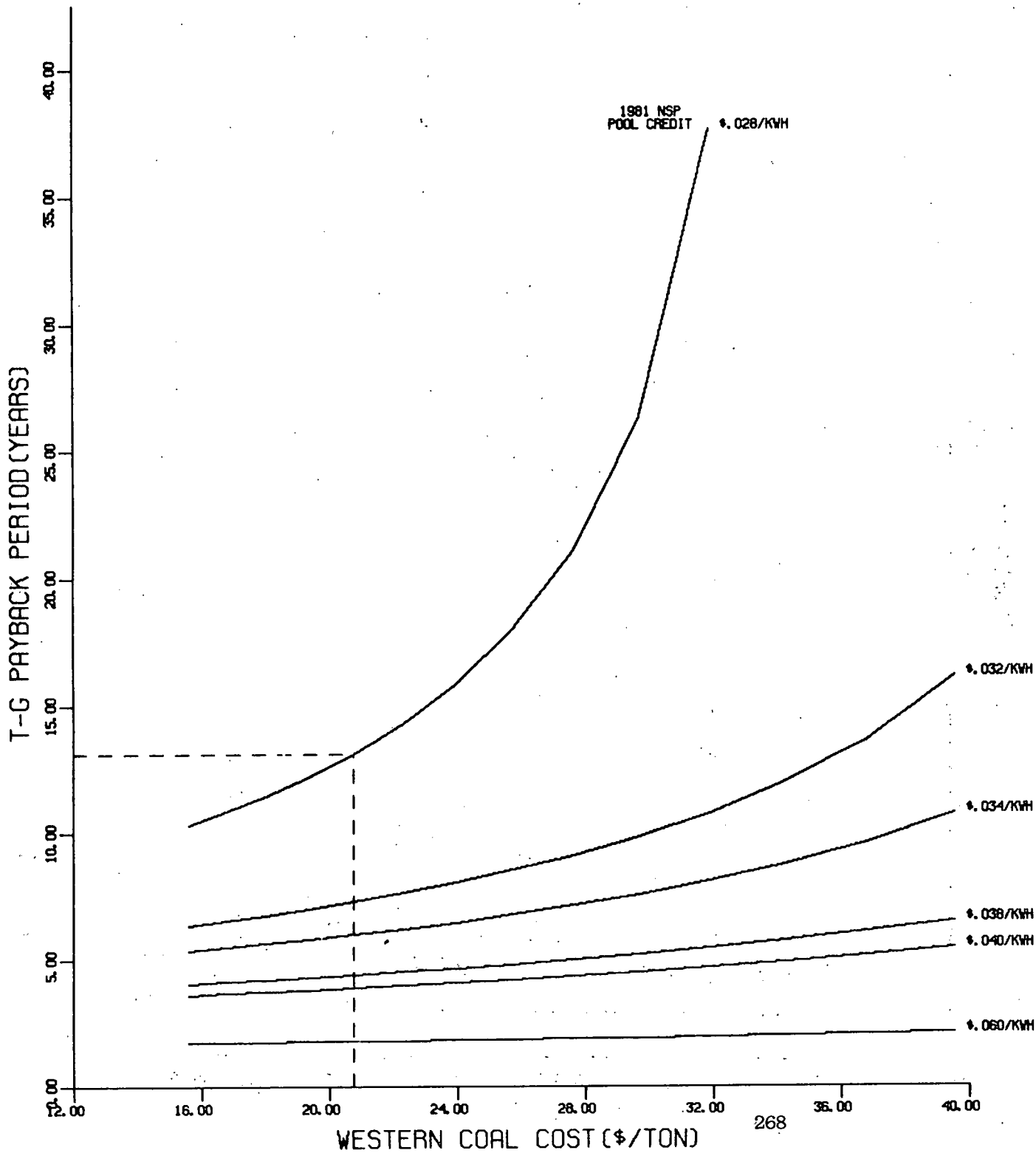
COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 7.40 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	8	5	4	3	3	2	1	P
1978	16.78	8	5	4	3	3	2	1	A
1979	18.02	9	5	4	3	3	2	1	Y
1980	19.35	9	5	4	3	3	3	1	B
1981	20.78	10	6	4	3	3	3	1	A
1982	22.32	12	6	4	4	3	3	1	C
1983	23.97	14	6	4	4	3	3	1	K
1984	25.74	29	6	4	4	3	3	1	
1985	27.65	NONE	7	5	4	3	3	1	Y
1986	29.69	NONE	7	5	4	3	3	1	E
1987	31.89	NONE	8	5	4	3	3	1	A
1988	34.25	NONE	9	5	4	3	3	2	R
1989	36.79	NONE	11	6	5	4	3	2	S
1990	39.51	NONE	14	6	5	4	3	2	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

