- o Exhibit XVI-K: Prices used for "Western Coal in Western Location" analysis.
- o Exhibit XVI-L: Prices used for "Current January 1982" analysis (these reflect actual prices).

3.4.3 Prices Forecasts By Others

No price forecasts other than Chem Systems' were commissioned for the Tri-State Project. As mentioned earlier the Chem Systems prices were outdated even prior to publication and were in serious need of revision.

As part of their Study 27, Fluor commented on the Chem Systems forecasts and unofficially compared them to their own view of prices. Attached are two exhibits which document this exercise:

- o Exhibit XVI-M: Fluor's comments regarding the Chem Systems price forecasts.
- o Exhibit XVI-N: Tri-State's comparison of Fluor's forecast and the Chem Systems forecast.

3.5 SALES EFFORTS

Attached as Exhibit XVI-O is the general plan for marketing the original products of the Project. As discussed in Section 2.0, only preliminary efforts had been expended on implementing the sales plan.

Specific discussions were held with the following companies on the following products:

- o SNG: Texas Eastern and Texas Gas (see Exhibit XVI-P).
- o Sulfur: Texasgulf Chemical Co. (see Exhibit XVI-Q).
- o Crude phenols: Merichem Company (see Exhibit XVI-R).

3.6 TRANSPORTATION OF PRODUCTS

Only preliminary plans and analyses had been made regarding the storage and transportation options available to the Project. The following exhibits document the work effort which was conducted:

EXHIBIT-L

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: J. M. Hossack

CO/DIV: Synfuels

FROM: W. N. Shoff WNS

DATE: March 15, 1982

SUBJECT: January 1982 Product Prices

As you requested, I have compiled a table of Gulf Coast and Illinois Basin product prices for January 1982.

The prices are based on posted Gulf Coast contract prices. Illinois Basin netback prices were calculated by adding Chem Systems' transportation differentials between the Gulf Coast and the Illinois Basin to the Gulf Coast prices. (Exhibit I). Where there is no netback value, Chem Systems has determined no price difference between the Gulf Coast and the Illinois Basin.

WNS/ca

xc: L. S. Rathbun

Exhibit I

ILLINOIS BASIN NETBACKS

Illinois Basin Netback Analysis = Gulf Coast Price + Chem Systems' Netback adjusted for inflation (1½ yrs.)

Gasoline: Gulf Coast Price + 1.7¢/gallon
1.04 + 1.7¢ = 1.057 $/gallon

Diesel Fuel: Gulf Coast Price + 1.7¢/gallon
.97 + .017 = .987 $/gallon

Jet Fuel: Gulf Coast Price + 1.7¢/gallon
1.01 + .017 = 1.027 $/gallon

Propane: Gulf Coast Price + 2.27¢/gallon
44 + 2.3 = 46 ¢/gallon

Naphtha: Gulf Coast Price + 1.6¢/gallon
94 + 1.6 = 96 ¢/gallon

Isobutane: Gulf Coast Price + 1.135¢/gallon
52 + 1.135 = 53 ¢/gallon

Butane: Gulf Coast Price + 1.135¢/gallon
46 + 1.135 = 47 ¢/gallon

Ammonia: Gulf Coast Price + $11/ton
150 + 11 = 161 $/ton

Sulfur: Gulf Coast Price + $11/ton
128 + 11 = 139 $/ton

Phenol: Gulf Coast Price + 3.2¢/gallon
32 + 3.2 = 35 ¢/lb.

WNS
03/15/82

Actual January 1982
Product Prices

	Units	Gulf Coast/Illinois Basin Netback ($/Unit)	Btu/Unit	($/mmBtu)
Gasious Fuels				
1. New Gas (Incremental-Delivered)	mcf	$ 4.07	1.020mm	$ 3.99
2. Average Gas	mcf	3.11	1.020mm	3.05
3. Decontrolled (Btu eq of #6)	mcf	4.50	1.020mm	4.42
Liquid Fuels				
5. Domestic Crude	bbl	34.00	5.8mm	5.85
6. Foreign Crude	bbl	35.60	5.8mm	6.12
7. Average Crude Oil	bbl	34.62	5.8mm	5.96
8. Fuel Oil (#6, Low Sulfur)	bbl	28.50	6.4mm	4.42
9. Fuel Oil (#2)	bbl	40.74	5.8mm	6.99
10. Gasoline (Premium Unleaded)	bbl	43.68/44.39	5.25mm	8.32/8.45
11. Diesel Fuel	bbl	40.74/41.45	5.6mm	7.27/7.40
12. Jet Fuel	bbl	42.42/42.84	5.7mm	7.44/7.52
13. Methanol (Fuel Grade)	ton	81.3	18.3mm	4.42
14. Chemical Methanol	gal	.52	64,800	8.03
15. Propane	gal	.44/.46	91,500	4.81/5.03
16. Naphtha	gal	.94/.96	128,500	7.34/7.47
17. Isobutane	gal	.52/.53	94,600	5.49/5.60
18. Butane	gal	.46/.47	103,000	4.46/4.56
Chemicals				
19. Ammonia	ton	150/161	19.4mm	7.736/8.45
20. Sulfur	ton	128/139	7.6mm	16.94/18.29
21. Phenol	lb	.32/.35	75,800	4.22/4.62
Coal				
22. Kentucky #9 Minemouth	ton	30.00	20.8mm	1.44
23. Powder River Minemouth	ton	7.00	16.6mm	.42

WNS
03/09/82

Note: Netbacks are calculated based on Chem Systems' differentials between Illinois Basin & Gulf Coast prices.

EXHIBIT XVI-M
(From Fluor Study 27A)

TRI-STATE SYNFUELS COMPANY
Indirect Coal Liquefaction Plant
Western Kentucky

FLUOR ENGINEERS AND CONSTRUCTORS, INC.
Contract 835504

Revision 3
December 21, 1981

4.1.1 Task B - Review Product Pricing Basis

Introduction

The information contained in this section was prepared to provide Tri-State with Fluor's current views on present and future prices for the products to be produced by the Tri-State Synfuels Project. Forecasting prices in the changing environment that exists today is quite difficult and it is suggested that the information supplied be used only for the purpose of general comparison with more detailed studies prepared by the Tri-State Synfuels marketing consultant. In cases where there may be large differences of opinion, further discussion is recommended. Since these forecasts were prepared in a very short period of time, they reflect in most cases our best judgment rather than rigorous analyses.

Approach

The following general approach was used to forecast the synfuel prices for Tri-State. The products were separated into two groups:

1. Fuel products which must displace fuels derived from oil and natural gas (Tables 4.1.1-1 thru 4.1.1-6).

2. Other miscellaneous minor-quantity products (Tables 4.1.1-7 thru 4.1.1-9).

The primary forecasting effort was spent on the fuel products since they must generate most of the revenues. The following tables are attached.

Table No.	
4.1.1-1	Summary of Existing Fuel Price Schedule
4.1.1-2	Current Average Fuel Prices
4.1.1-3	Comparison of Existing Fuel Price Schedule with Current Fuel Prices
4.1.1-4	Base Case Prices - % Variation from Crude
4.1.1-5	Synfuels Substitution Potentials
4.1.1-6	Synfuels Price Ranges
4.1.1-7	Other Minor Products - Existing Price Schedule
4.1.1-8	Other Minor Products - Possible Price Ranges
4.1.1-9	Possible Real Escalations - Deviation from General Inflation

3

An effort was made to obtain today's prices, within the restraints of the time allowed. Platts Oilgram was used for most of the petroleum product prices, and the Chemical Marketing Reporter was used for most of the miscellaneous products. However, where specific knowledge of the price structure for a product was available, that knowledge was applied to current and forecasted prices. List prices must be used with caution

4.1.1 Task B - Review Product Pricing Basis (Continued)

for a major synfuel product. For example chemical methanol is now selling for from 50 to 60¢/gallon, even though its published list price remains at about 75¢/gallon. The Tri-State price structure was escalated one and one half years, analyzed, and compared to today's prices. A base price was then selected for each product. It is suggested that the price schedule should start with today's prices rather than an obsolete 1980 price. Tables 1 through 3 show the results of the above analysis.

The Table 1 summary of the Tri-State price schedule indicates its relationship to the reference crude price furnished. It appears that either the crude price is off, or the products do not bear the expected relationship to crude oil. If the percentage variations of refinery products were this high above crude cost, refinery margins would be higher than exists today. For example, gasoline is not selling for half again more than crude value. The crude and natural gas prices appear to be quite low.

On Table 2, the current average fuel prices of today show a more nearly traditional relationship to crude. Natural gas has not been included on this table since its price probably varies more than any other fuel. Also, the price is specific to the purchasing company, its locations, and its specific problems. Another approach is taken for SNG forecasts, as will be explained later. The forecasting of refinery product prices is a highly refined approach. Many forecasts describe the relationship of individual refinery product prices to a Composite Product Worth, which is equal to the crude cost plus the gross refinery margin. Time did not permit such an evaluation, which would furnish different results for specific refineries. Instead, all fuel prices were related to crude prices, with some past experience as a guide.

3 The Tri-State price schedule is compared with current prices in Table 3. In current price rankings, the Tri-State schedule appears generally higher than today's prices, except for jet fuel. Isobutane appears to be priced exceptionally high. The current prices shown were used as Base Case prices on Table 6.

Since forecasts are so difficult today, it is not wise to evaluate a project on only one set of prices. Also, synfuels have an unusual feature since generally they may be substituted for a number of different fuels which have widely varying prices, market quantities, and market characteristics. Tables 4 through 6 show the development of ranges for risk analysis, however, the high range may be just as real as the base price. For example, medium BTU gas and SNG can substitute for distillate at a higher price, just as easily as for natural gas.

4.1.1 Task B - Review Product Pricing Basis (Continued)

Additional processing is often required to upgrade a synfuel for a higher priced market, but the cost appears generally to be recoverable if the upgraded product is fully suitable in the market. A word of caution is appropriate here. The prices shown are estimated to be plant-fence prices. The costs of sales, transportation, storage, distribution, and substitution in fuel markets varies between synfuels and can vary between the synfuel and the product replaced. For example, methanol replacing gasoline will have substantial additional marketing and new infrastructure costs. For the distillate markets, methanol will have substantial marketing costs, but they should be lower than for gasoline replacement. Both markets are widely scattered, rather than large and concentrated uses. Most of the methanol fuel markets do not exist today, and must be developed. An analysis of these marketing costs beyond the plant fence is a necessary subsequent step to this analysis.

The current (base case forecast) and a long term price structure, relative to crude, are shown in Table 4. Such variations, when finalized, can be used as a check in evaluating escalations or in applying price cycles to forecasts. A listing of the potential fuel replacements possible for each synfuel is shown in Table 5. These substitutions can be used to establish ranges. Table 6 shows the end result of the price range analysis. The fuels which can be replaced are first determined. The high, base, and low prices then are determined as competitively equal to the fuel substituted, for simplicity. For example, SNG can substitute for distillate or natural gas, and it has no possible sale price between these two fuels. Another word of caution is necessary, since the synfuel may need to be sold initially below the market value of the substituted fuel to penetrate the market.

Other pluses and minuses to synfuel prices which must be considered are: efficiency changes, cost differences, ease of use and conversion, etc. These price shifts need to be evaluated as part of the market analysis recommended previously in this discussion. The basis of the ranges in Table 6 are explained in the table. These ranges can be used with an economic DCF model to evaluate upside and downside price potentials. It can be seen that the base prices are often skewed toward high or low, and this is an indication of price risk.

Since gasoline, methanol, and SNG are prime synfuel product possibilities, some comments on the price ranges for these products are important.

Synthetic coal derived gasoline should substitute directly for petroleum derived gasoline unless some quality problems arise. Alternatively, it can serve as a blending stock. A Clean Air Act waiver from the EPA may be necessary.

4.1.1 Task B - Review Product Pricing Basis (Continued)

SNG can substitute for any liquid fuel (as can medium BTU gas in many applications), or it can substitute for natural gas. If the SNG can be blended with natural gas (a review of recent court decisions in this regard is appropriate), theoretically it could replace the incremental highest priced gas. So the higher of the distillate oil or the incremental gas should provide the best market price. A review of the Joint Venture Company's specific gas costs, average and incremental, should be helpful. The base price should at least be equal to the average gas cost at the point of entry to the pipeline system.

Methanol should be a premium fuel, and it is questionable whether it can be produced at a low enough cost to compete in the residual or natural gas markets. It should compete in the distillate and gasoline markets. In the gasoline market, some believe that blending into gasoline may be necessary as a first step for market penetration rather than 100 percent substitution for gasoline. If so, a co-solvent of higher alcohols and other additives may be required. If these co-solvents and additives are higher priced than gasoline, they affect the methanol price required for economic gasoline blending. Engine modifications may still be required for blends and revised engine designs may be best for 100 percent alcohols. A EPA Clean Air Act waiver should be necessary to use alcohol in vehicles.

The best price possible for methanol would be small blended quantities into gasoline where the methanol performs identical to pure gasoline. If engine modifications are not required, then the methanol is theoretically equal to gasoline price on a volume basis. This is shown as the high range for methanol in Table 6. It is questionable that such a price could be maintained for a long time, and it may be difficult to sell methanol at widely varying prices from one plant, due to competitive forces. The methanol base and low prices are the only prices on the table where a competitive reduction has been included as compared to the fuel replaced.

The other minor-product price schedules are evaluated and compared to current prices in Table 7. Table 8 indicates possible ranges for these products.

Table 9 shows the escalations used in the existing price schedule, and shows forecasts which are different from the existing schedule. The basic approach for the forecasts is a general real escalation of 2 or 3 percent for oil products as compared to coal and other operating costs. The rationales involved are too detailed for this written discussion, and should be handled verbally. The benefits of changing escalations each five years is questionable.

4.1.1 <u>Task B - Review Product Pricing Basis</u> (Continued)

Other market possibilities are:

1. Produce medium BTU gas for local industries or electric utilities and reduce purchases of higher priced incremental natural gas for the pipeline system.

2. Small syngas sales to chemical companies or ammonia plants.

3. Future production of CO_2 for oil field enhancement.

These markets have promising cost <u>vs</u> price potential.

TABLE 4.1.1-1 Rev. △3

SUMMARY OF TRI-STATE FUEL PRICE SCHEDULE

$/MM BTU

	$ 1980 Tri-State Price Schedule	Annual Real ** % Escalation, 80-85	△3 Tri-State Jan 1982* Prices	1982 Prices - % Variation From Crude
ISOBUTANE	11.20	5.5	13.66	+123
GASOLINE	7.61	5.5	9.28	+52
NAPHTHA	6.80	7.1	8.48	+38
JET FUEL	6.36	7.5	7.97	+30
DIESEL	6.08	7.3	7.60	+24
PROPANE	4.89	9.4	6.28	+3
REFERENCE CRUDE	4.86	7.7	6.11	-
FUEL OIL	4.86	6.1	5.98	-2
NATURAL GAS	2.59	14.4	3.55	-42

△3 *With 1-1/2 years of real escalation plus general inflation.

△3 **General Inflation = 8.9% for 1980-81 and 7.8% for 1981-82.

TABLE 4.1.1-2

CURRENT AVERAGE FUEL PRICES

	Current $/BBL	MM BTU/BBL	$/MM BTU*	% Variation From Crude
GASOLINE	44.50	5.2	8.60	+43
JET FUEL	44.50	5.4	8.20	+37
NAPHTHA	39.60	5.2	7.60	+27
NO. 2 FUEL OIL	42.00	5.6	7.50	+25
DIESEL	40.70	5.6	7.30	+21
CRUDE	35.00**	5.8	6.00	-
ISOBUTANE	25.20	4.2	6.00	-
PROPANE	18.92	3.8	5.00	-17
FUEL OIL	27.70	6.1	4.50	-25
NATURAL GAS	(SEE SNG ON TABLE 6)			

*Rounded to closest 10¢

**Approximate low and high for current prices is $30 and $40 per BBL.

TABLE 4.1.1-3 Rev. △3

COMPARISON OF TRI-STATE PRICE SCHEDULE
WITH CURRENT PRICES

$/MM BTU

	3 Jan 1982 Tri-State Price Schedule	Current Prices	△3 Current Prices Minus Tri-State Schedule
GASOLINE	9.28	8.60	- 0.68
JET FUEL	7.97	8.20	0.23
NAPHTHA	8.48	7.60	- 0.88
DIESEL	7.60	7.30	- 0.30
CRUDE	6.11	6.00	- 0.11
ISOBUTANE	13.66	6.00	- 7.66
PROPANE	6.28	5.00	- 1.28
FUEL OIL	5.98	4.50	- 1.48

TABLE 4.1.1-4

BASE CASE PRICES
% VARIATION FROM CRUDE

	Current	Long Term Trend
GASOLINE	+43	+30
JET FUEL	+37	+25
NAPHTHA	+27	+20
DIESEL	+21	+15
NO. 2 FUEL OIL	+25	+12
ISOBUTANE	-	+10
CRUDE	-	-
PROPANE	-17	-10
FUEL OIL	-25	-15

TABLE 4.1.1-5

SYNFUELS SUBSTITUTION POTENTIALS

Synfuel	Potential Fuels Replaced
SNG	Distillates, Residual, Natural Gas
GASOLINE	Gasoline
NAPHTHA	Reformer Feed
JET FUEL	Jet Fuel
DIESEL	Diesel
PROPANE	Propane
FUEL OIL	No. 4, 5, or 6 (low sulfur)
CREOSOLS	Same
CREOSOTES	Same
FUEL METHANOL	Gasoline, Diesel, Distillates, Natural Gas, Residual
SYNGAS	Gas/Oil Feedstock Syngas
IBG	Distillates, Natural Gas, Residual*

*Conditions may be limited for each specific replacement.

TABLE 4.1.1-6

SYNFUELS PRICE RANGES, JAN $1982/MM BTU*

(ROUNDED TO NEAREST 10¢)

PRODUCT	HIGH	% CHANGE	BASE (Current Avg. Prices)	%CHANGE	LOW
GASOLINE	10.30 Gaso. + 20%	+20	8.60	-12	7.60 Naphtha
JET FUEL	- Base seems high	-	8.20	-12	7.20 Crude +25%
NAPHTHA	8.60 Base Gasoline	+13	7.60	-9	6.90 Crude +15%
DIESEL	8.60 Base Gasoline	+18	7.30	-10	6.60 #2 @ Crude +10
CRUDE (This range is not used in product range)	6.90	+15	6.00	-15	5.10
ISOBUTANE	6.60 Crude +10%	+10	6.00	-8	5.50 Propane +10%
PROPANE	6.00 Crude	+20	5.00	-10	4.50 75% of Crude

TABLE 4.1.1-6

CONTINUED

	HIGH	% CHANGE	BASE (CURRENT AVG. PRICES)	% CHANGE	LOW
FUEL OIL (SWEET)	5.40 90% of Crude	+8	5.00 83% of Crude	-24	3.80 Base-15% if impur. problem
METHANOL	16.60*** Base Gaso. Blend - Vol. Basis	+127	7.30 Base Gaso. 15% on BTU Basis		7.10 Base No. 2 Fuel-5%
SNG	7.50 ** No. 2 Oil Replacement	+36	5.50** Increm. cu. ft. cost	-18	4.50 Avg. Cost Basis

* A reduction may be necessary for <u>initial</u> competitive market incentive - say 10% less.
** Guesstimates - equate with cost of incremental purchased cu.ft. replaced or average gas cost - could vary with quantity to pipelines.
*** May not be able to sustain this price over long term.

