TRI-STATE SYNFUELS COMPANY
Indirect Coal Liquefaction Plant
Western Kentucky

FLUOR ENGINEERS AND CONSTRUCTORS, INC.
Contract 835504

PROCESS DEVELOPMENT STUDY NO. 3

ECONOMICS OF EXPORT POWER GENERATION

FINAL REPORT

SEPTEMBER 4, 1981

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I. Purpose and Basis for Design

Power for use in Tri-State's proposed synfuels plant will be obtained from two sources:

1) On-site generation by combustion of coal fines in a local boiler/power plant facility.

2) Purchase from the local power company.

In the original feasibility study it was assumed that incoming coal would contain 28.6% fines. This quantity is adequate to produce enough power to meet all but 83.2 megawatts of the plant's requirements. The 83.2 megawatts represents the power which must be purchased.

The purpose of this study is:

1) To determine the quantity of coal fines required to generate power to meet the plant's requirements.

2) To determine the additional fines required to produce export power over that required for the Tri-State project in generation increments of 100 MW.

3) To establish capital costs of power generation for each of the 100 MW increments for a total of ten increments.

4) To estimate annual operating and maintenance costs at each of the 100 MW export power increments.

5) To estimate annual chemical and catalyst consumptions at the various export power levels.

All data, calculations, and estimates were prepared using the following as a design basis:

° Sized coal feed rate to gasifiers	21,895 T/SD
° Coal Heating Value	11,464 BTU/lb.
° Plant on-stream days	340/yr.
° Overall turbir efficiency*	35.27%
° Cost estimates	mid-1981 dollars

* Overall turbine efficiency of 35.27% was calculated via theoretical steam turbine flow rate per KWH, together with mechanical turbine efficiency each based on steam i..let/outlet conditions (2400 psig, 1000°F/2" Hg. Abs.); and enthalpy data at the same conditions.

II. Fines Generation

One of the key questions regarding use of fines for power generation is how many fines will actually be generated during coal mining, transport and the numerous other handling processes between the mine and gasifier coal lock. In the absence of practical test data, Table I has been generated to indicate the quantities of export power which can be produced from different percentages of fines. Also given are the corresponding gross coal feed rates (constant sized-coal feed) and fines quantities.

This same information is presented graphically in Figure 1. As indicated, about 31% coal fines is the break-even point where enough power could be generated to supply total plant demand.

To accurately estimate the quantities of fines which will actually be generated for the Tri-State project a formal testing program would be required. Two possibilities are mentioned below:

- The ASTM Drop Test can be used to get a quantitative measure of the coal's friability.
- A commercial testing laboratory such as Hazen in Golden, Colorado can provide experimental data on fines production resulting from handling operations of the Tri-State coal.

III. Cost Estimates

In order to evaluate the economic impact of varying the size of the plant's power generation facilities, capital and operating cost estimates are included for 10 different power plant sizes. These range from 100 MW to 1000 MW in increments of 100 MW. All figures reflect mid-1981 dollars and represent incremental costs for additional facilities beyond those specified in the feasibility study. Results presented here have been compared with and agree closely with unpublished data prepared by the Electric Power Research Institute (EPRI).

The process design assumes use of FMC's dual alkali flue gas desulfurization (FGD) units for all size plants to meet current emission standards. About 17% of the power plant capital investment is for the FGD units.

It was assumed that existing equipment for coal unloading and a portion of the reclaiming equipment would be utilized for all power plants and no additional costs for this type of equipment were included in the capital cost estimates.

Table II shows additional capital investments beyond the feasibility study required to provide power plants with the indicated incremental capacities. Quantities of export power available for each case are also tabulated and are presented as a plot versus capital cost in Figure 2. Looking at point A in Figure 2, to export 117 MW electric power it would cost about $300 MM. It should be understood that this is the incremental cost to build a power plant that generates an additional 200 MW of electricity - 117 MW for export and 83 MW for plant use.

TABLE I

COAL FINES VS. EXPORT POWER

Coal Fines, Wt. %	Export Power, MW	Coal Feed Gross T/SD	Coal Feed Fines, T/SD
28.6*	-83.2	30,675	8,773
30.80	0.0	31,645	9,746
31.27	16.8	31,855	9,970
33.75	116.8	33,049	11,154
36.05	216.8	34,237	12,342
38.20	316.8	35,428	13,533
40.21	416.8	36,619	14,724
42.10	516.8	37,815	15,920
43.87	616.8	39,007	17,112
45.53	716.8	40,196	18,301
47.10	816.8	41,389	19,494
48.58	916.8	42,580	20,685
49.98	1,016.8	43,772	21,887