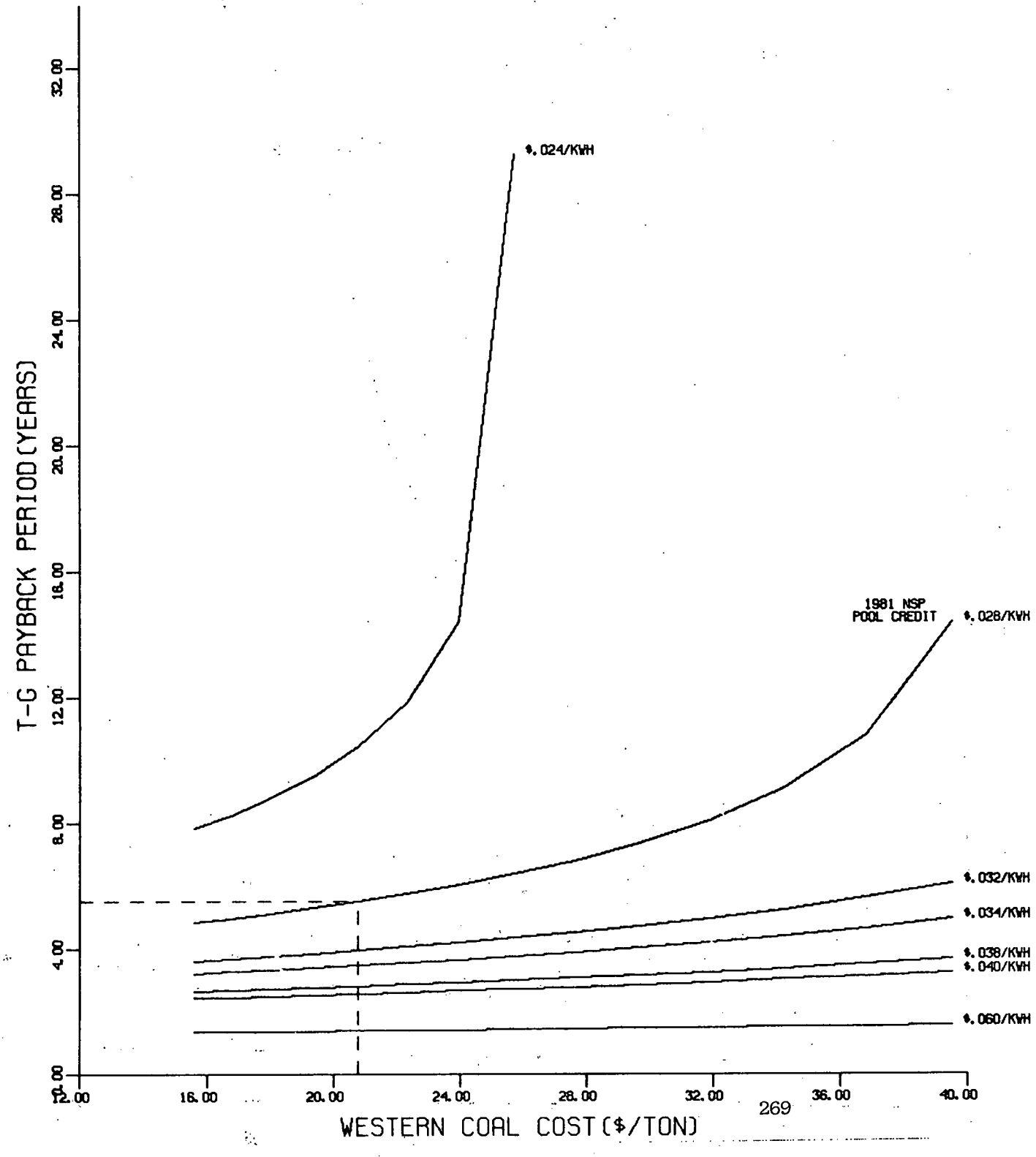
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 7.40 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 7.40 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 8.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	33	10	6	5	4	4	2	P
1978	16.87	43	11	7	5	4	4	2	A
1979	18.22	NONE	12	7	6	4	4	2	Y
1980	19.68	NONE	12	7	6	4	4	2	B
1981	21.25	NONE	13	7	6	4	4	2	A
1982	22.95	NONE	15	8	6	5	4	2	C
1983	24.79	NONE	17	8	7	5	4	2	K
1984	26.77	NONE	20	9	7	5	4	2	
1985	28.91	NONE	24	10	7	5	4	2	Y
1986	31.22	NONE	33	10	8	5	5	2	E
1987	33.72	NONE	NONE	12	9	6	5	2	A
1988	36.42	NONE	NONE	13	9	6	5	2	R
1989	39.33	NONE	NONE	16	11	6	5	2	S
1990	42.48	NONE	NONE	20	12	7	6	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