TABLE 4-[illegible].1-7 Rev. 3

OTHER MINOR PRODUCTS
TRI-STATE PRICE SCHEDULE

	$ 1980 Tri-State Price Schedule	Annual Real Escal. 1980 to 85	Tri-State Jan 1982 Prices (Rev. 3)	Current Avg. Prices
$/Lb				
PHENOLS	0.328	4.9	0.40	0.38
ETHYLENE	0.223	6.9	0.27	0.25
MBK	0.317	5.0	0.38	-
ACETONE	0.230	7.6	0.29	0.21
HIGHER KETONES	-	-	-	-
CRESOLS	0.53	0.4	0.63	0.58
$/Gal				
ETHANOL	1.105	5.5	1.34	1.70 to 1.95
PROPANOL	1.105	5.5	1.34	2.90
BUTANOL	1.105	5.5	1.34	2.43
PENTANOL PLUS	1.105	5.5	1.34	-
ARITH. AVG. ALCOHOLS	1.105	5.5	1.34	-
CREOSOTES	0.77	3.0	0.91	1.20
$/S. Ton				
SULFUR	93	2.9	110	125
AMMONIA	180	4.2	216	190
$/MCF				
CO_2	1.60	0.7	1.83	-

(Rev. 3) *General Inflation = 8.9% for 1980-81 and 7.8% for 1981-82.
(Rev. 3) **With 1-1/2 years of real escalation plus general inflation.

TABLE 4.1.1-8

OTHER MINOR PRODUCTS
POSSIBLE PRICE RANGES

Product	High	% Change	Base	% Change	Low
$/Lb					
PHENOLS	- Assume no upside potential	0	0.40	-50	0.20 Possible impurities
ETHYLENE	0.40 With plant shutdowns	+60	0.25	-20	0.20 Further market saturation
MBK	-	-	-	-	-
ACETONE	0.22 Base +10%	+10	0.20	-10	0.18 Base -10%
HIGHER KETONES	-	-	-	-	-
$/Gal					
ETHANOL	2.10 Higher corn price (Base +15%)	+15	1.80	-15	1.50 Possible improvements (Base -15%)
PROPANOL	3.20 Base +10%	+10	2.90	-15	2.50 Base -15%
BUTANOL	2.60 Base +10%	+10	2.40	-15	2.00 Base -15%
PENTANOL +	- Base +10%	+10	-	-15	- Base -15%
CREOSOLS	-	-	-	-	-
CRESOTES	1.30 Base +10%	+10	1.20	-15	1.00 Base -15%

TABLE 4.1.1-8 CONTINUED

Product	High	% Change	Base	% Change	Low
$/S Ton					
SULFUR	140 Base +10%	+10	125 Price now at high cycle	-50	60 Possible oversupply - Market swings (Base -50%)
AMMONIA	220 Base + 15%	+15	190	-20	150 Base -20%
$/MCF					
CO_2	1.60 Higher oil recovery - shorter distance.	+33	1.20	-40	0.70 Lower oil recovery - longer distance.

TABLE 4.1.1-9

POSSIBLE REAL ESCALATIONS
ANNUAL % DEVIATION FROM GENERAL INFLATION

	TRI-STATE PRICE SCHEDULE				POSSIBLE CHANGES		FUEL SUBSTITUTION ASSUMPTION BASIS
	80-85	85-90	90-95	95-2000	80-90	91-Beyond	
FUELS							
COAL - UGRD.	1	1	1	1	0	1	-
COAL - STRIP	1	1	1	1	-2	-2	-
GASOLINE	5.5	1.5	1.2	1.1	2	3	-
JET FUEL	7.5	1.7	1.5	1.2	4	2	-
NAPHTHA	7.1	8.3	1.1	1.1	0	3	-
DIESEL	7.3	1.9	1.5	1.2	4	2	-
CRUDE (REFERENCE)	7.7	2.2	1.2	-	2	3	-
ISOBUTANE	5.5	0.9	1.0	0.9	3	1	-
PROPANE	9.4	2.9	0.6	2.3	0	2	-
FUEL OIL	6.1	3.5	1.4	1.2	1	3	-
METHANOL	4.0	6.5	1.2	1.2	2	3	Gasoline
SNG	14.4	7.0	1.4	1.3	2	3	Distillate
SNG	14.4	7.0	1.4	1.3	10	3	Natural Gas
OTHER MINOR							
PHENOLS	4.9	2.9	1.9	1.7	3	2	-
ETHYLENE	6.9	3.4	3.4	1.3	0	2	-
MBK	5.0	5.7	1.8	-	2	2	-
ACETONE	7.6	1.5	1.3	1.3	-1	1	-
HIGHER KETONES	-	-	-	-	-	-	-
ETHANOL	5.5	0.9	1.0	0.9	2	1	-
PROPANOL	5.5	0.9	1.0	0.9	2	2	-
BUTANOL	5.5	0.9	1.0	0.9	2	3	Crude
PENTANOL +	5.5	0.9	1.0	0.9	2	2	-
CREOSOLS	0.4	-4.1	2.0	1.4	1	1	-
CREOSOTES	3.0	5.7	1.2	0.8	1	1	-
SULFUR	2.9	3.2	2.5	2.4	-2	2	-
AMMONIA	4.2	9.6	0.9	1.0	3	0	-
CO_2	0.7	2.0	1.4	2.0	2	3	Crude
OPERATIONS	?	?	?	?	0	0	-
GENERAL INFLATION	?	?	?	?	9	7	-

EXHIBIT XVI-N

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: Distribution*

CO/DIV: Synfuels

FROM: W. N. Shoff *WNS*

DATE: February 10, 1982

SUBJECT: Comparison of Fluor and Chem Systems' Price Forecasts for Products of Tri-State's Case "7R"

Hal Spohn of Fluor has prepared a price forecast for Tri-State products (presented in Section 4.1.B of Fluor Process Study 27A). His forecasted growth rates have been applied to the 1982 current prices for products of 7R. These are presented for comparison with Chem Systems' marketing study price forecasts. U. S. Gulf Coast prices (Table IC C-1 & 2 - Chem Systems), not Kentucky netbacks, are the basis for this comparison.

Three tables are attached. Table I contrasts forecasted real growth rates. Table II is a comparison in constant dollars (real growth). Table III adds inflation (current dollars) of 9% in the 1980's and 7% in the 1990's. Spohn's high and low prices in tables II and III were set according to the current price of substitutes for each product. These ranges were increased at the same growth rates as the average price for each product. Spohn makes a distinction between SNG that is a substitute for natural gas and SNG that can substitute for distillate. Each has a different forecasted rate of growth. Chem Systems does not distinguish between the two.

Generally, Spohn predicts lower rates of growth than Chem Systems in the 1980's and higher growth in the 1990's. One thing must be pointed out, however, before these rates can be used for comparison: Spohn's growth rates are based on the 1982 current prices. Chem Systems' growth rates apply to the lower 1980 base prices. Chem Systems' forecasted rates of growth seem high now in 1982, but the country did experience high energy price growth in 1980 and 1981.

As a result, the 1985 forecasted prices of Spohn and Chem Systems despite much different rates, are fairly similar. Only LPGs (isobutane and propane) are substantially different.

For 1985-2000: SNG, Gasoline, Phenol, and Crude Oil price forecasts are similar. Chem Systems' forecasted prices for LPG, Ammonia, Naphtha, and Fuel Oil are generally higher than the prices in the Fluor forecast.

If further information is required, please advise.

WNS/ca
attachments

*O. D. Adams
P. M. Anderson
M. D. Burke
A. de Leon
J. M. Hossack
R. A. Jones
M. N. Kelley
L. S. Rathbun

TABLE 1

CHEM SYSTEMS AND FLUOR ANNUAL AVERAGE REAL GROWTH RATES
FOR PRODUCTS OF TRI-STATE'S CASE "7R"

	Chem Systems				Fluor	
	80-85	85-90	90-95	95-2000	80-90	90-2000
SNG (Distillate)					2	3
SNG (Natural Gas)	13.1	6.8	1.4	1.3	10	3
Gasoline	5.5	1.5	1.2	1.1	2	3
Naphtha	7.1	1.2	1.1	1.1	0	3
Isobutane	5.5	.9	1.0	.9	3	1
Phenols	4.9	2.9	1.9	1.7	3	2
Sulfur	2.9	3.2	2.5	2.4	-2	2
Ammonia	4.2	9.6	.9	1.0	3	0
LPG (Propane)	9.4	2.9	.6	2.3	0	2
Crude Oil	7.7	2.3	1.2	1.5	2	3
Fuel Oil	6.1	3.5	1.4	1.2	1	3

WNS
02/08/82

TABLE II

COMPARISON OF FLUOR AND CHEM SYSTEMS PRICE FORECAST FOR PRODUCTS OF TRI-STATE'S CASE "7R"

CONSTANT DOLLARS
(Real Growth)

FLUOR'S		1982 CURRENT PRICES	1985 Low	1985 Average	1985 High	1990 Low	1990 Average	1990 High	1995 Low	1995 Average	1995 High
*SNG (DISTILLATE)	¢/MMBtu	550	477.5	583.7	795.9	527.8	644.4	878.7	611.2	747.1	1,01
**SNG (NATURAL GAS)	¢/MMBtu	550	599	732.1	990.3	964.6	1,179.0	1,607.7	1,110	1,366.7	1,86
GASOLINE (PREMIUM UNL.)	¢/Gal	106	99.8	112.5	134.8	110.1	124.2	148.8	127.7	144	17
NAPHTHA	¢/Gal	94	85	94	106	85	94	106	98.5	109	12
ISOBUTANE	¢/Gal	60	60.1	65.0	72.1	59.7	76	83.6	73.2	80	8
PHENOLS	¢/Lb	38	21.9	41.5		25.3	48.1		28.0	53.2	
SULFUR	$/Ton	125	56.5	117.7	131.0	51.1	106.4	119.1	56.4	117.4	13
AMMONIA	$/Ton	190	164	207.6	240.4	190	240.7	278.7	190	240.7	27
LPG (PROPANE)	¢/Gal	45	41	45	54	41	45	54	45.3	49.7	5
CRUDE OIL	$/Bbl	34.90	31.20	37	42.30	34.40	40.90	46.70	39.90	47.40	5
FUEL OIL	¢/Gal	66	56.7	68	80.4	59.6	71.5	84.5	69.1	82.9	9

CHEM SYSTEMS		1985	1990	1995
SNG	¢/MMBtu	500	700	750
GASOLINE (PREMIUM UNL.)	¢/Gal	123.3	132.6	140.5
NAPHTHA	¢/Gal	117.5	124.5	131.5
ISOBUTANE	¢/Gal	83.2	97.1	102.1
PHENOLS	¢/Lb	38.8	45.3	50
SULFUR	$/Ton	87.2	105.4	122.2
AMMONIA	$/Ton	211.3	339.8	355
LPG (PROPANE)	¢/Gal	67.4	80.6	85.7
CRUDE OIL	¢/Bbl	40.85	45.70	48.48
FUEL OIL	¢/Gal	75	102	110.5

*SNG as substitute for distillate
**SNG as substitute for natural gas

TABLE II

COMPARISON OF FLUOR AND CHEM SYSTEMS PRICE FORECAST FOR PRODUCTS OF TRI-STATE'S CASE "7R"

1982 CURRENT PRICES	1985 Low	1985 Average	1985 High	1990 Low	1990 Average	1990 High	1995 Low	1995 Average	1995 High	2000 Low	2000 Average	2000 High
550	477.5	583.7	795.9	527.8	644.4	878.7	611.2	747.1	1,018.7	708.5	866	1,180.9
550	599	732.1	990.3	964.6	1,179.0	1,607.7	1,118	1,366.7	1,863.8	1,296.4	1,584	2,160.6
106	99.8	112.5	134.8	110.1	124.2	148.8	127.7	144	172.5	148	167	200
94	85	94	106	85	94	106	98.5	109	122.9	114.2	126.3	142.5
60	60.1	65.0	72.1	69.7	76	83.6	73.2	80	87.9	77	84	92.4
38	21.9	41.5		25.3	48.1		28.0	53.2		30.9	58.7	
125	56.5	117.7	131.0	51.1	106.4	119.1	56.4	117.4	131.5	62.2	129.6	145.2
190	164	207.6	240.4	190	240.7	278.7	190	240.7	278.7	190	240.7	278.7
45	41	45	54	41	45	54	45.3	49.7	59.6	50	54.9	65.8
34.90	31.20	37	42.30	34.40	40.90	46.70	39.90	47.40	54.20	46.30	55.00	62.80
66	56.7	68	80.4	59.6	71.5	84.5	69.1	82.9	98	80.1	96.1	113.8

1985 Average	1990 Average	1995 Average	2000 Average
500	700	750	795
123.3	132.6	140.5	148.1
117.5	124.5	131.5	138.6
83.2	97.1	102.1	107.5
38.8	45.3	50	54.6
87.2	105.4	122.2	140
211.3	339.8	355	373
67.4	80.6	85.7	90.7
40.85	45.70	48.48	52.52
75	102	110.5	118.1

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TABLE III

COMPARISON OF FLUOR AND CHEM SYSTEMS PRICE FORECAST FOR PRODUCTS OF TRI-STATE'S CASE "7R"

CURRENT DOLLARS

FLUOR		1982 CURRENT PRICES	1985 Low	1985 Average	1985 High	1990 Low	1990 Average	1990 High	1995 Low	1995 Average	1995 High
*SNG (DISTILLATE)	¢/MMBtu	550	615.4	752.2	1,025.7	1,037	1,267.5	1,728.4	1,670.2	2,041.3	2,783.6
**SNG (NATURAL GAS)	¢/MMBtu	550	758.3	926.8	1,264	1,809.6	2,211.8	3,016	2,914.4	3,562.1	4,857
GASOLINE (PREMIUM UNL.)	¢/Gal	106	128.6	145	173.3	217	244.3	292.7	348.8	393.4	471.[illegible]
NAPHTHA	¢/Gal	94	110.1	121.7	137.3	169.4	187.3	211.2	272.8	301.7	340.2
ISOBUTANE	¢/Gal	60	77.3	84.3	92.73	136.2	148.6	163.4	200	218.3	240.1
PHENOLS	¢/Lb	38	28.1	53.4		49.5	94.1		76.2	144.8	
SULFUR	$/Ton	125	73.5	153.1	171.5	103	214.8	240.5	158.6	330.5	370
AMMONIA	$/Ton	190	210.7	267	309.1	371.4	470.4	544.7	521	659.8	764
LPG (PROPANE)	¢/Gal	45	53.1	58.3	69.9	81.7	89.7	107.6	125.7	138	165.5
CRUDE OIL	$/Bbl	34.90	40.19	47.60	54.56	67.75	80.35	91.94	109.12	129.40	148.0
FUEL OIL	¢/Gal	66	73.2	87.9	103.8	118	141.5	167.2	189.9	227.9	269.3
CHEM SYSTEMS											
SNG	¢/MMBtu			769			1,478.7			2,220.4	
GASOLINE (PREMIUM UNL.)	¢/Gal			189.6			292.7			424.5	
NAPHTHA	¢/Gal			180.7			274.8			397.3	
ISOBUTANE	¢/Gal			128.0			214.3			308.4	
PHENOLS	¢/Lb			59.7			135.5			151.1	
SULFUR	$/Ton			134.1			232.6			369.2	
AMMONIA	$/Ton			325			749.9			1,072.5	
LPG (PROPANE)	¢/Gal			103.7			177.9			258.9	
CRUDE OIL	$/Bbl			62.68			100.86			146.45	
FUEL OIL	¢/Gal			115.4			209.6			302.1	

* SNG as a substitute for distillate
** SNG as a substitute for natural gas

TABLE III

COMPARISON OF FLUOR AND CHEM SYSTEMS PRICE FORECAST FOR PRODUCTS OF TRI-STATE'S CASE "7R"

1982 CURRENT PRICES	1985 Low	1985 Average	1985 High	1990 Low	1990 Average	1990 High	1995 Low	1995 Average	1995 High	2000 Low	2000 Average	2000 High
550	615.4	752.2	1,025.7	1,037	1,267.5	1,728.4	1,670.2	2,041.3	2,783.6	2,690	3,287	4,483
550	758.3	926.8	1,264	1,809.6	2,211.8	3,016	2,914.4	3,562.1	4,857	4,094	5,736	7,823
106	128.6	145	173.3	217	244.3	292.7	348.8	393.4	471.4	562	634	759
94	110.1	121.7	137.3	169.4	187.3	211.2	272.8	301.7	340.2	439	486	548
60	77.3	84.3	92.73	136.2	148.6	163.4	200	218.3	240.1	294	321	353
38	28.1	53.4		49.5	94.1		76.2	144.8		117	223	
125	73.5	153.1	171.5	103	214.8	240.5	158.6	330.5	370	244	509	569
190	210.7	267	309.1	371.4	470.4	544.7	521	659.8	764	731	925	1,071
45	53.1	58.3	69.9	81.7	89.7	107.6	125.7	138	165.5	193	212	255
34.90	40.19	47.60	54.56	67.75	80.35	91.94	109.12	129.40	148.00	175.56	208.32	238.56
66	73.2	87.9	103.8	118	141.5	167.2	189.9	227.9	269.3	306	367	434

1985	1990	1995	2000
769	1,478.7	2,220.4	3,219
189.6	292.7	424.5	599.7
180.7	274.0	397.3	561.2
128.0	214.3	308.4	435.3
59.7	135.5	151.1	221.1
134.1	232.6	369.2	566.9
325	749.9	1,072.5	1,513.9
103.7	177.9	258.9	367.2
62.68	100.86	146.45	211.36
115.4	209.6	302.1	425.1

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EXHIBIT XVI-O
PLAN FOR DISPOSITION OF TRI-STATE PRODUCTS

	Product	Disposition
Gasification Products	SNG	Sell to partners
	CO_2	Sell for use in EOR
	Sulfur	Sell in the region
	Ammonia	Sell to across-the-fence urea or ammonium nitrate plant
	Phenol	Sell in the region
	Naphtha	Convert to benzene and sell in the region
	Cresol	Convert and blend in gasoline pool
	Creosote	Convert and blend in gasoline pool
Transportation and Fuel Products	Gasoline, Diesel, Jet Fuel, Propane, Fuel Oil	Sell to partners
Chemical Products	Acetone	Sell in the region
	MEK	Sell in the region
	Ethylene	Sell to polyethylene producers
	Ethane	Convert to ethylene
	Alcohols	Blend in gasoline pool