*Feasibility Study

FIGURE 1

EXPORT POWER VS. COAL FINES

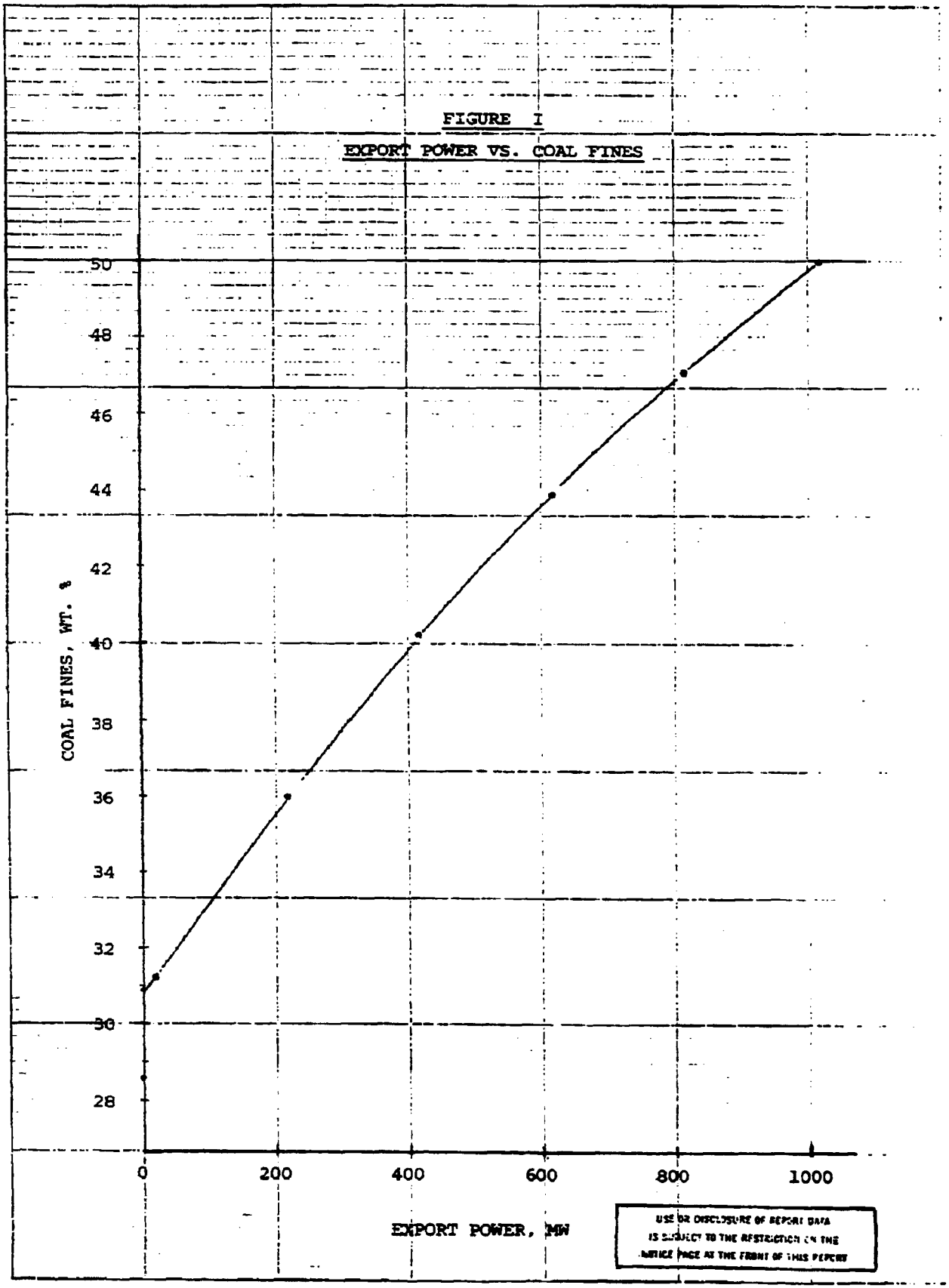

TABLE II

POWER GENERATION VS. CAPITAL COST

Incremental Power Generation, MW	Export Power, MW	Incremental Capital Cost, $MM
0	-83.2*	0
100	16.8	178.5
200	116.8	300.2
300	216.8	406.9
400	316.8	504.9
500	416.8	596.9
600	516.8	684.3
700	616.8	768.2
800	716.8	849.1
900	816.8	927.6
1,000	916.8	1,003.8