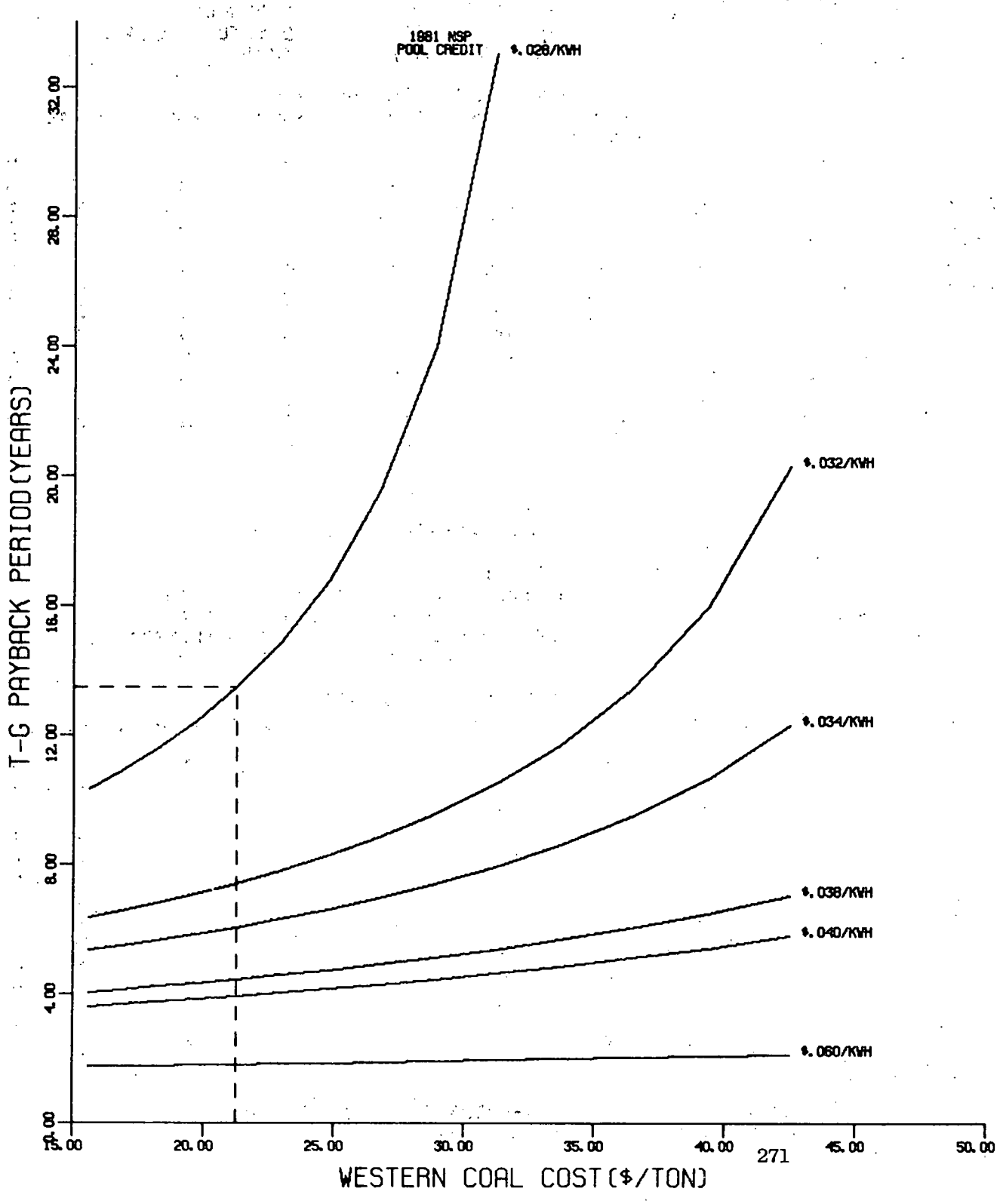
COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 8.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	8	5	4	3	3	2	1	P
1978	16.87	8	5	4	3	3	2	1	A
1979	18.22	9	5	4	3	3	2	1	Y
1980	19.68	10	5	4	3	3	3	1	B
1981	21.25	11	6	4	3	3	3	1	A
1982	22.95	13	6	4	4	3	3	1	C
1983	24.79	17	6	4	4	3	3	1	K
1984	26.77	NONE	7	4	4	3	3	1	
1985	28.91	NONE	7	5	4	3	3	1	Y
1986	31.22	NONE	8	5	4	3	3	1	E
1987	33.72	NONE	9	5	4	3	3	2	A
1988	36.42	NONE	11	6	5	3	3	2	R
1989	39.33	NONE	14	6	5	4	3	2	S
1990	42.48	NONE	NONE	7	5	4	3	2	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