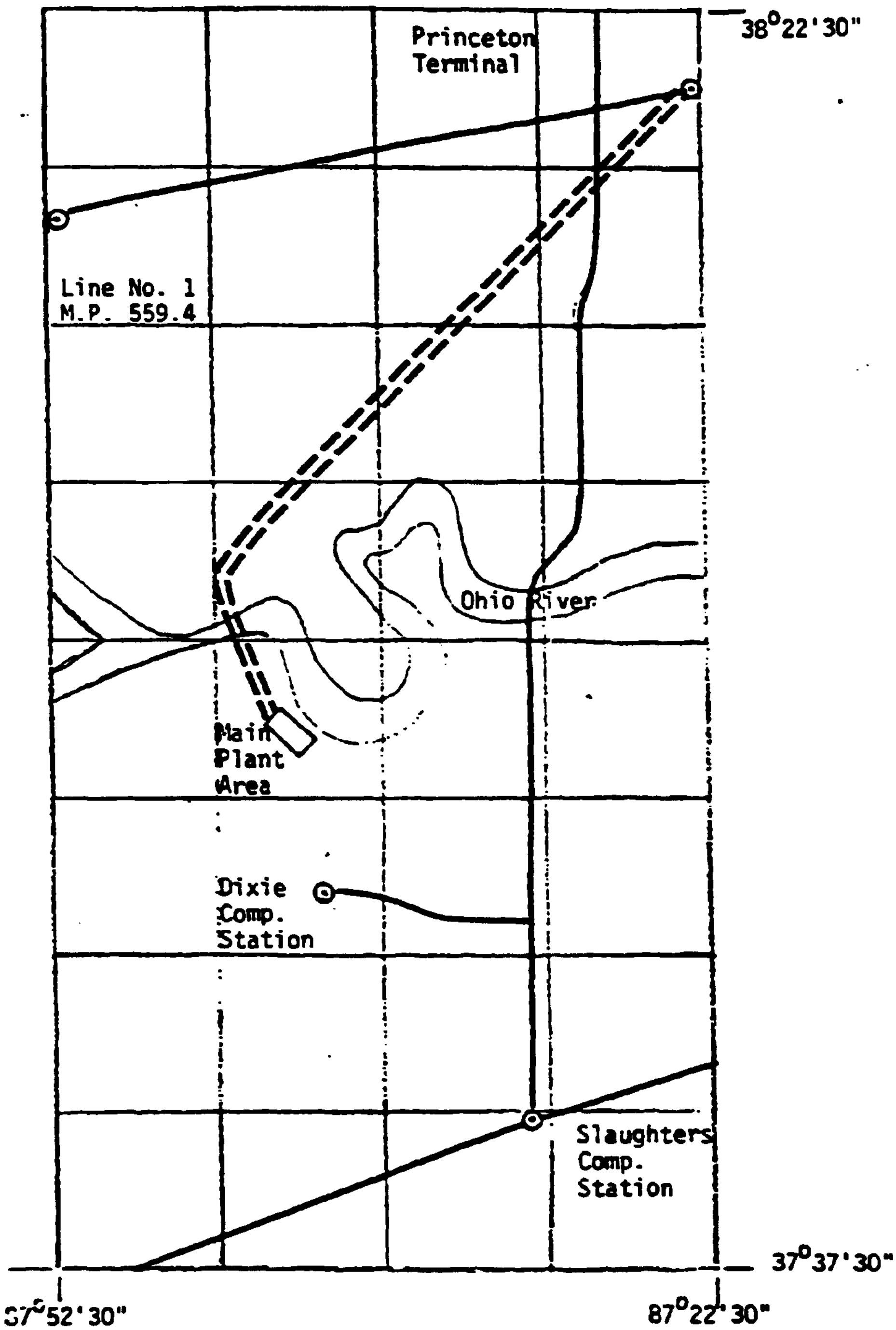

Figure 2. Routing Case I-B

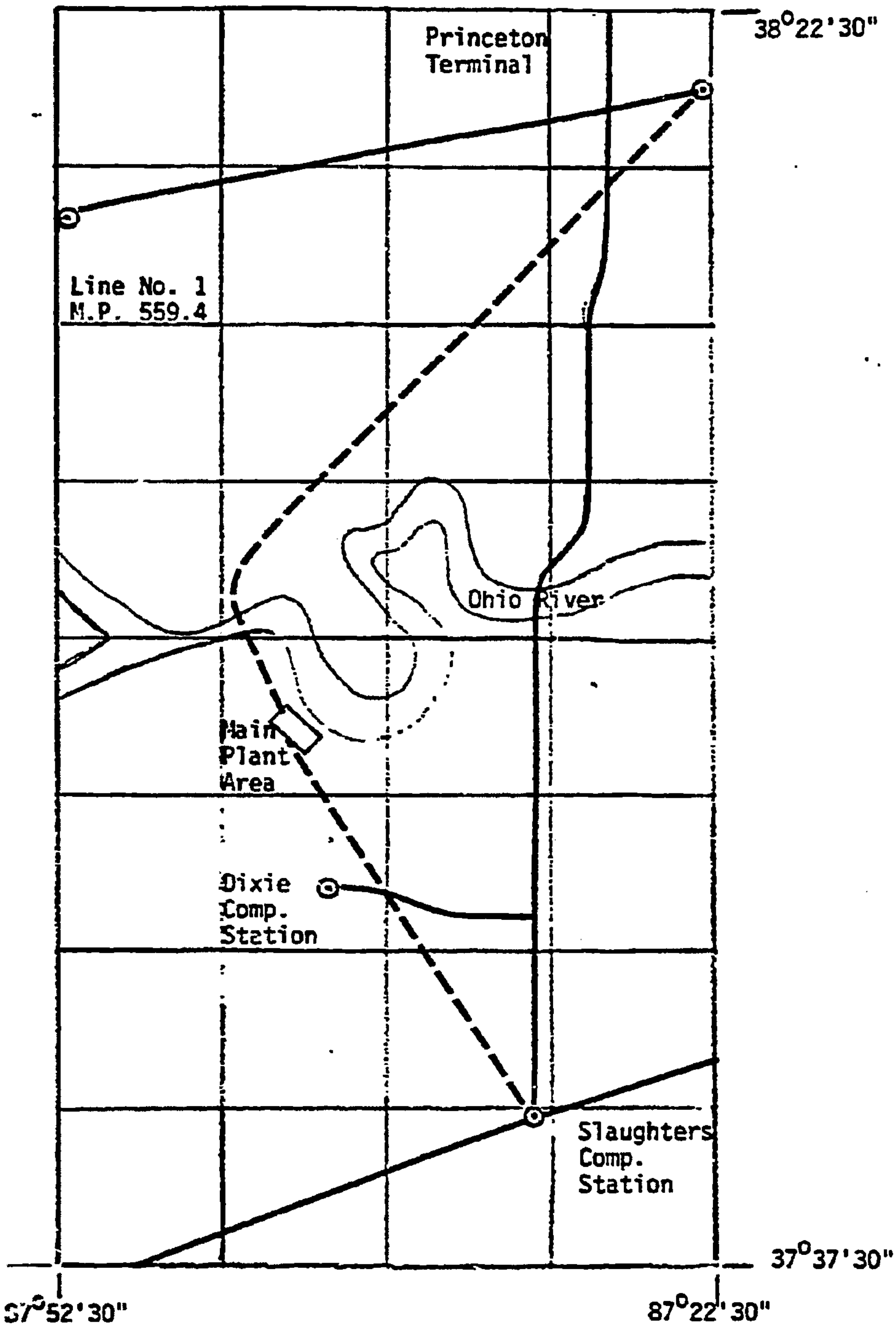

Figure 3. Routing Case II-A

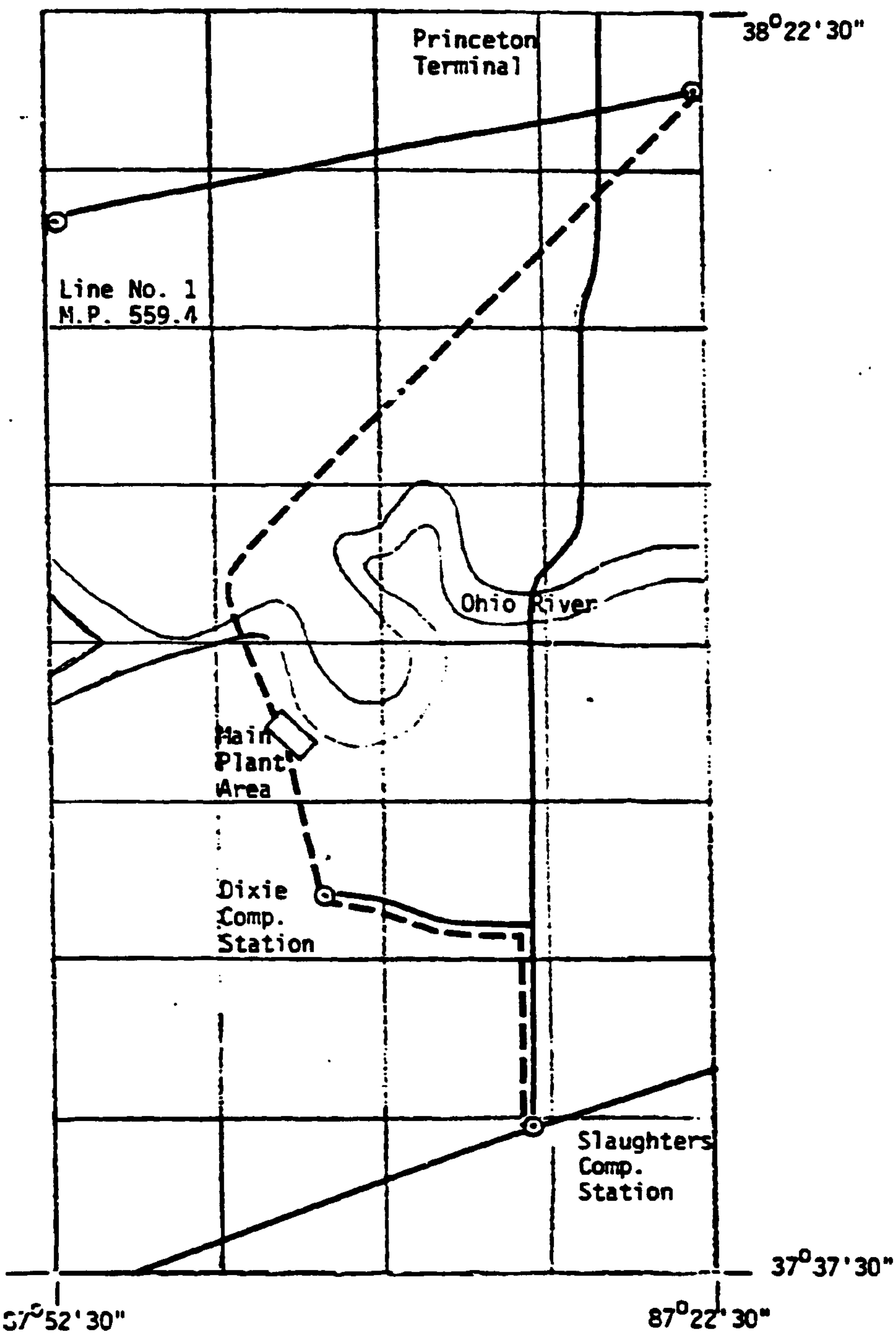

Figure 4. Routing Case II-B

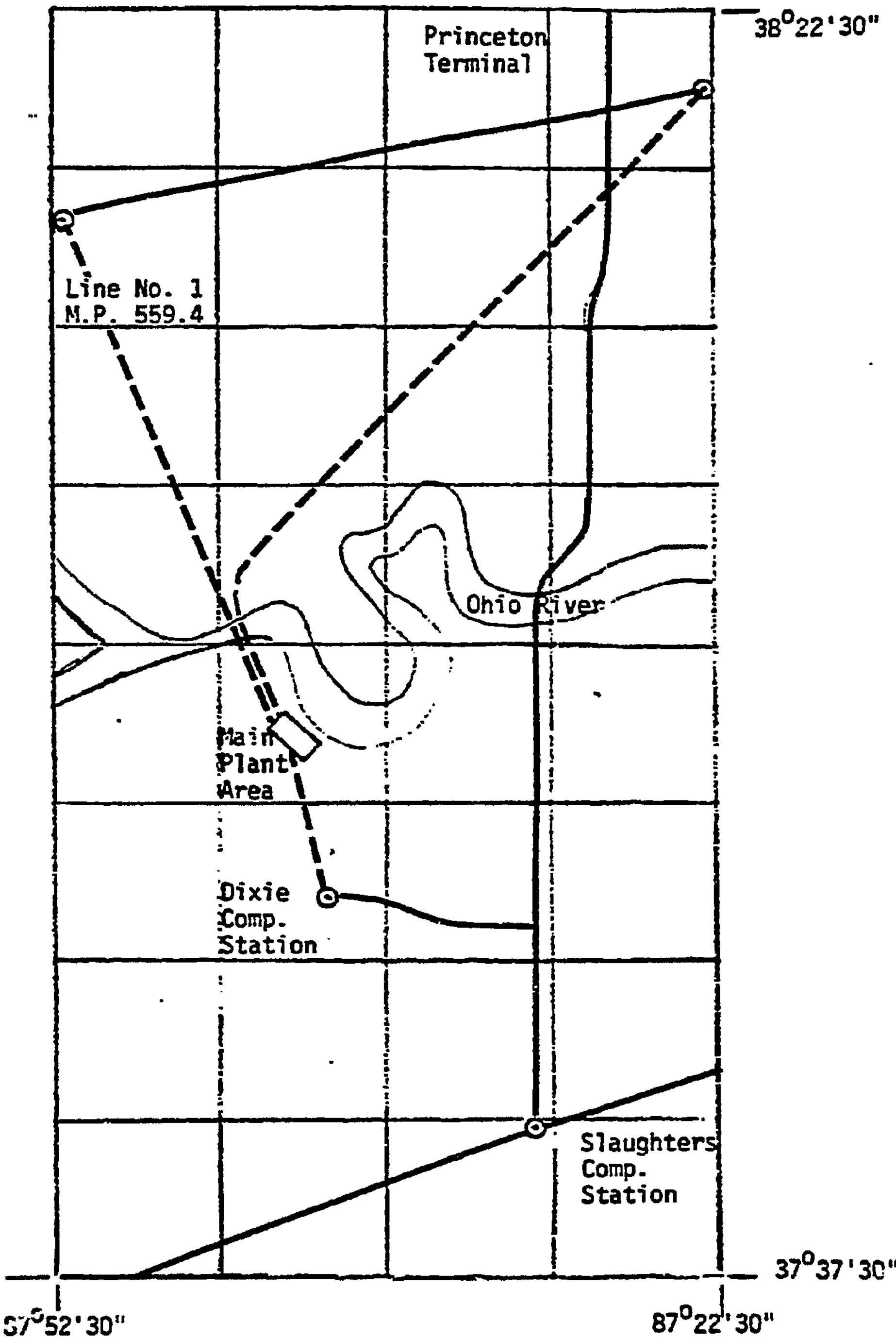

Figure 5. Routing Case III-A

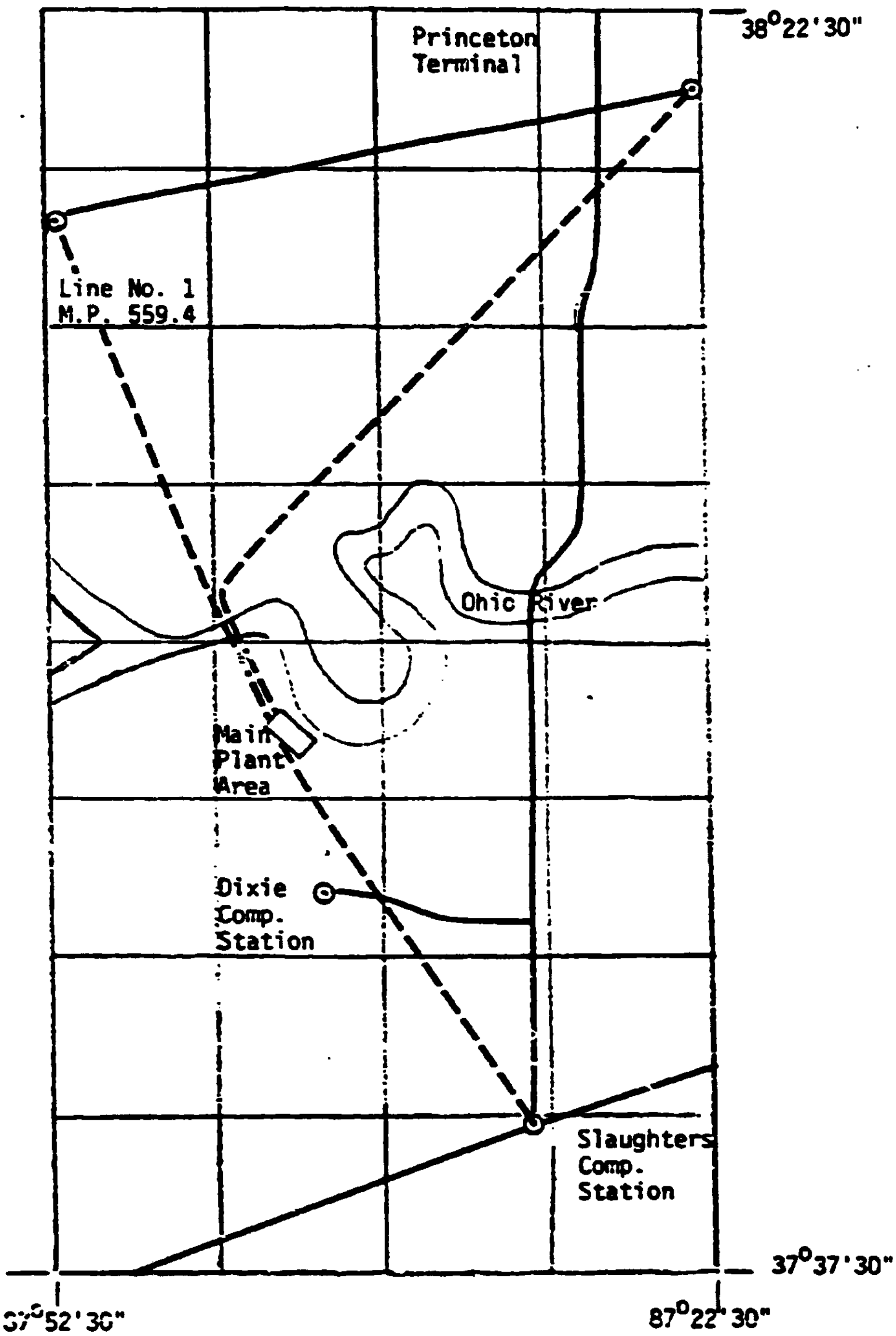

Figure 6. Routing Case III-B

Case I-A: All SNG is transported through a single gas pipeline to the nearest point (M.P. 559.4) on TETCO line No. 1. SNG can either be physically transferred to Texas Gas through existing interconnections, or a paper exchange could be arranged.

As in all cases, liquid products are transported to the TETCO Princeton Terminal.

Case I-B: This case is identical to I-A, except the SNG pipeline is also routed to the Princeton Terminal along the same right-of-way used for the products pipeline.

Case II-A: All SNG is transported through a single pipeline to the Slaughters Compression Station on the main Texas Gas transmission line. As with Case I-A and I-B SNG can be either physically transferred or a paper exchange arranged.

Liquid products are transported to the TETCO Princeton Terminal.

Case II-B: This case is identical to II-A except the gas line runs first to the Dixie Compression Station, then by existing right-of-way to the Slaughters Compression Station.

Case III-A: This case uses two separate gas pipeline sized to take equity shares of SNG both north to TETCO line No. 1, and south to the Texas Gas Dixie Compression Station.

Liquid products are transported to the TETCO Princeton Terminal.

Case III-B: This case is identical to Case III-A, except that each SNG line is sized to allow flow of 100% of SNG production in case one line is shutdown. The higher flow rate would require looping from the Dixie Compression Station to the Slaughters Station, so that it becomes less costly to run the pipeline directly to the Slaughters Station from the plant.