*Feasibility Study

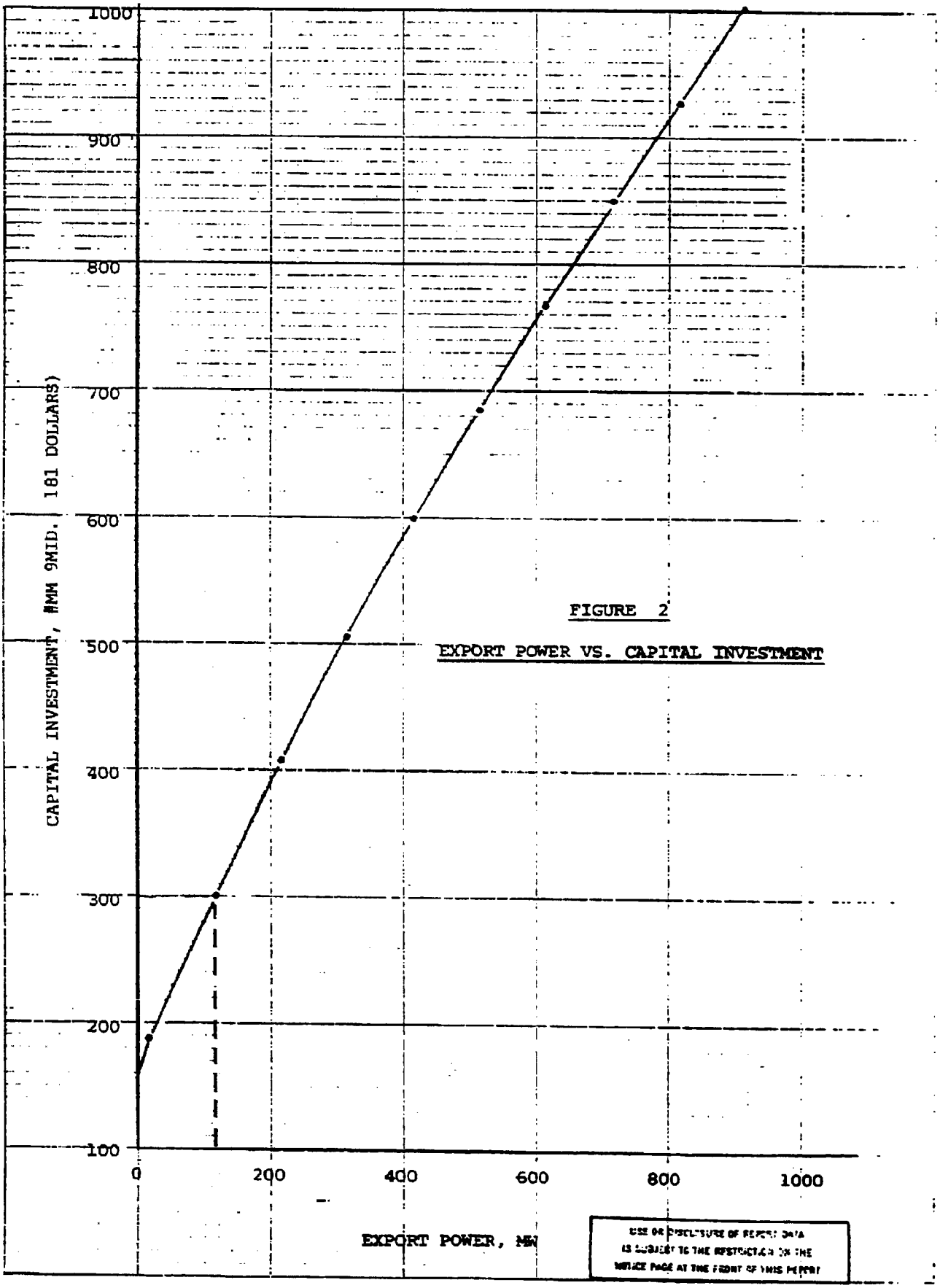

FIGURE 2

EXPORT POWER VS. CAPITAL INVESTMENT

III. Cost Estimates (Continued)

Table III lists the incremental annual power plant operation and maintenance costs in addition to annual costs associated with consumption of catalysts and chemicals.

TABLE III

OPERATING COSTS

(EXCLUSIVE OF COAL COSTS)

Incremental Power Generation, MW.	Plant Operation & Maintenance	Chemicals & Consummables (including FGD Treating)
0	0	0*
100	$6.1 MM/yr.	$1.1 MM/yr.
200	9.9	2.1
300	13.3	3.1
400	16.3	4.1
500	19.2	5.2
600	22.0	6.2
700	24.7	7.3
800	27.2	8.3
900	29.7	9.3
1000	32.1	10.3

*Feasibility Study

APPENDIX 1

PROCESS DEVELOPMENT STUDY NO. 3

ECONOMICS OF EXPORT POWER GENERATION

SCOPE OF STUDY

PROCESS STUDY

ECONOMICS OF EXPORT POWER GENERATION

1.0 GENERAL

This study will provide the economics of export power generation.

2.0 WORK DEFINITION

2.1 Determine the quantity of fines required to provide additional process steam to generate the electrical power which was to be purchased for the feasibility study.

2.2 Determine the additional fines required to produce export power over that required for the Tri-State project in increments of approximately 100 mw.

2.3 Estimate incremental capital cost of power generation for each of the 100 mw increments for a total of 4 increments.

2.4 Estimate the fines requirement for each of the 100 mw increments.

3.0 DELIVERABLE TO TRI-STATE

A formal report that contains the following:

3.1 Curve showing total fines with purchased coal vs. export power.

3.2 Curve of incremental capital cost vs. export power.

4.0 SCHEDULE

It is estimated that the above work will be completed 10 weeks after the work is started by Fluor.