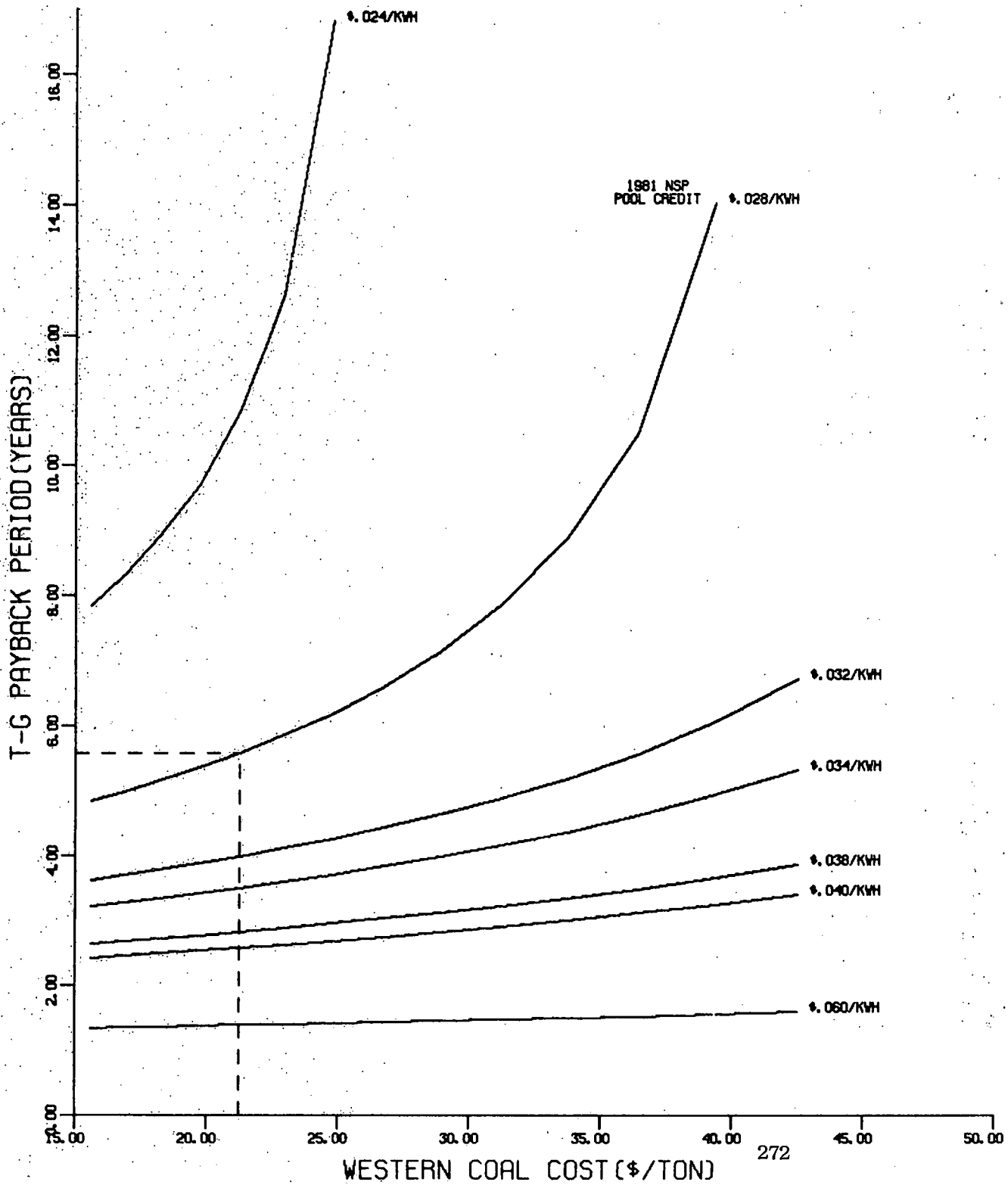
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 8.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 8.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250



TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 10.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	33	10	6	5	4	4	2	P
1978	17.18	48	11	7	6	4	4	2	A
1979	18.90	NONE	12	7	6	4	4	2	Y
1980	20.79	NONE	13	7	6	4	4	2	B
1981	22.87	NONE	15	8	6	5	4	2	A
1982	25.16	NONE	17	8	7	5	4	2	C
1983	27.67	NONE	21	9	7	5	4	2	K
1984	30.44	NONE	29	10	8	5	5	2	
1985	33.48	NONE	76	12	9	6	5	2	Y
1986	36.83	NONE	NONE	14	10	6	5	2	E
1987	40.51	NONE	NONE	17	11	7	6	2	A
1988	44.57	NONE	NONE	25	14	7	6	2	R
1989	49.02	NONE	NONE	NONE	18	9	7	2	S
1990	53.92	NONE	NONE	NONE	32	10	8	2	

TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

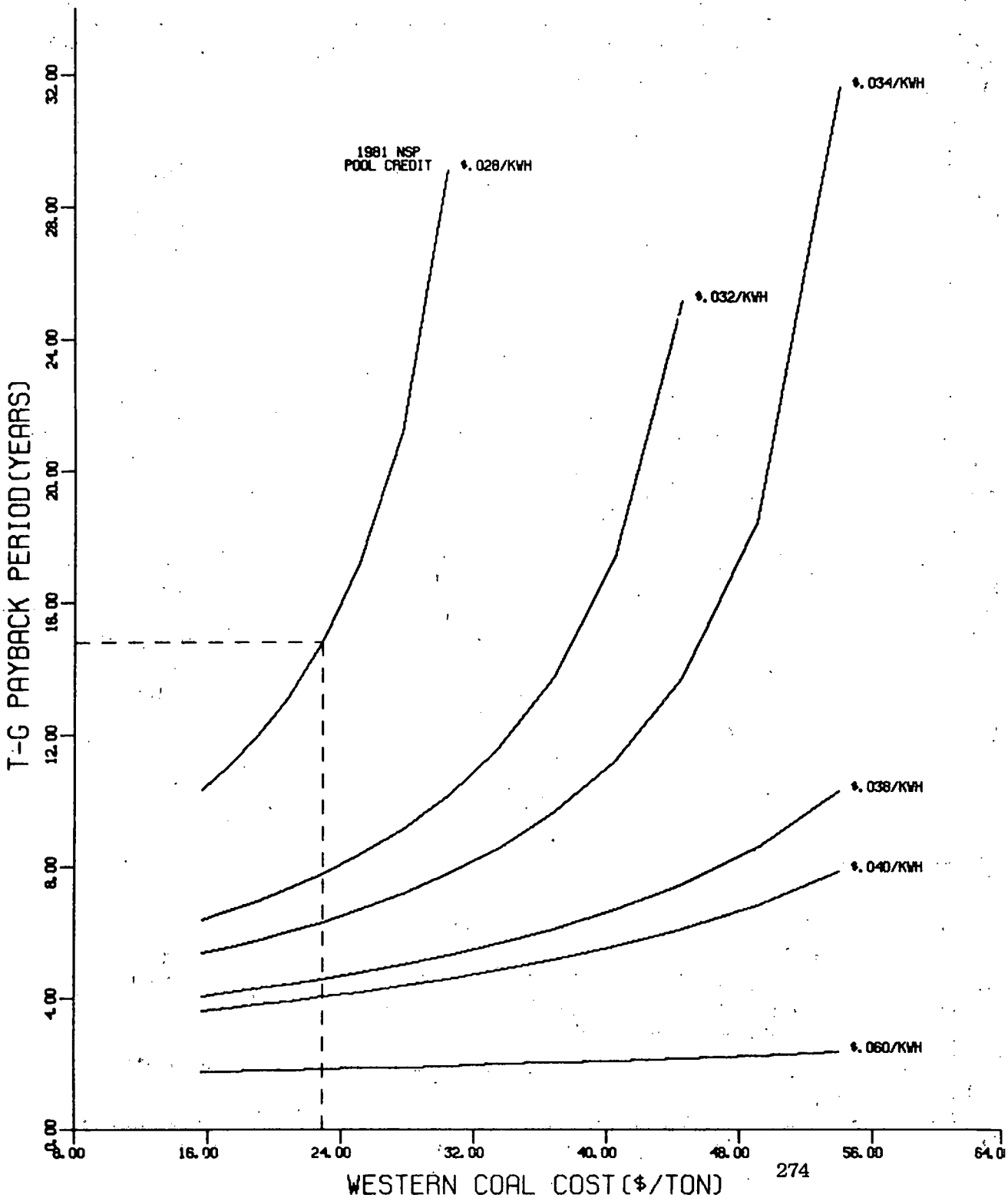
COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 10.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250