Results

The six different cases are compared in Table 1. Case III-A is selected as offering the optimum combination of cost, system reliability, marketing flexibility, and minimal environmental impact. This case would allow some flexibility in adjusting SNG relative flow rates to TETCO and Texas Gas depending on system demand and peak load. This arrangement would also assure that the baseload SNG production would not be totally shutdown as a result of a pipeline failure or accident. The capital investment, which is 1.3 times

Case	Case Variation	Line Type	Dia. Inches	Flow Rate MMSCFD or BPD	Length (Miles)	Cost Per Mile ($000)	Total Capital Cost ($000-1980)	Texas Eastern Share of Capital Cost ($000-1980)	Comments
I	A	SNG (Tetco)	16	138	29.7	395	11,713	5,866	Shortest SNG route, but requires two ROW's.
		Prod.	10	24,120	42.2	217	9,157	9,157	All SNG to Tetco Line No. 1 (Transfers agreement or split later.
							20,870	15,013	
	B	SNG (Tetco)	18	138	42.2	377	15,909	7,955	Same as I-A, except requires only one ROW.
		Prod.	10	24,120	42.2	217	9,157	9,157	
							25,066	17,112	
II	A	SNG (Tx Gas)	16	138	24.6	342	8,416	4,208	All SNG to Texas Gas (Transfer agreement or split later).
		Prod.	10	24,120	42.2	217	9,157	9,157	Tx Gas SNG Line to Slaughters instead of Dixie Station to avoid probable need for looping from Dixie Station.
							17,573	13,365	
	B	SNG (Tx Gas)	16	138	9.5	342	3,198	1,599	All SNG to Texas Gas.
		SNG (Tx Gas)	12	138	21.5	349	7,503	3,751	Tx Gas SNG line to Dixie Station then to Slaughters by existing ROW.
		Prod.	10	24,120	42.2	217	9,157	9,157	Tx Gas SNG Line to Dixie Station, then to Slaughters by existing ROW.
							19,858	14,507	
III	A	SNG (Tetco)	12	69	29.7	349	10,370	10,370	Equity shares of physical gas flows.
		SNG (Tx Gas)	12	69	9.5	300	2,850	-0-	Avoids total interruption of base-load SNG flow due to pipeline malfunction.
		Prod.	10	24,120	42.2	217	9,157	9,157	
							22,377	19,527	
	B	SNG (Tetco)	16	up to 138	29.7	395	11,713	11,713	Allows 0-100% share of physical gas flow.
		SNG (Tx Gas)	16	up to 138	24.6	342	8,416	-0-	Avoids possible interruption of baseload SNG flow due to pipeline malfunctio...
		Prod.	10	24,120	42.2	217	9,157	9,157	
							29,286	20,870	

the lowest cost case (Case II-A), is viewed as reasonable for the added system advantages.

Other alternate cases were evaluated and eliminated as follows:

Case I-A: While use of a single pipeline does result in generally lower capital cost, Case II-A provides a lower cost alternate by running a single pipeline over a shorter distance to the Texas Gas Slaughters Compression Station.

Case I-B: This case is the only case using a single right-of-way from the plant. The capital cost (1.4 times the lowest cost case, II-A) was judged to be excessive since this case only offers the advantaged of offering a single right-of-way.

Case II-A: This routing arrangement required the lowest capital investment, requires only two right-of-ways, but would not allow flexibility in adjusting the relative SNG flow rate to TETCO and Texas Gas. Use of a single SNG pipeline running north to TETCO Line No. 1 would provide less reliability than a pipeline arrangement using two separate SNG lines.

Case II-B: This case was suggested in a Texas Gas Synfuels Corporation memorandum dated 20 July 1981. About two-thirds of the route for this case uses existing right of-way by connecting through the Dixie Compression Station. This case is considered less desirable since the capital investment is higher than Case II-A.

Case III-A: (Selected as best alternative, see previous discussion)

Case III-B: This case would provide the highest reliability and availability factors, and allow complete marketing flexibility in shifting SNG production between TETCO and Texas Gas, because the two SNG pipelines, are each sized to take 100% of gas production. However, the capital investment required is 1.7 times the least expensive Case II-A.

Recommendations

1. The three right-of-ways used for Case III-A should be surveyed to gather information for future environmental assessment reports and cost estimates. The three right-of-ways are shown on Figure 5 and also designated on the 7.5 minute quadrangle maps.
2. The six cases should be submitted for order of magnitude estimates to verify the capital costs and provide estimates which will allow calculations of tariffs for the various routes.
3. Additional consideration should be given to the desirability of a case such

as III-B where two pipelines each capable of carrying up to 100% of the SNG production are provided to obtain maximum system reliability and marketing flexibility. The optimum case may be two pipelines with diameters between that of Case III-A and III-B (between 12" to 16"). These pipelines would offer the capability of transporting 50-100% of total SNG production. If this option is given further consideration, the direct right-of-way between the synfuels plant and the Slaughters Compression Station (see Figure 6) should also be surveyed.

EXHIBIT XVI-S(c)

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: J.S. Christopher

CO/DIV: Engr. Services-Conceptual Design

FROM: W.W. Slaughter

DATE: September 23, 1981

SUBJECT: TRI-STATE SYNFUELS PROJECT, PIPELINE ROUTE SELECTION

Per your memos of September 8 and 14, the routings of the gas and products lines have been adjusted to cross the SIGECO powerplant through an apparent undeveloped section and totally bypass Indiana State University by running to the north of the campus. The major difference between the adjusted routing and the previous routing in my memo of August 26, is that the products pipeline parallels the gas pipeline for about 1.1 miles further before branching off towards the Princeton Terminal. The changes only effect the routing on the West Franklin, Ind.-Ky. quadrangle sheet. Additional copies of the thirteen quadrangle maps show all proposed routes are also forwarded per your request. The arrangement of the thirteen sheets are shown in Figure 1.

The crossing at the Ohio River has not been relocated. It is the opinion of the Pipeline Design group-ESD that moving the crossing downstream to beyond the west side of the SIGECO plant perimeter would place the crossing at an unstable section of river bank. Moving the crossing point upstream would route the pipelines through relatively rough terrain and is therefore considered less desirable. The adjusted routing adds 1.0 mile to the products pipeline to the Princeton Terminal, i.e., 43.2 versus the previous 42.2 miles. This would increase the estimated price from $9,157 million to $9,374 million. The adjusted routing also adds a negligible distance of 0.05 to the gas line to mile post 559.4 on TETCO Line No. 1.

Additional modifications to the pipeline routing due to residential, commercial and industrial development will be required. It is recommended that the probable routes be scouted by helicopter to determine further adjustments to the routes prior to detailed surveys. One to two days of rental should be sufficient to scout the Tri-State pipeline routes.

JJ:pv
Attachment

xc: O.D. Adams
G.H. Rich

1 2 3 4 5
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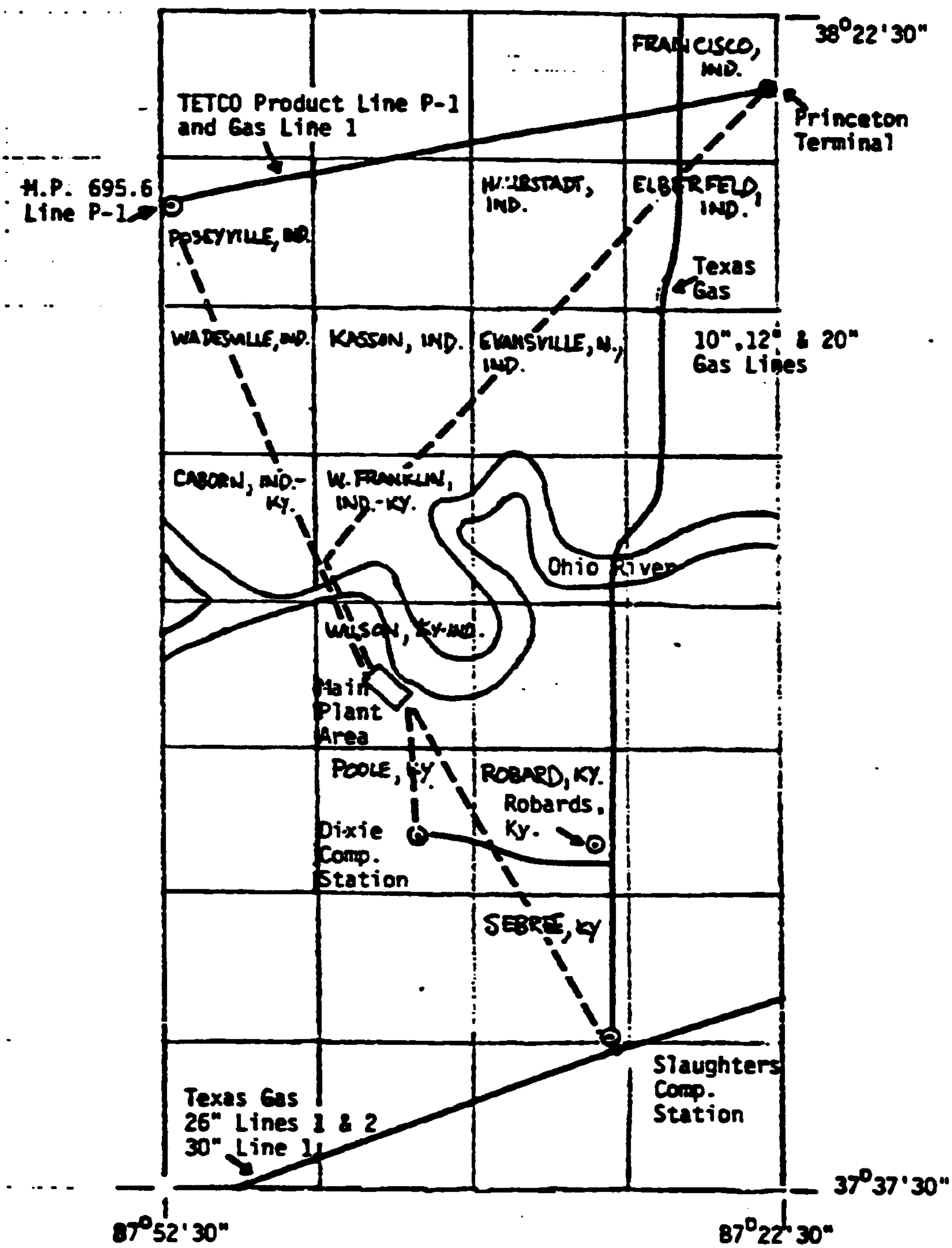
SEP 2 . 1981
OWEN D. ADAMS
ENGINEERING



TETCO Product Line P-1 and Gas Line 1
M.P. 695.6 Line P-1
FRANCISCO, IND.
Princeton Terminal
ELBERFELD, IND.
POSEYVILLE, IND.
Texas Gas
WADESVILLE, IND.
KASSON, IND.
EVANSVILLE, N., IND.
10", 12" & 20" Gas Lines
CABORN, IND.-KY.
W. FRANKLIN, IND.-KY.
Ohio River
WILSON, KY-IND.
Main Plant Area
POOLE, KY.
ROBARD, KY.
Robards, Ky.
Dixie Comp. Station
SEBREE, KY
Slaughters Comp. Station
Texas Gas 26" Lines 1 & 2 30" Line 1
38°22'30"
37°37'30"
87°52'30"
87°22'30"

EXHIBIT XVI-T

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: O. D. Adams

FROM: J. P. McIlvoy

CO/DIV: Synfuels

DATE: October 12, 1981

SUBJECT: Design Criteria - Product Storage and Handling

This is to confirm my discussion with Roger Fincher last week of the marketing influence on the product and by-product storage, transportation and distribution design criteria. At this point and time, the quantities expected to be handled by each transportation and distribution mode cannot be determined precisely. However, some general guidance has been provided by Texas Eastern's Products Pipeline Company and Chem Systems.

The storage, transportation and distribution facilities for product and by-product disposition should be designed for maximum flexibility. The following list summarizes my discussion with Roger.

SNG

- Pipeline transportation interconnection to Texas Eastern and Texas Gas separate lines.

Liquid Transportation Fuels

- Storage based upon a minimum two (2) weeks production, or 25,000 barrels, whichever is greater.
- On-site distribution for gasoline, diesel, propane and fuel oil via truck, rail and barge.
- Pipeline transportation facilities sized to deliver the stream day rate of the largest component of production, i.e., gasoline.

Ethylene

- Storage based upon six (6) weeks production
- Transportation off-site via barge and railtank.

Ammonia

- Storage based upon four (4) weeks production
- Transportation off-site via barge, railtank and tanktruck

Phenol

- Storage based upon four (4) weeks production
- Transportation off-site via railtank and tanktruck

Benzene

- Storage based upon four (4) weeks production
- Transportation off-site via barge, railtank and tanktruck

Acetone

- Storage based upon four (4) weeks production
- Transportation off-site via barge, railtank and tanktruck

MEK

- Storage based upon four (4) weeks production
- Transportation off-site via railtank and tanktruck

The remaining products and by-products described in the Feasibility Study are not listed because alternative uses to direct sales have been recommended.

Additional definition of product and by-product storage, transportation and distribution will not be available until later in next year when purchase commitments are expected and locations of customers pinpointed.

Please advise if you desire additional information.

JPM/ca

xc: M. D. Burke
L. S. Rathbun

EXHIBIT XVI-U

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: R. A. Jones

CO/DIV: Synfuels

FROM: L. S. Rathbun LSR

DATE: March 23, 1982

SUBJECT: Your memo TITH-0154/AD.ST.5-Regarding Product Dock
Ref. No. THTI-0044

I wanted to expand upon a comment you made in the referenced memo. You state that I feel the option to ship liquid products by barge will provide the project with valuable flexibility. This is, of course, true but I wanted to clarify that from a marketing point of view I can not justify the costs of providing a products barge dock for Cases 13 and 15. If costs are indeed minimal, then we might choose to include the dock for these "flexibility" reasons but if the costs prove to be higher than the estimated "around one million dollars" we should reconsider its inclusion in our design for these two Cases.

As we decided, Cases 14 and 16 should include the products dock to handle the chemical grade methanol and/or acetic acid.

LSR/ca

xc: O. D. Adams
M. D. Burke

4.0 APPENDIX

The following is an appendix to section XVI, Marketing.

EXHIBIT XVI-V
MARKETING
MAJOR CONTACTS

Company & Address	Individual	Title/Position	Telephone
1. Chem Systems Inc. 14925 Memorial Drive Suite 210 Houston, TX	Ray Ory	Manager, Houston Operations	(713) 493-4115
2. Various potential customers	(See Chem Systems' call reports in Tri-State's files for names, addresses, and phone numbers.)		
3. Texasgulf Chemicals Co. 4509 Creedmoor Rd. Raleigh, NC 27612	Robert E. Clagett	V.P. Marketing - Sulfur and Soda Ash	(919) 829-2700
4. Resource Planning Associates 5433 Westheimer Houston, TX	Phillip Waters		(713) 840-0041
5. Merichem Company P. O. Box 61529 Houston, TX	Richard A. Coderre	Project Manager, Development	(713) 224-3030

EXHIBIT XVI-W
MARKETING

MAJOR REFERENCE DOCUMENTS*

	Item	Description	Author	Date	Location	Utility**
1.	Chem Systems Marketability Report	Marketability price forecasts for Tri-State products	Chem Systems, Inc.	08/81	TS File Room	3
2.	Chemical Economics Handbook	Multi-client chemical market research	SRI-International	Updated monthly	Mineral Resources Library - 2900	2.5
3.	Marketability Study for the New Mexico project	Marketability of SNG, Methanol, & gasification by-products	Pace Consultants	03/82	Western Project File Room	2.5
4.	KDOE - Marketability Study	Preliminary study for F-T Chemicals	Division of Technology assessemnt KDOE	04/80	TS File Room	2
5.	Synfuels Marketability	Preliminary study for F-T Chemicals	Petgroup Plans & Controls	04/80	TS File Room	2
6.	SNG Marketing info.	Marketability and transportation of SNG - T.E.	Gas Group	04/80	TS File Room	2

* Reports, maps, papers, reference/research groups, schedules.
** Utility: 3 - very important, 2 - useful, 1 - questionable value.

EXHIBIT XVI-W

MARKETING

MAJOR REFERENCE DOCUMENTS*

	Item	Description	Author	Date	Location	Utility**
7.	Methanol Economics, Production and Markets	Seminar papers - sponsored by chemical week 12/81		12/81	Western Project File Room	2
8.	Methanol - A Global Analysis	Multi-client study	Chem Systems, Inc.	05/79	Petgroup Plans & Controls File Room	2
9.	Chemical Origins and Markets	Petrochemical flow charts and tables	SRI-International	1977	Library	2
10.	CO_2 Potential	CO_2 potential for EOR in Midwest	National Cup - Chemies Inc.	1981	TS File Room	1

EXHIBIT XVI-P

PMA Distribution:
M. D. Burke
J. M. Hossack
L. S. Rathbun
Central Files

TEXAS GAS SYNFUEL CORPORATION
3800 Frederica Street
P. O. Box 1160
Owensboro, Kentucky 42302
Phone 502/926-8686

Subsidiary of Texas Gas Development Corporation

Marc N. Kelley
Vice President

December 14, 1981

Mr. Paul M. Anderson
Texas Eastern Synfuels Company
P. O. Box 2521
Houston, Texas 77001

GAS TRANSMISSION SERVICES DIVISION

P. O. Box 1160 · 3800 Frederica Street
Owensboro, Kentucky 42301
Phone 502/926-8686

DIVISION OF
TEXAS GAS TRANSMISSION CORPORATION

John R. Gregory
Vice President

December 7, 1981

Mr. Marc Kelley
Vice President
Texas Gas Synfuel Corporation
3800 Frederica Street
Owensboro, Kentucky 42301

EXHIBIT XVI-Q

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: M. D. Burke

FROM: L. S. Rathbun

SUBJECT: Sulfur Marketing

CO/DIV: Synfuels

DATE: March 23, 1982

I recently called Robert E. Clagett, Vice President of Marketing (for sulfur and soda ash) with Texasgulf Chemicals to talk to him about the recent behavior of sulfur price and his view of the current/future sulfur market. (I have known Bob for a number of years through Rocky Mountain Energy's soda ash activities.)

In our discussion I also brought up two items which I wanted to make you aware of. I asked him about the potential poisoning of sulfuric acid catalysts by sulfur produced by the Stretford unit. He said that he would relay the question to his technical people and get back to me on this. We also discussed Texasgulf's interest in either purchasing or brokering Tri-State's sulfur. Bob is very interested in talking to us about this and will be in contact shortly to set up a meeting. I told him that there was no particular urgency on our part, and for him to make it a time that is convenient with him. I expect that it will be within the next three-four weeks.

LSR/ca

xc: P. M. Anderson
W. N. Shoff

EXHIBIT XVI-R

TEXAS EASTERN Synfuels, Inc.

A TEXAS EASTERN COMPANY

ANTON ROEGER, III
TECHNICAL MANAGER

October 23, 1981

Mr. Richard A. Coderre
Project Manager, Development
Merichem Company
P. O. Box 61529
Houston, TX 77208

Subject: Tri-State Synfuels Project
Crude Phenol Sample from Kentucky 9 Coal

Dear Mr. Coderre:

In accordance with your request of October 15, 1980, I am pleased to furnish you with one gallon of crude phenol produced in our coal gasification test in South Africa for your in-house evaluation. The sample is being sent under separate cover.

Texas Eastern Synfuels requests that you provide us with analytical results and methods on the sample. Further, we are furnishing you this sample with the understanding that no results be published.

It would be desirable to review the results when you complete the lab examination. At that time, we could discuss any additional processing steps which would be required to upgrade the products.

Please advise if you need any background on the quality of the coal.

We are looking forward to your assessment of the crude phenol.

Very truly yours,

Anton Roeger, III

Anton Roeger, III

jf
xc: J. T. Wooten

bxc: H. C. Homeyer
P. M. Anderson
M. D. Burke
O. D. Adams
L. S. Rathbun
File

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: Mr. Owen D. Adams

CO/DIV: Synfuels

FROM: Anton Roeger, III

DATE: February 25, 1982

SUBJECT: Tri-State Synfuels Project
Future Testing of Crude Phenols and Tars

I am furnishing Merichem two 5-gallon containers of crude phenols for processing tests from the recent shipment of 19 containers. Merichem tells me that the early tests indicate market potential for phenols in the Ohio River area and specifically for Tri-State phenols. A meeting will be set up in April or May to discuss these matters further with Linda Rathbun.

Further, the tar samples at Lake Charles would be available for bench scale tests for the Texaco partial oxidation step, if desired. Phenols could be added to simulate the expected feedstock. I have discussed this prospect with Bob Jones and believe that they should be considered after June.

In light of the value of phenols and tars for further testing, please maintain the samples at Lake Charles.

Tony

jf
xc: H. C. Homeyer
P. M. Anderson
M. D. Burke
L. S. Rathbun
J. T. Wooten
R. A. Jones

MERICHEM COMPANY

PHONE: A/C 713—224-3030 • 4800 TEXAS COMMERCE TOWER
TELEX: 775-178 • HOUSTON, TEXAS 77002-3088

February 19, 1982

A meeting will be set up in mid April to provide specific price data
~~HCH~~ ~~PAAA~~ ~~PADD~~
LSR
AR

Dr. Anton Roeger
Technical Manager
Synfuels Division
Texas Eastern Corporation
P. O. Box 2591
Houston, TX 77001

Dear Tony:

The sample of Phenosolvan-recovered crude phenols from your gasification test at SASOL has been evaluated as a feedstock for our cresylic acid business. Our laboratory found it to be typical. We assume there has been no pretreatment for removal of pitch.

Following is a summary of the analyses:

1. Isomer distribution - (wt% by GC method)

   35% phenol
   8% o-cresol
   18% m,p-cresol
   7% xylenols
   3% ethyl phenols
   2% alkyl phenols
   26% unknown compounds* (by difference)

   *Unknown compounds would include nitrogen compounds, neutral oils and high-boiling tar acids.

2. Nitrogen compounds (wt% by titration method)

   4.0% compounds (as m.w.=100)

You also requested methods for these analyses. I have attached the ASTM GC method and SMA-17 (direct pyridine base titration).

<u>You can believe the material will have commercial value.</u>

Merichem wants to take the crude phenols at the tank.

Sincerely yours,

Dick

R. A. Coderre
Project Manager, Development

RAC/cmm
Attachments

- Exhibit XVI-S: Memos regarding connections to Texas Gas' and Texas Eastern's gas pipelines.
- Exhibit XVI-T: Memo on product storage and handling.
- Exhibit XVI-U: Memo regarding no marketing justification for a product barge dock.

EXHIBIT XVI-S(a)

TEXAS GAS SYNFUEL CORPORATION
3800 Frederica Street
P. O. Box 1160
Owensboro, Kentucky 42302
Phone 502/926-8686

MDB Distribution 7/23/81:
LSR
JPMc-Incorporate in your products distribution system planning
ODA -Please forward copy to Fluor
JSC -Please forward copy to Radian

Subsidiary of Texas Gas Development Corporation

Marc N. Kelley
Vice President

July 20, 1981

Mr. Paul M. Anderson
Tri-State Synfuels Company
P. O. Box 2521
Houston, Texas 77001

Re: Tri-State Synfuels Project
Texas Gas Pipeline Routes
GOTH-0035

Dear Paul:

I recently asked the Texas Gas engineering department to develop a system for transporting one-half of the SNG produced from the Tri-State plant for the following three cases.

	One-Half SNG Production Rate
Case 1	79.0 MMSCFD
Case 2	103.5 MMSCFD
Case 3	167.0 MMSCFD

That study produced the following alternatives for transporting our share of the SNG. The first and most likely route to transport volumes in the range of those for Cases 1 and 2 involves laying a new 12-inch line, 9.5 miles long, from the plant site to our Dixie compressor station (Attachment I). The gas would then be transported through an existing line to a junction near Robards, Kentucky, where it would be transferred to an existing 12-inch line for transport to the Texas Gas Slaughters compressor station.

For the higher Case 3 rate, there are two alternatives that will require further study. The first requires laying 9.5 miles of 16-inch line from the plant to an existing line running from Dixie to the junction near Robards, then instead of using only the existing 12-inch line from Robards to Slaughters, a new 12-inch line that loops this existing line would also be needed (Attachment 2). This system is our best estimate at this time of how we would handle the higher production rates associated with Case 3. However, there is some concern that the remaining line from Dixie to Robards might not have the capacity to handle higher withdrawal rates of our peak day from the Dixie Storage Field. As a result of this concern, we have considered a second alternative for Case 3 which involves building a new line from the Tri-State plant site directly to the Slaughters compressor station. This new 16-inch line would be approximately 24.6 miles in length and is shown in Attachment 3.

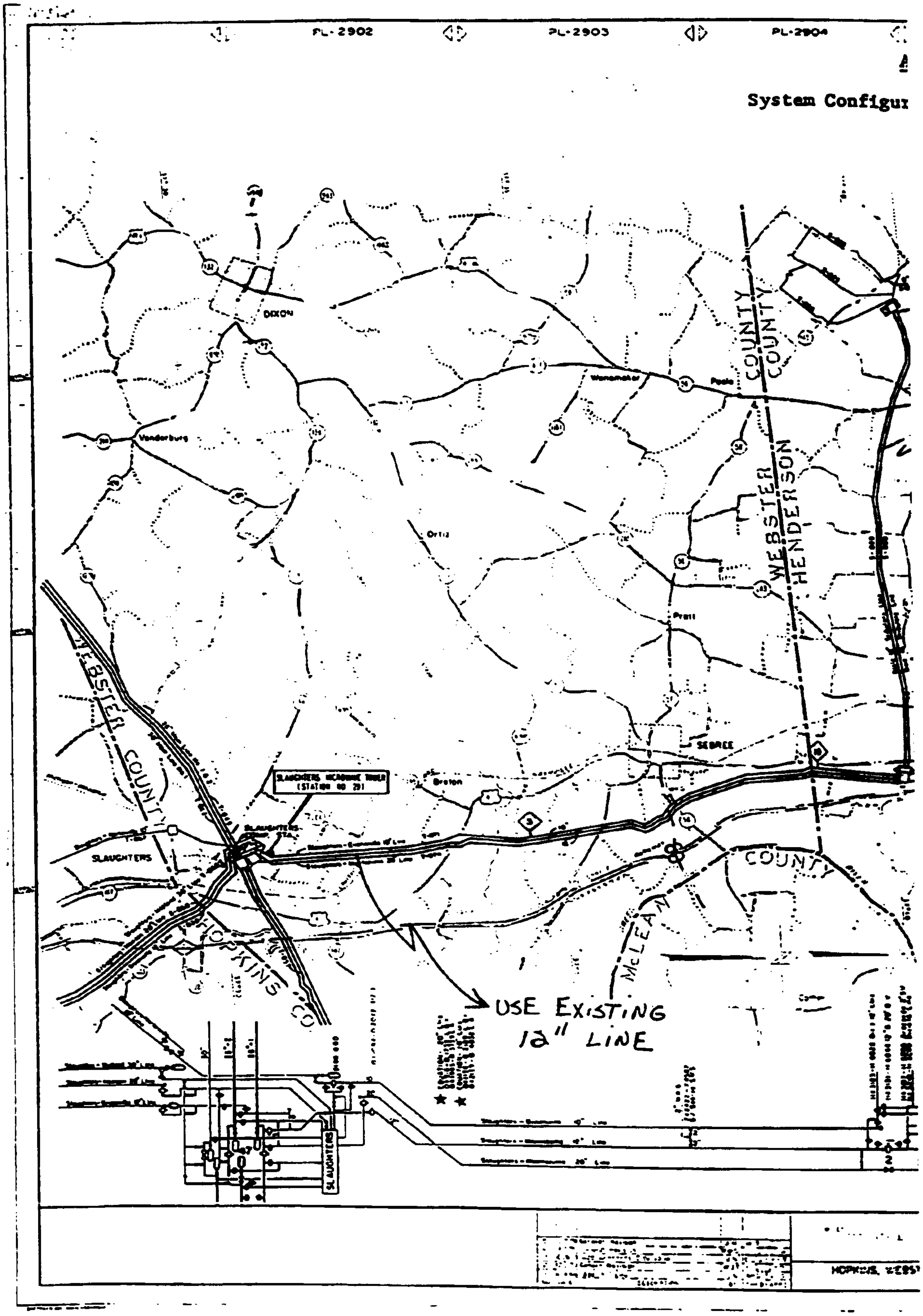
This summarizes the results of our engineering studies. For planning purposes it should be assumed that for a full-scale, Fisher-Tropsch type plant, (and Texas Gas handling one-half of the 158 MMSCF per stream day of gas) that we would implement the system described by Attachment I. If it is decided that we will build a plant with production levels of SNG in the range of that for Case 3, we will have to do some further study on our system to determine which one of the two alternates for Case 3 we would choose. I have also asked our engineering department to look at how we might handle double the gas of the three cases listed above and then transfer half of that gas to the Texas Eastern system. A report on that study should be ready in the near future.

This information will be of interest to Fluor and Radian in connection with their aerial survey and environmental work.

Sincerely,

Marc N Kelley /HDJ

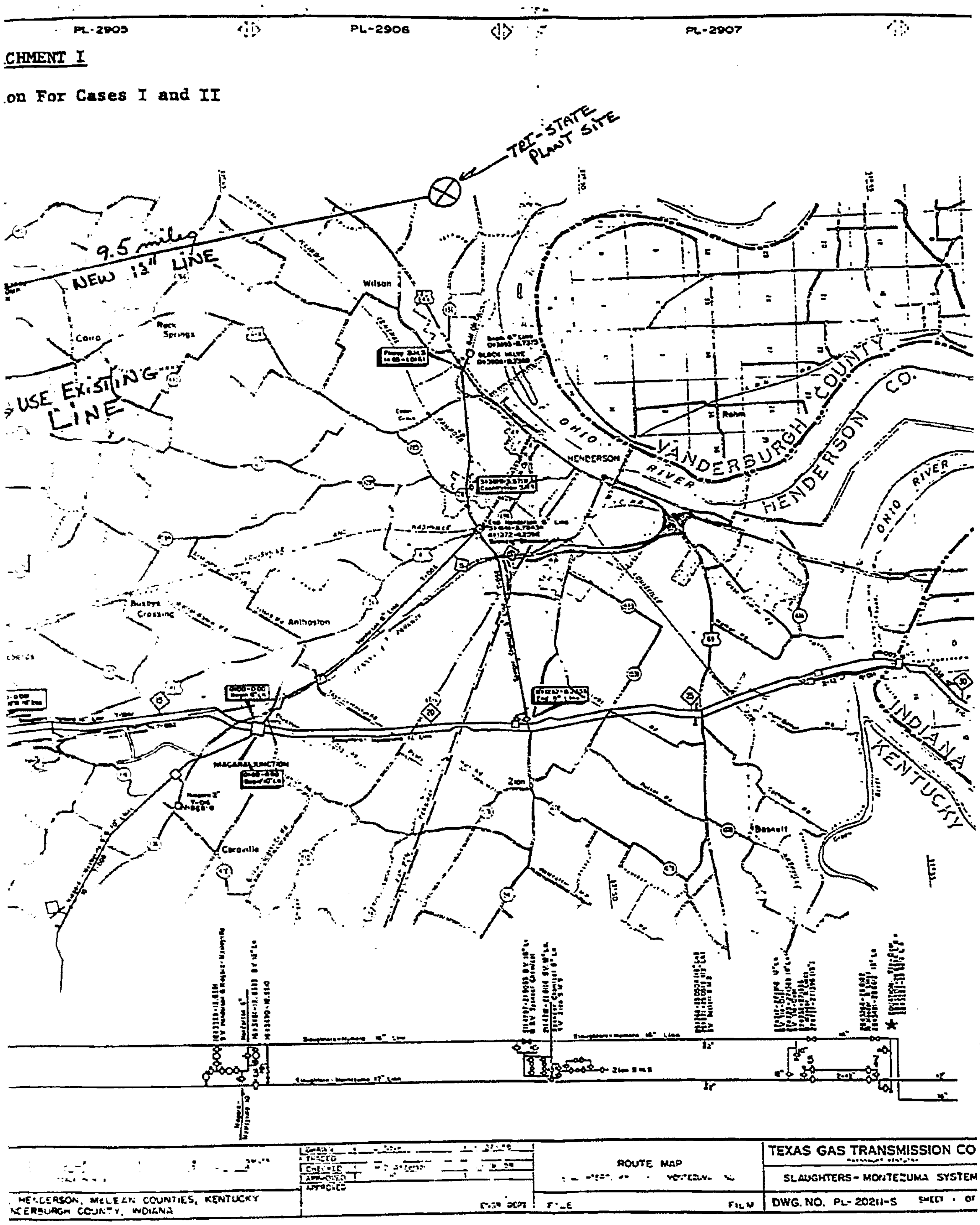
vl
c: Mr. R. S. Kramer
File 21-190-21



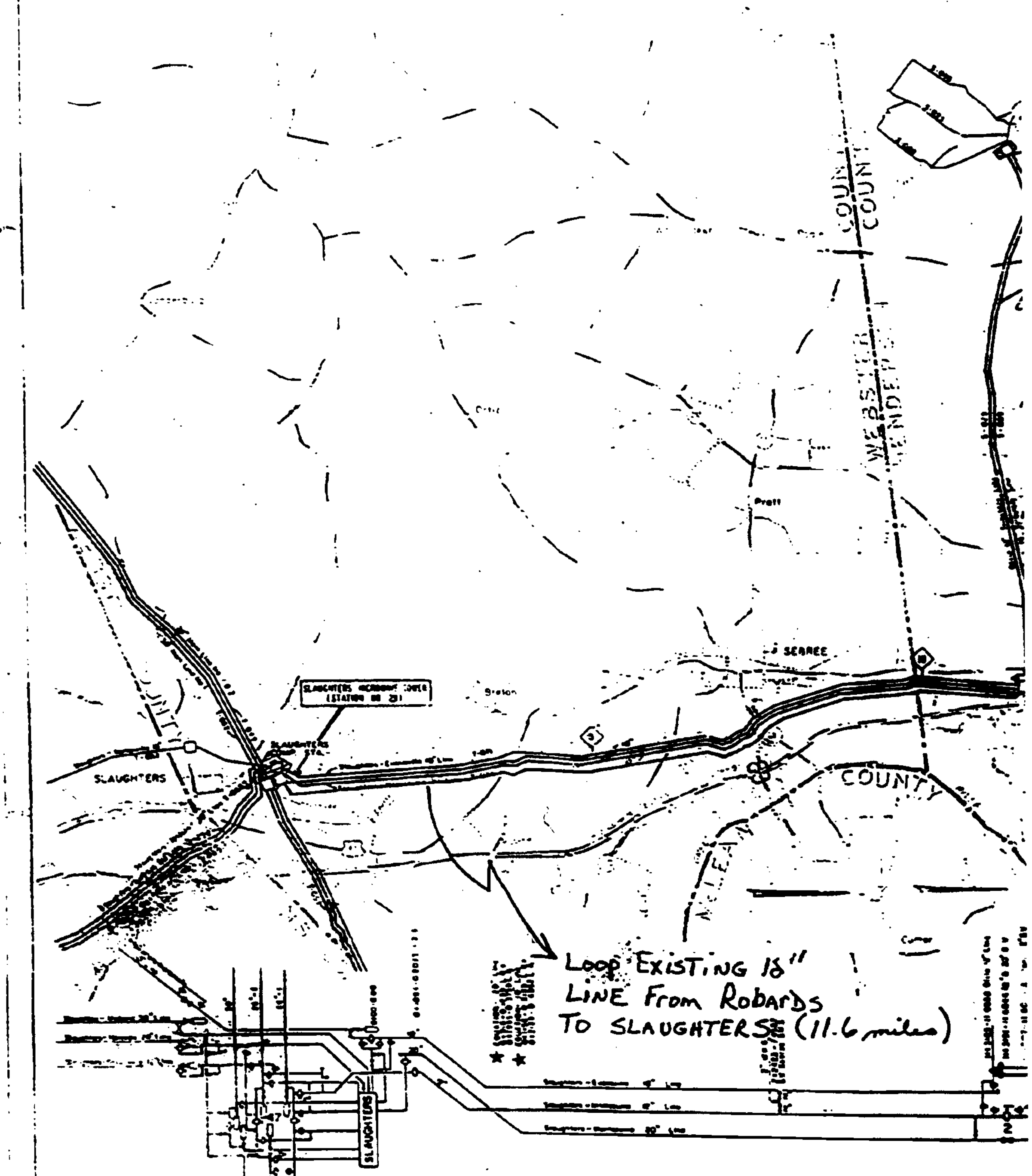
PL-2902
PL-2903
PL-2904
System Configur
DIXON
Vanderburg
Wanamaker
Poole
Ortiz
Pratt
SEBREE
Breton
SLAUGHTERS
SLAUGHTERS MICROWAVE TOWER (STATION 00 29)
WEBSTER COUNTY
HENDERSON COUNTY
HOPKINS CO
McLEAN COUNTY
USE EXISTING 12" LINE
SLAUGHTERS