END OF YEAR	COAL COST ($/TON)	POOL CREDIT(DOLLARS/KWH) .02400	.02804 (1981)	.03200	.03400	.03800	.04000	.06000	
1977	15.62	8	5	4	3	3	2	1	P
1978	17.18	8	5	4	3	3	2	1	A
1979	18.90	9	5	4	3	3	3	1	Y
1980	20.79	10	6	4	3	3	3	1	B
1981	22.87	13	6	4	4	3	3	1	A
1982	25.16	19	6	4	4	3	3	1	C
1983	27.67	NONE	7	5	4	3	3	1	K
1984	30.44	NONE	8	5	4	3	3	1	
1985	33.48	NONE	9	5	4	3	3	1	Y
1986	36.83	NONE	11	6	5	4	3	2	E
1987	40.51	NONE	18	6	5	4	3	2	A
1988	44.57	NONE	NONE	7	6	4	4	2	R
1989	49.02	NONE	NONE	9	6	4	4	2	S
1990	53.92	NONE	NONE	13	8	5	4	2	

END OF YEAR COLUMN CORRELATES TO ESCALATED
COAL COST, NOT TO PAYBACK PERIOD.

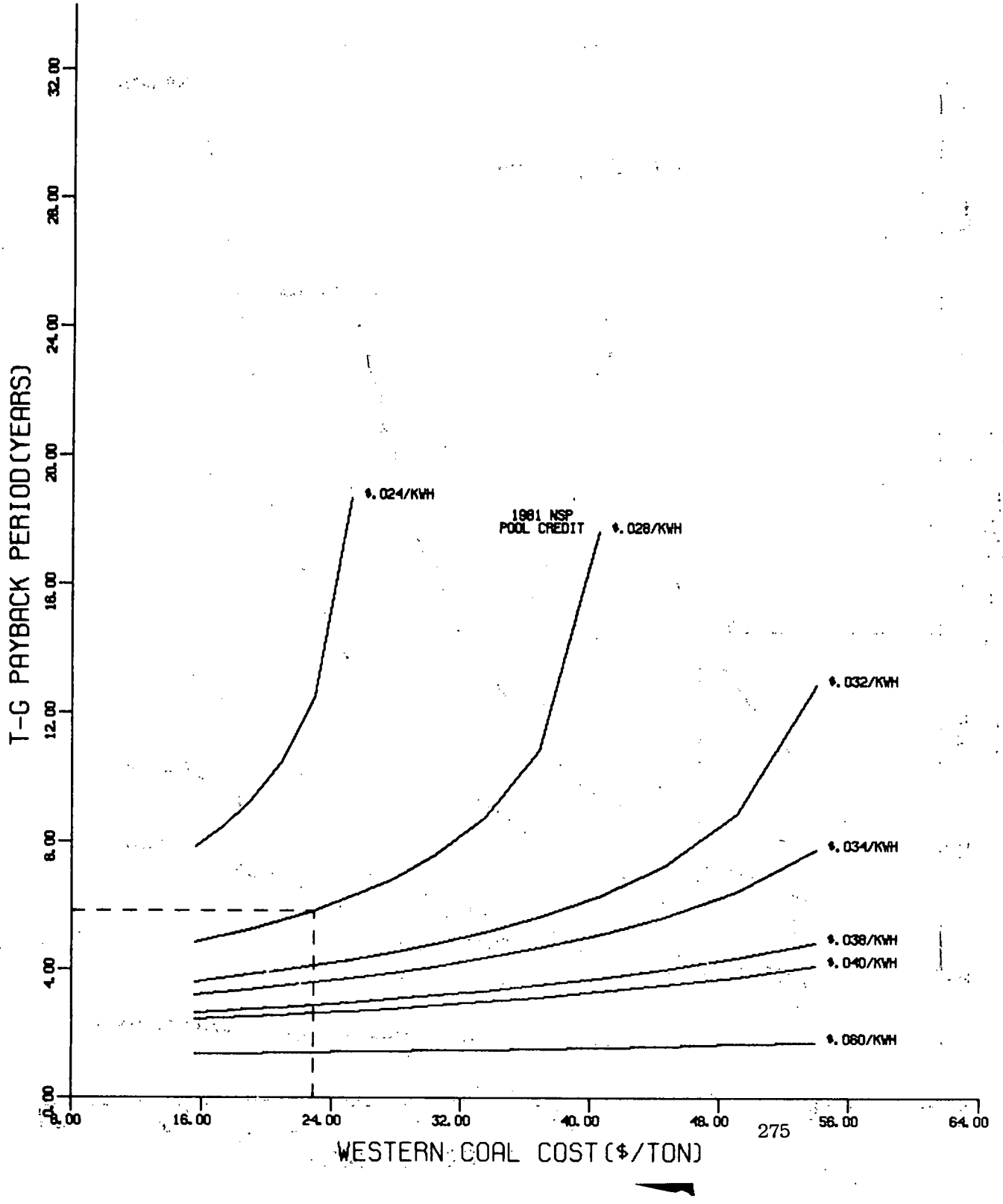
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 10.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.06345