CHMENT I

on For Cases I and II

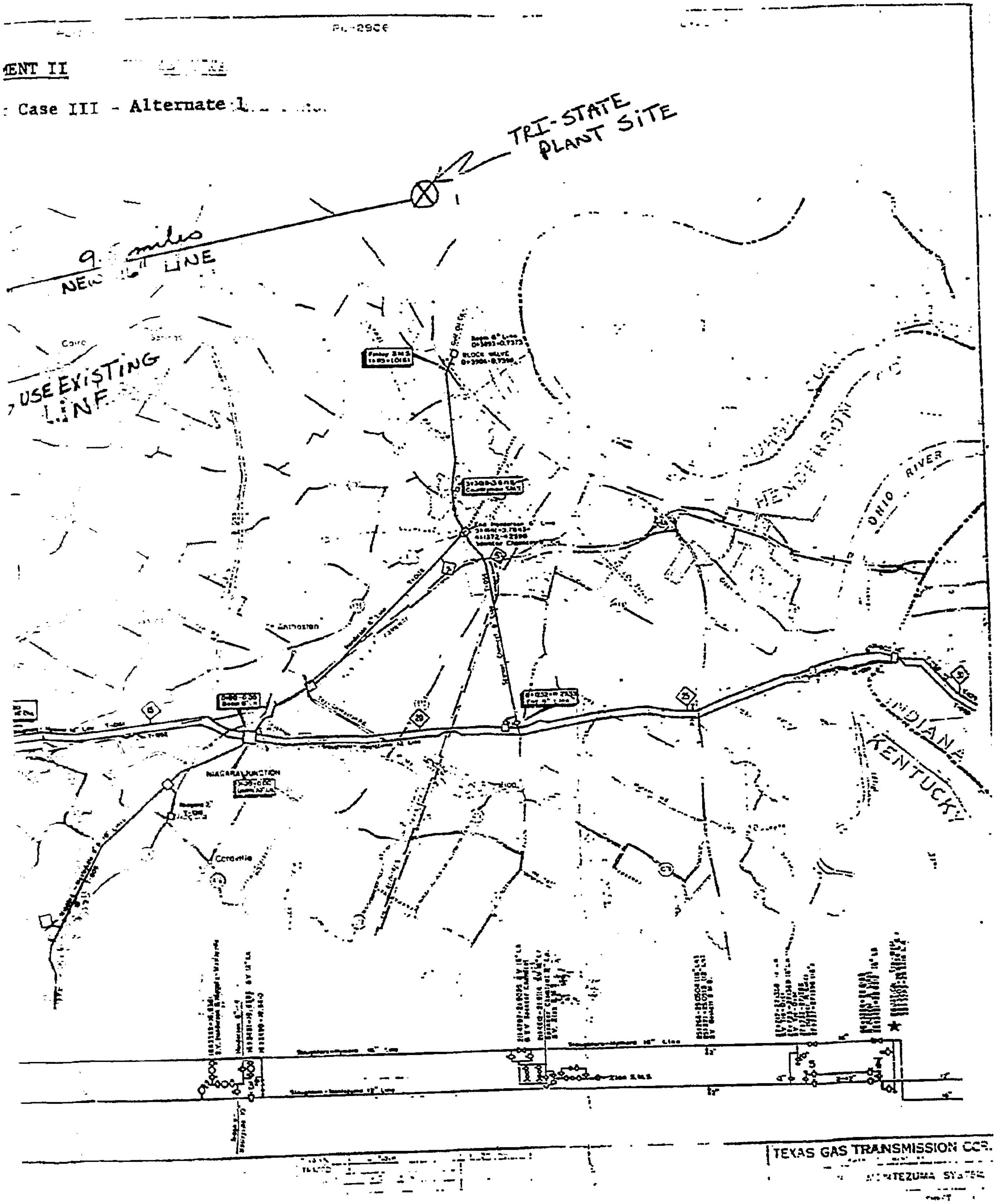


System Configurati



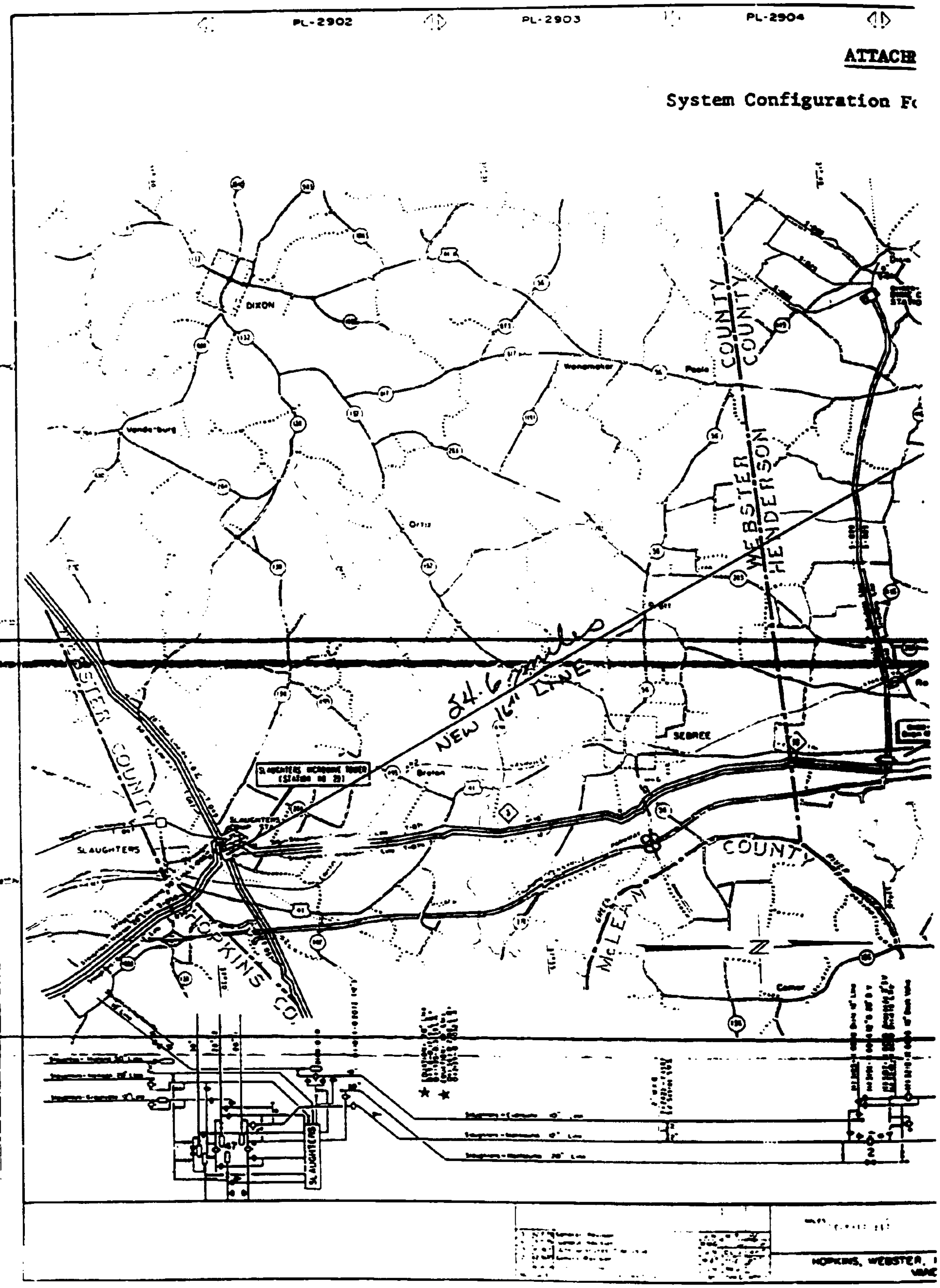
ENT II

Case III - Alternate 1



ATTACH

System Configuration F



ENT III

r Case III - Alternate 2

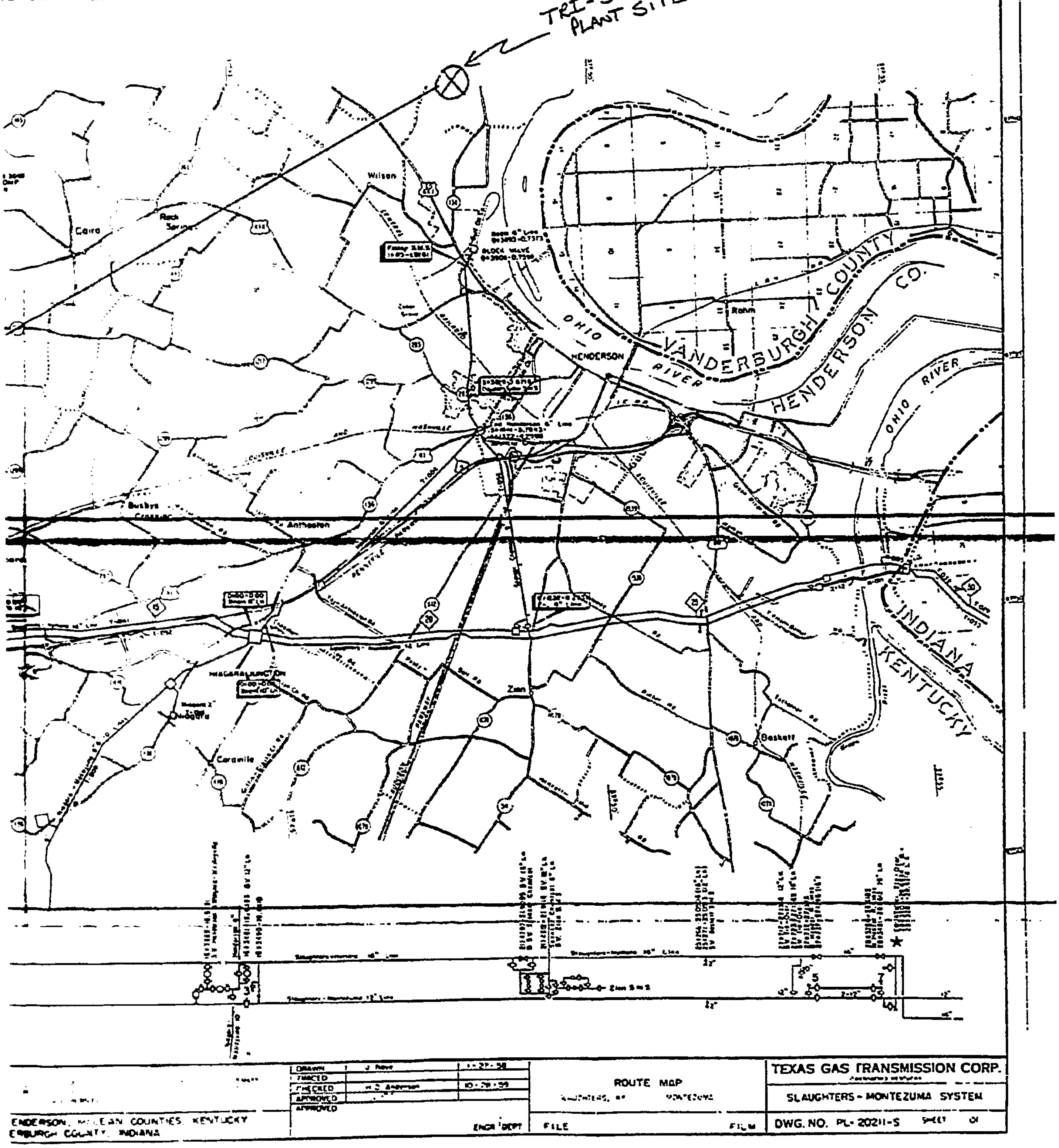


EXHIBIT XVI-S(b)

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: Distribution*

CO/DIV: Synfuels

FROM: O. D. Adams

DATE: August 25, 1981

SUBJECT: Pipeline Routes from the Tri-State Plant

Attached is a study prepared by Engineering Services depicting various options for pipelines from the proposed Tri-State Plant at Geneva to Texas Eastern and Texas Gas pipelines.

ODA:psj

*M. D. Burke
J. M. Conaway
H. C. Homeyer
R. A. Jones
M. N. Kelley
L. S. Rathbun
W. M. Scriber
TS File

TEXAS EASTERN

INTEROFFICE CORRESPONDENCE

TO: CO/DIV:

FROM DATE:

SUBJECT: SELECTION OF SNG AND PRODUCT PIPELINE ROUTES FOR THE TRI-STATE SYNFUELS PLANT

This memorandum summarizes current options and provides recommendations for pipeline transportation of SNG and major liquid fuel products, i.e., gasoline, diesel fuel, and jet fuel, from the Tri-State Synfuels Plant in Henderson County to existing TETCO and Texas Gas Transmission pipelines. The evaluation of alternate routing at this stage of the project serves to balance considerations of minimum transportation costs, system reliability, marketing requirements, and environmental and regulatory requirements, prior to the preparation of routing surveys and more precise order of magnitude cost estimates and facility descriptions. Recommendations of specific routes are provided and designated on 7.5 minutes series quadrangle maps to assist in developing new cost estimates and route surveys.

Texas Gas Synfuels Corporation recently forwarded a description of their preferred routes for connecting to the Texas Gas pipeline system. Therefore, it is possible to consider all possible combinations of SNG and products pipelines. Previous order of magnitude cost estimates prepared 12 March 1980, were limited to evaluating the cost impact of selecting a TETCO routing option which either used a single right-of-way to the Princeton Terminal, or which routed individual gas and product by their respective most direct routes. Estimates indicated that routing the gas pipeline in the same right-of-way with the product pipeline (to Princeton Terminal), resulted in a 20% greater capital investment due to the increased length of the SNG line.

The additional mixed ethane/ethylene stream from the synfuels plant is not included in this evaluation. The ethane/ethylene stream will either be utilized on site for polyethylene production or pipelined to a existing area customer. Two steps are necessary before there are clear requirements for an ethane/ethylene pipeline; (1) further economic analysis must indicate whether the optimum disposition of this stream would be sale and transportation to an existing area customer, and (2) suitable preliminary agreement must be negotiated with one of the five existing Tri-State area producers.

Routing Considerations

The selection of optimum routing for the SNG and products pipelines requires evaluation of the following considerations:

1. The products pipeline should be run to the nearest existing TETCO products terminal, in order to minimize capital and operating costs. Therefore, for all cases considered, the products pipeline is routed to the TETCO Princeton Terminal. Since storage facilities will be provided in the products delivery system, a failure in a single product pipeline would not effect plant production capacity factors.

2. For SNG transportation, the cases selected evaluate the system advantages of a single pipeline versus two pipelines capable of carrying varying flow rates to existing TETCO and Texas Gas pipeline facilities. Use of two SNG pipelines would assure continuous gas flow from the baseload synfuels plant in the event of pipeline failure or accidents. Therefore, comparison of single vs. multiple gas pipelines allows evaluation of the trade-off between transportation costs, system reliability and marketing flexibility.

3. For SNG transportation, a cost trade-off also occurs between using combined right-of-ways for the SNG and products pipelines versus the shortest possible distance for each line.

4. Minimizing environmental impact implies selecting a routing case with the lowest number of pipelines and right-of-ways.

5. Crossing of the Ohio River should occur at a point sufficiently upstream or downstream from river bends to guarantee a stable river bank area.

Cases Considered

Rough order of magnitude capital cost estimates were prepared for three main cases, I-A, II-A and III-A. In addition, slight variations in each of these three cases were prepared, i.e., Cases I-B, II-B and III-B. These six cases were developed using a total of four different right-of-ways from the plant. The different cases are shown graphically in Figure 1 through 6 and are defined as follows:

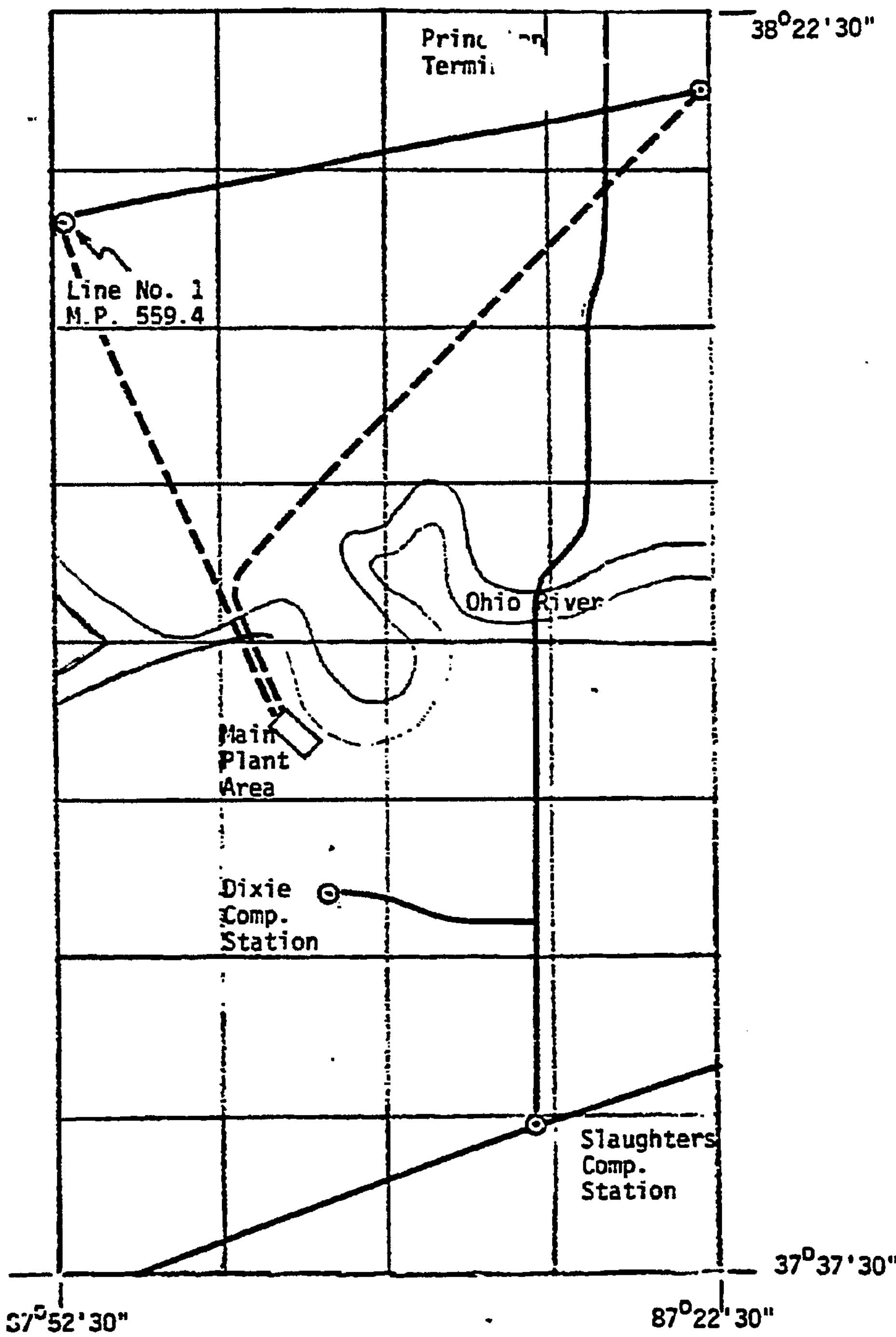


Figure 1. Routing Case I-A

EXECUTIVE SUMMARY

THE TRI-STATE SYNFUELS PROJECT

PRODUCT/BY-PRODUCT MARKETABILITY

PREPARED FOR

TRI-STATE SYNFUELS COMPANY

CHEM SYSTEMS. INC.
14925 MEMORIAL DR.
HOUSTON. TEXAS

AUGUST 1981

I CONTENTS

EXECUTIVE SUMMARY

I CONTENTS

I CONTENTS

II INTRODUCTION

A. Scope of the Report

The Tri-State Synfuels Project is an endeavor of Tri-State Synfuels Company, a partnership between Texas Eastern Synfuels, Inc., and Texas Gas Synfuel Corp., and has been selected by the U. S. Department of Energy for Cooperative Agreement funding. The coal conversion facility will be located near Henderson, Kentucky and will utilize the Lurgi and Fischer Tropsch technologies to convert 28,600 tons per day of Illinois Basin coal to high BTU synthetic natural gas (SNG), liquid transportation and heating fuels, and a wide range of chemical products and by-products. The facility is expected to be operational in 1987.

Chem Systems, under contract to Tri-State Synfuels Company, examined in detail the markets for Tri-State's proposed products within the general eight state region surrounding the proposed plant. This analysis focused on assessing the marketability of Tri-State's products and identifying potential customers and competitors. Future product prices and values were forecast, based on Chem Systems' current long-term prognosis of energy, petroleum and petrochemical demands. As directed by Tri-State, this analysis concentrated on the chemical products and did not examine the regional markets for synthetic natural gas (SNG) or transportation and heating fuels (i.e., gasoline, diesel, jet fuel, fuel oil and propane) but did address them on more general, national terms. The Chem Systems analysis of the markets for these fuels was limited because of the Tri-State partners' expertise in these areas.

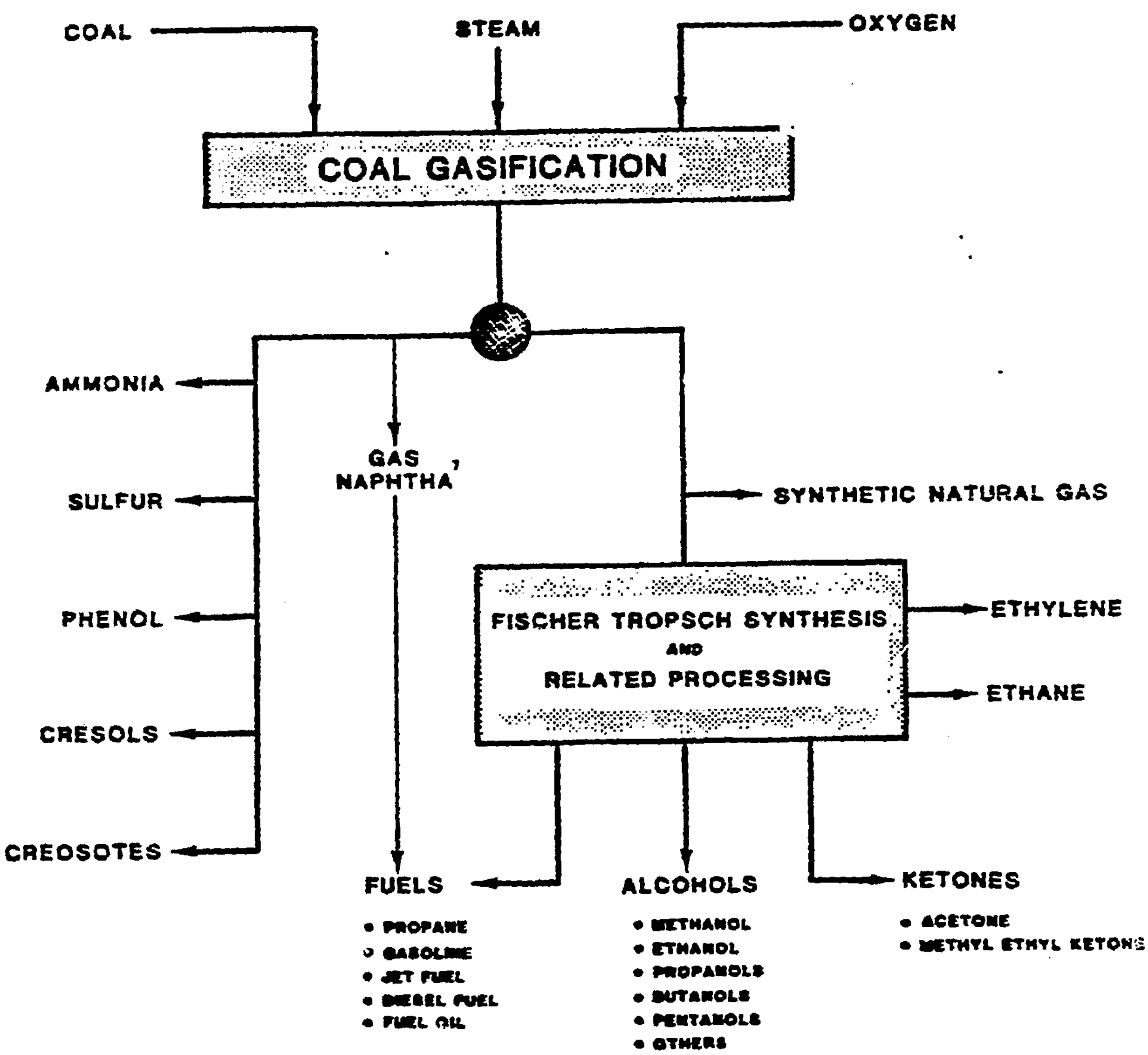
Recommendations and observations were also made relating to possible changes in the originally envisioned slate of products (Figure II-A-1) which might improve the marketability of the Project's products and its revenue generation capability. Chem Systems did not evaluate the economic viability of its recommendations for the Tri-State Project since Tri-State Synfuels Company will conduct these studies in conjunction with optimization studies on the design of the process equipment.

This report is a summary of Chem Systems' findings and includes the principal conclusions and recommendations. The recommendations in this report will be used as a basis for further study by Tri-State.

FIGURE II-A-1

TRI-STATE PRODUCT SLATE

(AS ORIGINALLY ENVISIONED)



[1] *GAS NAPHTHA IS CONSUMED INTERNALLY IN GASOLINE*

CHEM SYSTEMS

B. General Economic and Energy Assumptions

There are a number of assumptions pertaining to the U.S. economic and energy outlook which underlie the analysis presented in this report. They establish the overall environment in which the markets for the Tri-State Project's products were evaluated. These assumptions are:

- Worldwide economic growth and energy consumption will increase at a slower rate in the future than it has in the past. This is caused by limited supplies of, and higher prices for petroleum, and the effect of sustained energy conservation practices.

- Long-term (1980-2000) growth in the U.S. gross national product (GNP) will increase an average of 2.5 percent per year in real terms. This is a direct result of higher energy costs, declining rates of increase in the labor force and low labor productivity growth rates.

- Long-term energy consumption in the U.S. will increase approximately 1.5 percent per year. This growth rate is substantially lower than the pre-1973 OPEC embargo historical rates.

- Coal will re-emerge as a key energy source, increasing its contribution to total U.S. energy supply from 21 percent in 1980 to almost 35 percent by 2000.

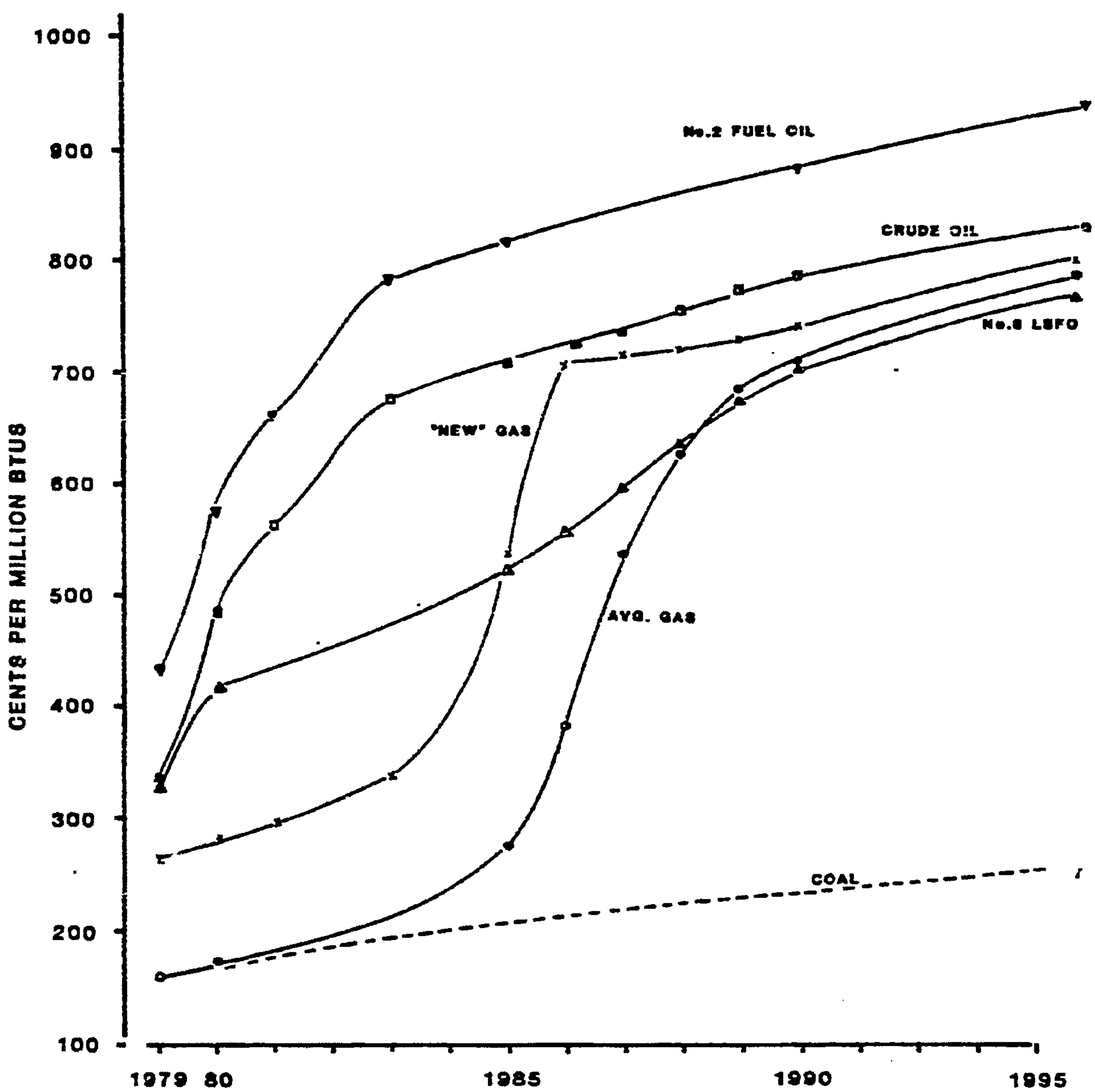
- The contribution of synfuels (i.e., liquid and gas products from coal, oil shale and tar sands) to the U.S. energy supply will be limited through 2000 due to financing, technical, and environmental barriers to development.

- Despite a lower growth rate of energy consumption and improved efficiency in energy use, the United States will continue to import a significant share of its total energy. Approximately 37 percent of the total petroleum supply will be imported in 2000 compared to 39 percent in 1980. Imports of natural gas will increase from 5 percent of supply in 1980 to over 15 percent by the end of the century.

FIGURE II-B-1

U. S. ENERGY PRICES

U.S. GULF COAST - CENTS PER MMBTU
(CONSTANT 1980 DOLLARS)



- Total U.S. demand for refined petroleum products will remain stable. Long-term declines in gasoline demand will be offset by increased demand for jet fuel and automotive diesel fuels.

- As a result of continued social and political uncertainty in the Middle East and other areas, the long-term price of foreign crude oil is forecast to rise, in real terms, at about 3.0 percent per year (Figure II-B-1).

- Natural gas prices, after deregulation under the Natural Gas Policy Act, will tend to equalize with the price of low sulfur residual fuel oil (Figure II-B-1). The availability of gas in the future will result in greater industrial and utility use as a thermal fuel than is presently envisioned under the Fuel Use Act.

- Coal use will be demand limited with future prices reflecting the incremental costs of opening new mines (Figure II-B-1), but will not rise with increases in petroleum price.

- Future petrochemical prices will increase at a rate somewhat greater than energy values, reflecting the real capital cost of constructing new plants.

III CONCLUSIONS AND RECOMMENDATIONS

A. The Tri-State Product Slate - General

- The eight-state region surrounding the proposed Tri-State Synfuels facility represents a good marketing area for virtually all products of the recommended product slate (Figure III-A-1).

- The opportunity for Tri-State to regionally market the higher valued end-products, i.e. transportation and heating fuels, chemicals and petrochemical raw materials, is improved by:

  - Continued importation into the Tri-State region of virtually all recommended products and/or their derivatives, yielding a transportation cost advantage

  - Ohio River access affording economical water-borne distribution to markets in the Ohio River Valley and the Gulf Coast region

  - Local access to Texas Eastern's refined products pipeline serving the Midwest and the East Coast

- The opportunity to market Tri-State's output of high BTU synthetic natural gas is enhanced by:

  - Large regional market in which current and future demands must be supplied from other regions

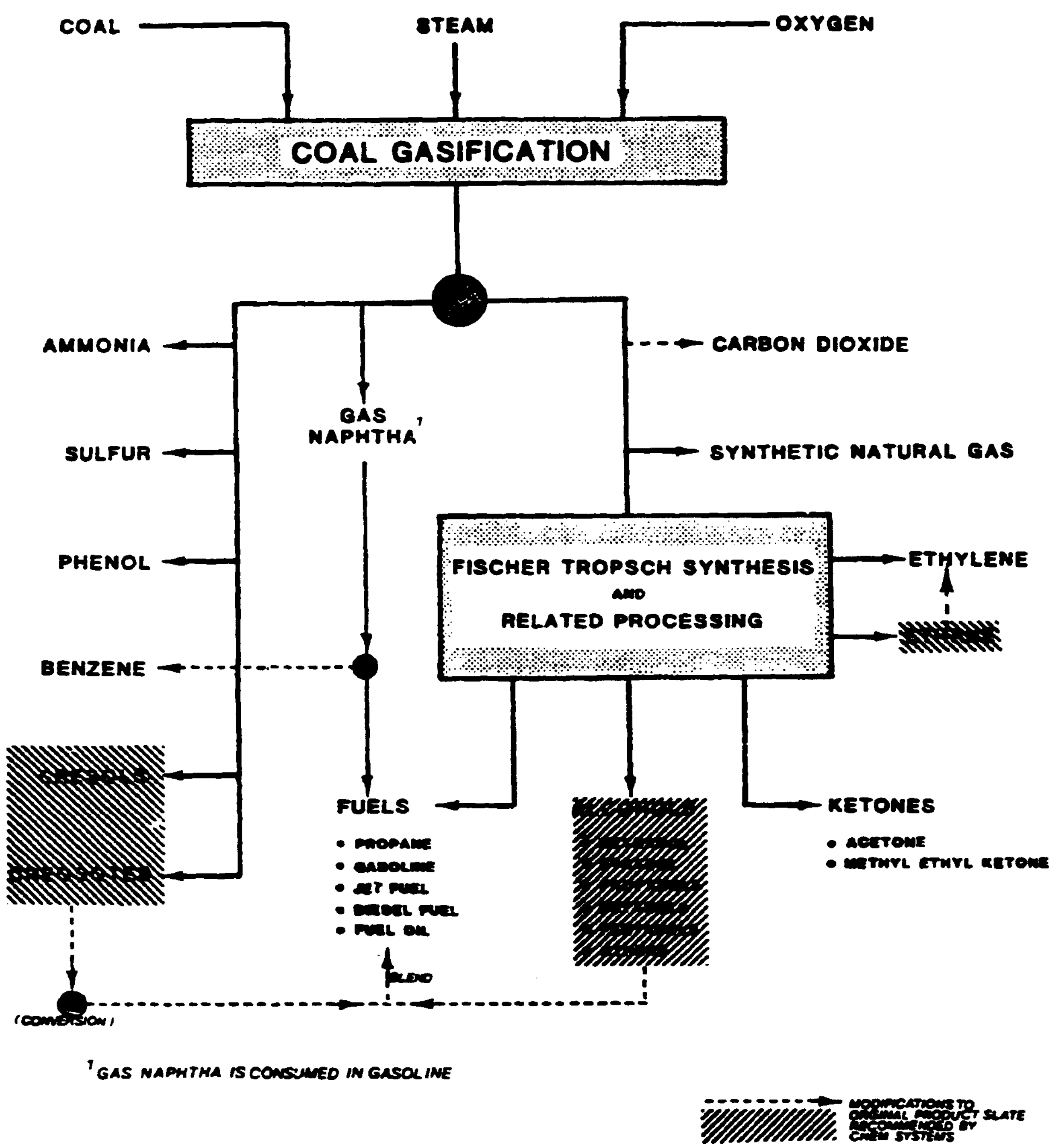
  - Local accessibility of Texas Eastern Transmission Corporation's natural gas transmission lines to the East Coast

  - Local accessibility of Texas Gas Transmission Corporation's natural gas transmission line to the Midwest.

FIGURE III-A-1

TRI-STATE PRODUCT SLATE

(AS RECOMMENDED)



[1] GAS NAPHTHA IS CONSUMED IN GASOLINE

B. Tri-State Product and By-Product Marketability

A comprehensive review and analysis of the marketability of the Tri-State product slate as originally envisioned (Figure II-A-1) resulted in selection of a "recommended" product slate (Figure III-A-1). The principal conclusions and recommendations associated with this product slate are as follows.

1. Gasification Products

Synthetic Natural Gas (SNG)

- Conclusion - Domestic supplies of indigenous natural gas will decline through the year 2000, with supplies from coal and other non-conventional sources increasing in significance towards the end of the century. Demand for gas in the Tri-State region will continue to be supplied from other regions - principally those of the Gulf Coast States.

- Recommendation - That SNG of a composition, quality and market price compatible with indigenous natural gas be produced to supply projected demands in the United States in general, and the Tri-State region in particular.

Carbon Dioxide

- Conclusion - A significant opportunity lies in the recovery of carbon dioxide from the project, and subsequent use in increasing domestic crude oil production by approximately 50 thousand barrels per day (MBPD) through enhanced oil recovery (EOR). The availability of over 400 million standard cubic feet per day (MMSCFD) of carbon dioxide also enhances the attractiveness of project participation by major domestic crude oil producers.

- Recommendation - That the plant's carbon dioxide production be recovered and transported via pipeline to an area where it can be used in EOR (e.g., West Texas, Illinois Basin, Louisiana Gulf Coast)

Sulfur

- Conclusion - The United States in general and the Tri-State region particularly will continue as a net importer of sulfur. Sulfur output from the proposed facility could easily displace a portion of these imports.

- Recommendation - That sulfur be recovered in a molten form and sold into available regional markets

Ammonia

- Conclusion - The favorable economics of producing ammonia in other world areas from available indigenous natural gas will essentially eliminate expansion of the U.S. industry on similar feedstocks. This will result in increased U.S. dependency on imported ammonia. Demand within the Tri-State region is currently met by movement of product from other regions.

- Recommendation - That ammonia be converted to urea, ammonium nitrate or nitrogen solutions by a second party at the plant site. Alternatively, regional ammonia sale is recommended if available quantities are not sufficient for economical on-site conversion.

Phenol

- Conclusion - Although substantial excess capacity will persist in the near term significant merchant market requirements for phenol are projected to exist within the Tri-State region by the time the plant becomes operational. Demands must be met through movement of product from other regions, notably the Gulf Coast. The output of Tri-State is projected to have no impact on the regional market.

- Recommendation - That phenol be recovered in a commercially acceptable form and sold into regional markets.

Cresols

- Conclusion - The overall market size and forecast demand growth for cresols will not support the output of the Tri-State Project. The prospect for other coal gasification facilities with similar product potential complicates the marketing problem.

- Recommendation - That cresols be converted, via known technologies, to aromatics suitable for direct blending into the plant's gasoline pool. It is further recommended that any benzene produced as a result of cresol conversion be recovered as a separate specification product and sold into available merchant markets.

Creosotes

- Conclusion - The overall market size combined with expected declines in demand for creosotes will result in a significant marketing problem for Tri-State production. The prospect for additional coal gasification facilities with similar product potential and the environmental sensitivity of this product are additional deterrents to marketability.

- Recommendation - That creosotes be converted, via suitable technologies, to a material (e.g., diesel fuel) suitable for blending into the plant's saleable transportation fuels. Consideration should be given to the conversion facilities accommodating purchased creosote streams from other regional synfuels plants.

2. Chemical Products

Ethylene/Ethane

- Conclusion - No regional market for ethylene is easily accessible to Tri-State. However, the availability of ethylene and subsequent conversion to polyethylene at the site could result in the penetration of a growing, available regional polyethylene market.

- Recommendation - That ethane be separated from ethylene and subsequently be converted to additional ethylene. Further, it is recommended that ethylene then be converted to polyethylene, at the site by a second party, and marketed in the region.

Acetone

- Conclusion - Growing markets exist within the Tri-State region for acetone. Increased availability of by-product acetone will eliminate intentional production. Tri-State product will compete in a market dominated by by-product acetone. The output of Tri-State will not have a significant affect on the regional marketplace.

- Recommendation - That acetone be recovered in a commercially acceptable quality and sold in the regional market.

Methyl Ethyl Ketone (MEK)

- Conclusion - Growing markets exist within the region for MEK. The output of Tri-State could easily be accommodated in the regional marketplace.

- Recommendation - That MEK be recovered in a commercially acceptable quality and sold in the regional marketplace.

Alcohols

- Conclusion - The quality of the alcohols (e.g., methanol, ethanol, propanols, butanols, pentanols and others) that would be produced under the proposed process configuration renders them unacceptable for sale as specification grade competitive products. It does not appear that the cost to upgrade the individual alcohols to the purity demanded by the market is economically justifiable. Their use as a blendstock in the plant's gasoline pool appears to offer the highest economic alternative disposition.