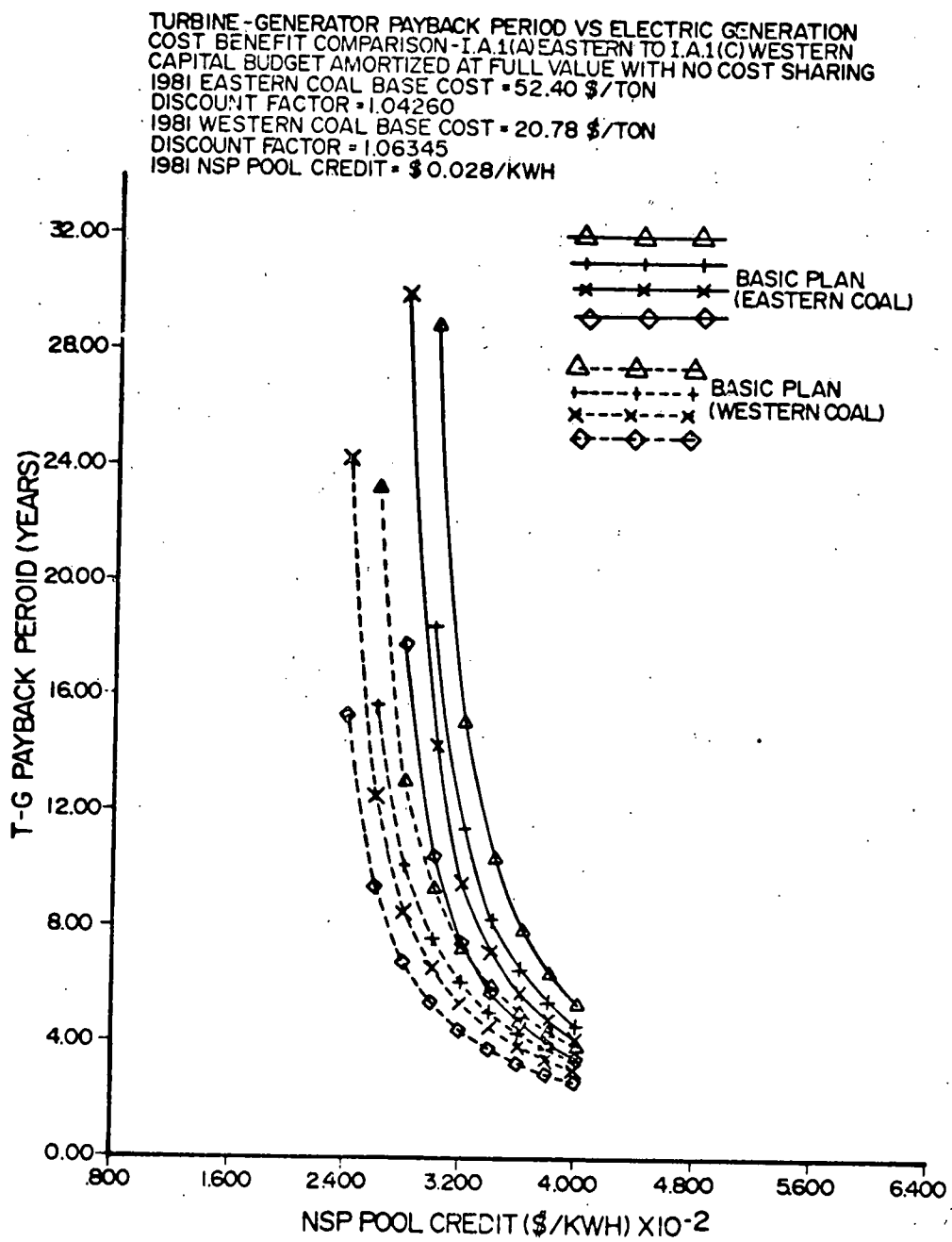
TURBINE-GENERATOR PAYBACK PERIOD VS COAL COST

COST BENEFIT COMPARISON - I.A.2(B)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH COST SHARING
ESCALATION OF BASE COAL COST PER ANNUM = 10.00 PERCENT
WESTERN COAL BASE COST = 15.62 $/TON(1977)
DISCOUNT FACTOR = 1.27250



3.6.3 SENSITIVITY OF ELECTRIC GENERATION

The following plots present the sensitivity of the annual amounts of electric generation escalation to the credit for generation.



BY	BUILDING	SCALE	SHEET
GDM			
CHECKED	DATE	REVISED	DRAWING
JCO	3-17-78		

PRELIMINARY DESIGN-PHASE II-STAGE 2
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
TURBINE-GENERATOR PAYBACK VS ELECTRIC GENERATION

TURBINE-GENERATOR PAYBACK PERIOD VS ELECTRIC GENERATION

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
1981 EASTERN COAL BASE COST = 52.40 $/TON
DISCOUNT FACTOR = 1.04260

NSP POOL CREDIT ($/KWH)	ANNUAL ELECTRIC GENERATION(1000 KWH) 40566 (BASIC PLAN)	44775 (OPTION 1)	48233 (OPTION 2)	54035 (OPTION 3)	
.0100	NONE	NONE	NONE	NONE	P
.0150	NONE	NONE	NONE	NONE	A
.0200	NONE	NONE	NONE	NONE	Y
.0240	NONE	NONE	NONE	NONE	B
.0260	NONE	NONE	NONE	NONE	A
.0280(1981)	NONE	57	30	18	C
.0300	29	18	14	10	K
.0320	15	11	9	7	
.0340	10	8	7	6	Y
.0360	8	7	6	5	E
.0380	6	5	5	4	A
.0400	5	5	4	3	R
.0600	2	2	2	1	S

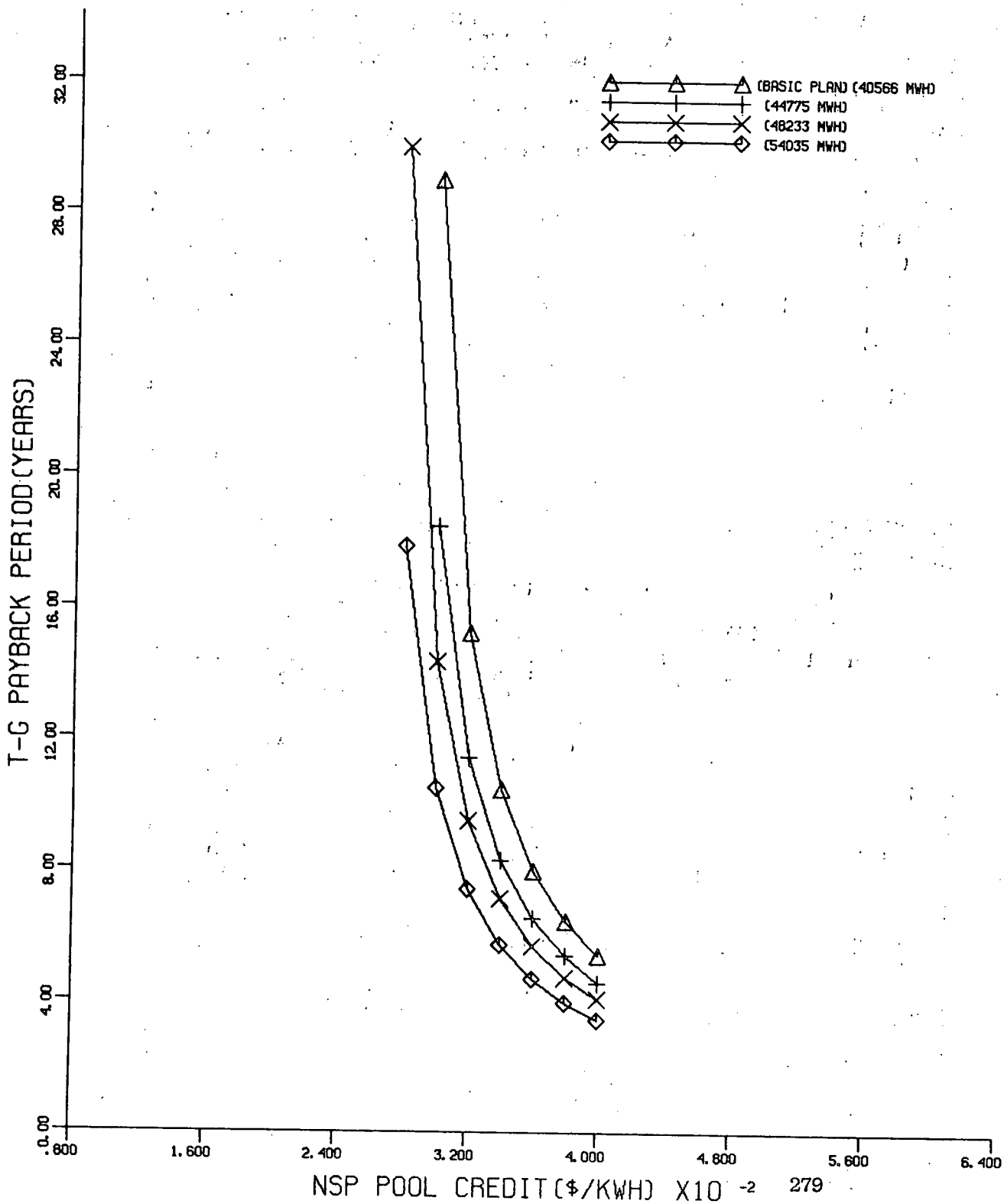
TURBINE-GENERATOR PAYBACK PERIOD VS ELECTRIC GENERATION

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
1981 WESTERN COAL BASE COST = 20.78 $/TON
DISCOUNT FACTOR = 1.06345

NSP POOL CREDIT ($/KWH)	ANNUAL ELECTRIC GENERATION(1000 KWH) 40566 (BASIC PLAN)	44775 (OPTION 1)	48233 (OPTION 2)	54035 (OPTION 3)	
.0100	NONE	NONE	NONE	NONE	P
.0150	NONE	NONE	NONE	NONE	A
.0200	NONE	NONE	NONE	NONE	Y
.0240	NONE	42	24	15	B
.0260	23	16	13	9	A
.0280(1981)	13	10	9	7	C
.0300	9	8	7	5	K
.0320	7	6	5	4	
.0340	6	5	4	4	Y
.0360	5	4	4	3	E
.0380	4	4	3	3	A
.0400	4	3	3	3	R
.0600	2	2	1	1	S

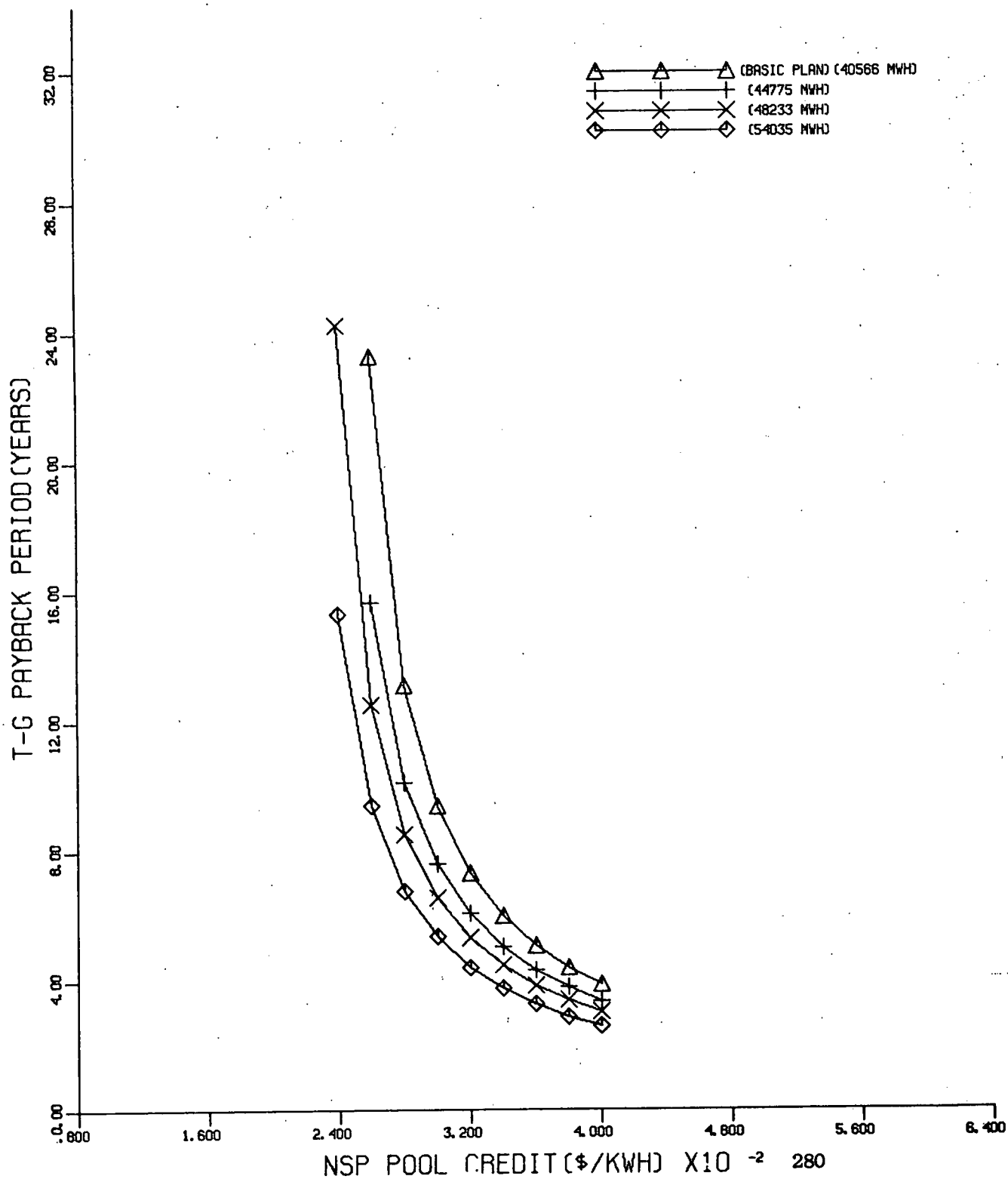
TURBINE-GENERATOR PAYBACK PERIOD VS ELECTRIC GENERATION

COST BENEFIT COMPARISON - I.A.1(A)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
1981 EASTERN COAL BASE COST = $52.40/TON
1981 NSP POOL CREDIT = $0.028/KWH
DISCOUNT FACTOR = 1.04260



TURBINE-GENERATOR PAYBACK PERIOD VS ELECTRIC GENERATION

COST BENEFIT COMPARISON - I.A.1(C)
CAPITAL BUDGET AMORTIZED AT FULL VALUE WITH NO COST SHARING
1981 WESTERN COAL BASE COST = $20.78/TONN
1981 NSP POOL CREDIT = $0.028/KWH
DISCOUNT FACTOR = 1.06345



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