- Recommendation - That the mixed alcohols stream be blended into the plant's gasoline pool. The resulting octane increase will allow marketing of the gasoline as a premium unleaded grade. The volume of the plant's gasoline pool will be increased about 9 percent.

3. Transportation and Heating Fuels

Unprocessed Hydrocarbon Streams (Syncrude)

- Conclusion - The ability of regional refiners to process the raw hydrocarbon stream emanating from the Fischer Tropsch process is highly questionable. The nature of the streams' chemical compositions is incompatible with normal, naturally occurring hydrocarbons and its use by refiners would likely necessitate large capital expenditure in hydrogen production facilities. This will result in other refiners placing a low value on the syncrude stream.

- Recommendation - That facilities be constructed at the site to upgrade the raw hydrocarbon streams (i.e., "Syncrude") into specification transportation fuel products.

Gas Naphtha

- Conclusion - The blending of gas naphtha into the gasoline pool may result in environmentally undesirable levels of benzene in gasoline. Chemical values for benzene are considerably higher than gasoline values. Although existing regional supply is currently in excess of demand substantial markets for benzene exist on the Gulf and East Coasts of the United States and are accessible by Tri-State.

- Recommendation - Extraction and sale of the benzene contained in the coal gas naphtha stream is recommended. The remaining raffinate stream could easily be blended into the gasoline pool of the facility.

Fuels Products (Gasoline, Jet Fuel, Diesel, Fuel Oil, Propane)

- Conclusion - Demand for petroleum products in the United States and the Tri-State region will be essentially stagnant over the remainder of the century. Despite negative growth patterns in total gasoline and residual fuels, the region will continue its reliance on movement of products from the U.S. Gulf Coast. The positive future growth in regional demand for jet fuel and diesel will also necessitate increases in such movements.

- Recommendation - That Tri-State produce a slate of fuels products emphasizing transportation fuels (i.e., high octane unleaded gasoline, jet fuel and diesel fuel). Regional sale, via barges and/or the existing products pipeline systems, is also recommended.

IV SUMMARY

A. General

The Tri-State Synfuels Project is located near Henderson, Kentucky. The plant will utilize the Lurgi and Fischer Tropsch processes to convert approximately 28,600 tons per day of coal to 145 million cubic feet per day of high BTU SNG, 25,000 barrels per day of liquid transportation and heating fuels, and 2,000 tons per day of basic chemical intermediate products.

The development of the Tri-State Synfuels Project, as well as all synfuels development, will occur in a future environment dictated by national and international trends. In examining the markets for, and general price levels of, the products produced by Tri-State it is necessary to establish the future environment in which the facility will operate, and to possess a basic understanding of the processes and the competitive sources of these products.

In general, the opportunities for the recommended product slate of synthetic natural gas, transportation and heating fuels and chemicals produced from the Tri-State Synfuels Project will be in long term, moderate to high growth markets, offering minimal risk in marketing. Figure IV-A-1 presents the products from the Tri-State Synfuels facility as initially envisioned and the logic associated with the recommended product slate resulting from the market analysis.

This Summary first sets forth the energy and economy background and basis issues, and the United States energy and petrochemical pricing assumptions. This then serves as a backdrop against which a discussion of specific products recommended for the Tri-State Synfuels Project is summarized.

FIGURE IV-A-1

TRI-STATE SYNFUELS COMPANY
PRODUCT/BY-PRODUCT MARKETING OPTIONS

Product Slate Originally Envisioned	Potential Disposition(s)	Potential Barriers	Recommendation
Gasification By-Products			
Carbon Dioxide	• Rejection to atmosphere	• Environmental	-
	• Sale as chemical grade	• Volume too large	
	• Use in enhanced oil recovery (EOR)	• Location and access of amenable oil fields	• Pipeline to EOR location
Gas Naphtha	• Blend into gasoline	• High benzene content in gasoline	-
	• Recover benzene for sale-blend remainder	• None	• Recovery and sale
Phenol	• Recover as spec product	• None	• Recovery and sale
Cresols	• Recovery and sale	• Small market environmentally sensitive	• -
	• Use as plant fuel	• Very low value	-
	• Hydrogenate to aromatics-recover benzene	• Technology unproven	• Hydrogenate and recover benzene
Creosotes	• Recovery and sale	• Volume too large - environmental problem	-
	• Use as plant fuel	• Low value	-
	• Use as blend in external fuel sale	• Consumer avialability - environmental problem	
	• Hydrogenate to diesel fuel	• Technology unproven	• Hydrogenate to diesel fuel
Sulfur	• Recovery and sale to sulfuric acid plant(s)	• None	• Recover and sale in region
Ammonia	• Recovery and sale as fertilizer	• Declining market for direct direct ammonia application	-
	• Recovery and sale to chemical producers	• Small regional market	-
	• Make urea from CO_2 and ammonia	• Small volume avialable	• Recover and attract urea producer to site
Chemical Products			
Ethane/Ethylene Mix	• Pipeline mix to regional consumer	• High pipeline cost	-
	• Separate ethane and blend with SNG	• Interchangeability	-
	• Separate ethane and convert to ethylene-pipeline to consumer	• High pipeline cost-low ethane value	-
	• Separate ethane, convert to ethylene convert to polyethylene at site	• None	• Recovery and conversion of ethane to ethylene-conversion to polyethylene at site by second party
Acetone	• Recovery and sale of spec product	• None	• Recovery and regional sale
Methyl Ethyl Ketone	• Recovery and sale of spec product	• None	• Recovery and regional sale
Ethanol n-Propanol Butanols Pentanols Plus	• Recovery at site and regional sale • Sale of mix to producer for recovery • sale of mix to consumer • Blend into gasoline pool	• Purification may not be economical • Possible jeopardy of producers spec product • No consumer market • None	• Blend into gasoline pool for octane credit
Transportation			
Propane Unleaded Gasoline Jet Fuel Diesel Fuel (1-D) Diesel Fuel (2-D) Fuel Oil	• Sale of spec product regional	• None	• Sale of spec product into regional markets
Synthetic Natural Gas	• Sale into partners' markets	• None	• Sale into existing partners' distribution and marketing system

B. Background and Basis Issues

1. United States Energy and Economy

The United States will experience substantially lower future economic growth than in the past despite the improvements made in energy utilization and general conservation. The primary constraining factors will reflect high energy costs, declines in labor force growth rates and labor productivity growth rates. Inflation rates will continue to average between 6.0 and 9.0 percent over the century as national fiscal and monetary policy will be less than ideal. Table IV-B-1 represents the basic components of Chem Systems' forecast of the U.S. economy which formed the underlying basis for our analysis.

TABLE IV-B-1

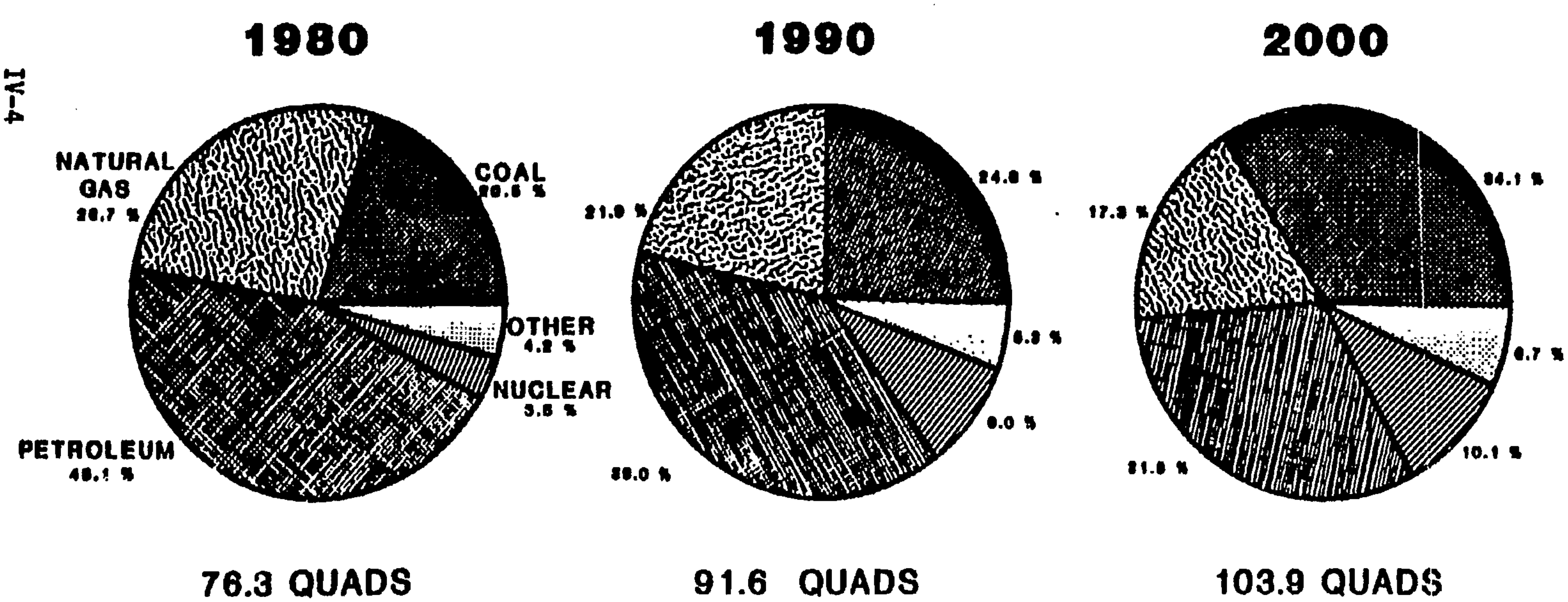
U.S. ECONOMIC FORECAST, 1978-2000*

	1978	1979	1980	1981	1985**	1990**	1995**	2000**
GNP (billion):								
1972 $	1436.9	1483.1	1480.0	1507.0	1685.0	1905.0	2155.0	2440.0
Current $	2156.1	2413.9	2629.0	2917.0	4600.0	7470.0	11580.0	17530.0
GNP Deflator, %	7.3	8.5	9.1	9.0	9.0	7.5	6.5	6.0
GNP Real Growth, %	4.8	3.2	(0.2)	1.8	2.6	2.5	2.5	2.5
Fixed Capital Cost								
Real Growth, %	10.0	11.8	12.1	12.0	12.0	10.5	9.5	9.0
New Housing								
Starts, millions	2.0	1.7	1.29	1.45	1.8	1.7	1.9	1.9
Auto Sales, millions	11.3	10.7	9.0	9.4	10.3	10.3	10.1	10.0

** These represent the annual percentage change for the 1980-1985, 1985-1990 and 1990-1995 periods, respectively.

FIGURE IV-B-1

UNITED STATES ENERGY DEMAND



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United States energy demands are forecast to increase about 1.5 percent per year between 1980 and 2000 (Table IV-B-2, Figure IV-B-1).

TABLE IV-B-2

U.S. PRIMARY ENERGY DEMAND FORECAST, 1980-1995
(Quads)

	1980	1985	1990	1995	2000	1980-2000 Rate of Change %
Coal	15.7	18.7	22.7	29.5	35.4	4.1
Natural Gas	20.4	19.8	20.1	19.0	18.0	(0.6)
Petroleum	34.3	35.6	35.7	34.0	33.0	(0.2)
Nuclear	2.7	5.9	8.2	9.0	10.5	7.0
Hydroelectric, Other	3.2	3.9	4.9	6.0	7.0	4.0
Total Primary Energy	76.3	83.9	91.6	97.5	103.9	1.5

The key implication of this forecast lies in the change in future energy use patterns from the pre-1974 U.S. energy environment. The shock of dramatic oil price increases in 1973-1974, 1979 and 1980 and the physical oil shortages during parts of those years have served to alter the energy use patterns of the U.S. consumer. Higher future prices will continue to result in conservation and consumer lifestyle changes, will effect increases on the cost of other forms of energy, and will result in further government policy aimed at conserving oil by improving the efficiency of its use. This environment is expected to continue through the remainder of the century and to restrain future energy demand growth.

United States energy supply will be characterized by the following key aspects:

- Declines in domestic crude oil production will slacken to about 1 percent per year from 1980-2000 period as compared to 3.2 percent per year 1975-1979. This reflects the expectations of new reserve discoveries and enhanced drilling activity.

- Continued financial and regulatory barriers to synfuels developments.
- Significant influence of coal as a major factor in supply.
- Domestic natural gas production to continue its decline, albeit at a slower rate than in the past, with imports and SNG from coal balancing demand post-1985.
- A continuation of the social and regulatory pressure inhibiting the development of nuclear power.

Despite reductions in energy consumption and improvements in energy efficiency, the United States will continue to import a significant share of its total energy. Approximately 37 percent of total petroleum supplies will be imported in the year 2000 compared to 39 percent in 1980. Imports of natural gas will increase from 5 percent of supply in 1980 to over 15 percent of supply in the 1995-2000 period.

C. United States Energy and Petrochemical Prices

Any energy conversion project evaluation must employ a consistent methodology for determination of hydrocarbon and product pricing. Chem Systems' forecast of prices utilizes a methodology which captures the effect of supply/demand, technology and economics, as well as expectations of government regulations on the marketplace price of products. Tables IV-C-1 and IV-C-2 represents Chem Systems' forecast of the main components of U.S. energy and petrochemical prices. The more important implicit assumptions of the forecast are:

- Foreign crude oil prices are forecast to rise, in real terms, about 2.5-3.0 percent per year over the remainder of the century as Middle East instability continues.
- Refinery margins will remain depressed with capital expenditures oriented towards increasing ability to process higher sulfur, lower gravity crude and increasing octane capability.

TABLE IV-C-1

REFINED PETROLEUM AND PETROCHEMICAL PRODUCTS
U. S. GULF COAST - CURRENT DOLLARS

		1980	1985	1990	1995	2000
Average Crude	$/Bbl	28.22	62.68	100.86	146.45	211.36
Full Range Naphtha	¢/Gal	83.5	180.7	274.8	397.3	561.2
Gasoline						
Premium Leaded	¢/Gal	92.0	186.1	-	-	-
Regular Leaded	¢/Gal	87.9	178.8	270.0	403.0	-
Regular Unleaded	¢/Gal	91.3	185.0	286.0	415.4	-
Premium Unleaded	¢/Gal	94.1	189.6	292.7	424.5	599.7
Kero/Jet	¢/Gal	80.4	178.1	278.3	410.9	585.5
Diesel	¢/Gal	80.0	175.5	277.2	409.3	593.5
No. 2 Fuel Oil	¢/Gal	79.8	174.3	269.5	392.1	555.1
No. 6 Fuel Oil (0.7S%)	¢/Gal	70.4	115.4	209.6	302.1	425.1
No. 6 Fuel Oil (3.0S%)	¢/Gal	44.8	105.1	214.3	316.6	455.1
Natural Gas						
Average Wellhead	¢/MM Btu	149.0	384.5	1478.7	2220.4	3219.0
"New" Gas Wellhead	¢/MM Btu	255.0	769.0	1478.7	2220.4	3219.0
Avg. Trans/Distrib - U.S.		70.0	115.4	209.6	302.1	425.1
Avg. Trans/Distrib - G.C.		27.0	53.8	88.3	145.0	202.5
Natural Gas Liquids						
Ethane	¢/Gal	28.7	66.3	129.8	195.2	273.7
Propane	¢/Gal	42.3	103.7	177.9	258.9	367.2
iso-Butane	¢/Gal	81.3	128.0	214.3	308.4	435.3
Butane	¢/Gal	57.0	117.2	201.1	293.3	415.0
Natural Gasoline	¢/Gal	69.7	154.0	244.5	355.9	504.1
Aromatics						
Benzene	¢/Gal	165.0	308.4	466.6	675.5	953.1
Toluene	¢/Gal	127.5	246.5	373.4	456.2	771.3
Xylene	¢/Gal	130.5	249.6	380.0	555.3	743.0
Olefins						
Ethylene	¢/lb	22.3	47.8	81.0	130.8	186.7
Propylene (PG)	¢/lb	19.4	40.8	65.1	107.5	149.8
Propylene (CG)	¢/lb	17.8	38.5	61.4	101.8	142.1

TABLE IV-C-2

REFINED PETROLEUM AND PETROCHEMICAL PRODUCTS
U.S. GULF COAST - CONSTANT 1980 DOLLARS

		1980	1985	1990	1995	2000
Average Crude	$/Bbl	28.22	40.85	45.70	48.48	52.20
Full Range Naphtha	¢/Gal	83.5	117.5	124.5	131.5	138.6
Gasoline						
Premium Leaded		92.0	121.0	-	-	-
Regular Leaded		87.9	116.9	125.5	133.4	-
Regular Unleaded		91.3	120.3	129.6	137.5	145.1
Premium Unleaded		94.1	123.3	132.6	140.5	148.1
Kero/Jet	¢/Gal	80.4	115.8	126.1	136.0	144.6
Diesel	¢/Gal	80.0	114.1	125.6	135.5	144.1
No. 2 Fuel Oil	¢/Gal	79.8	113.3	122.1	129.8	137.1
No. 6 Fuel Oil (0.7S%)	¢/Gal	60.4	75.0	102.1	110.5	118.1
No. 6 Fuel Oil (3.0S%)	¢/Gal	44.8	68.3	97.1	104.8	112.4
Natural Gas						
Average Wellhead	¢/MM Btu	149.0	250.0	670.0	735.0	795.0
"New Gas" Wellhead	¢/MM Btu	255.0	500.0	700.0	750.0	800.0
Av. Trans/Distrib - U.S.		70.0	75.0	95.0	100.0	105.0
Av. Trans Distrib - G.C.		27.0	35.0	40.0	48.0	50.0
Natural Gas Liquids						
Ethane	¢/Gal	28.7	43.1	58.8	64.6	67.6
Propane	¢/Gal	42.3	67.4	80.6	85.7	90.7
iso-Butane	¢/Gal	81.3	83.2	97.1	102.1	107.5
Butane	¢/Gal	57.0	76.2	91.1	97.1	102.5
Natural Gasoline	¢/Gal	69.7	100.1	110.8	117.8	124.5
Aromatics						
Benzene	¢/Gal	165.0	200.5	211.4	223.6	235.4
Toluene	¢/Gal	127.5	160.3	169.2	180.8	190.5
Xylene	¢/Gal	130.5	162.3	172.2	183.8	193.5
Olefins						
Ethylene	¢/lb	22.3	31.1	36.7	43.3	46.1
Propylene (PG)	¢/lb	19.4	26.5	29.5	35.0	37.0
Propylene (CG)	¢/lb	17.8	25.0	27.8	33.2	35.1

- Average natural gas prices after decontrol will tend to equilibrate with the BTU value of low sulfur No. 6 fuel oil at major industrial and/or utility boilers. The expected availability of gas will likely result in relaxation of the current requirements of the Power Plant and Industrial Fuel Use Act (Fuel Use Act) allowing greater use of natural gas as an industrial and utility thermal fuel.

- Coal prices will remain cost based and at the incremental cost of new mines. Approach to the cost of alternate fuels (i.e., ceiling price) is not expected over the forecast period.

- Basic petrochemicals will exhibit positive demand growth rates of 3-5 percent. This growth will necessitate new major increments of capacity by 1985 and beyond. Petrochemical market prices will therefore increase reflecting, not only higher feedstock cost, but also increasing cost of capital in real terms. Profitability, however, will remain lower than historical for major basic commodities as market maturity and increased participation identifies with the long-term outlook.

D. The Tri-State Project

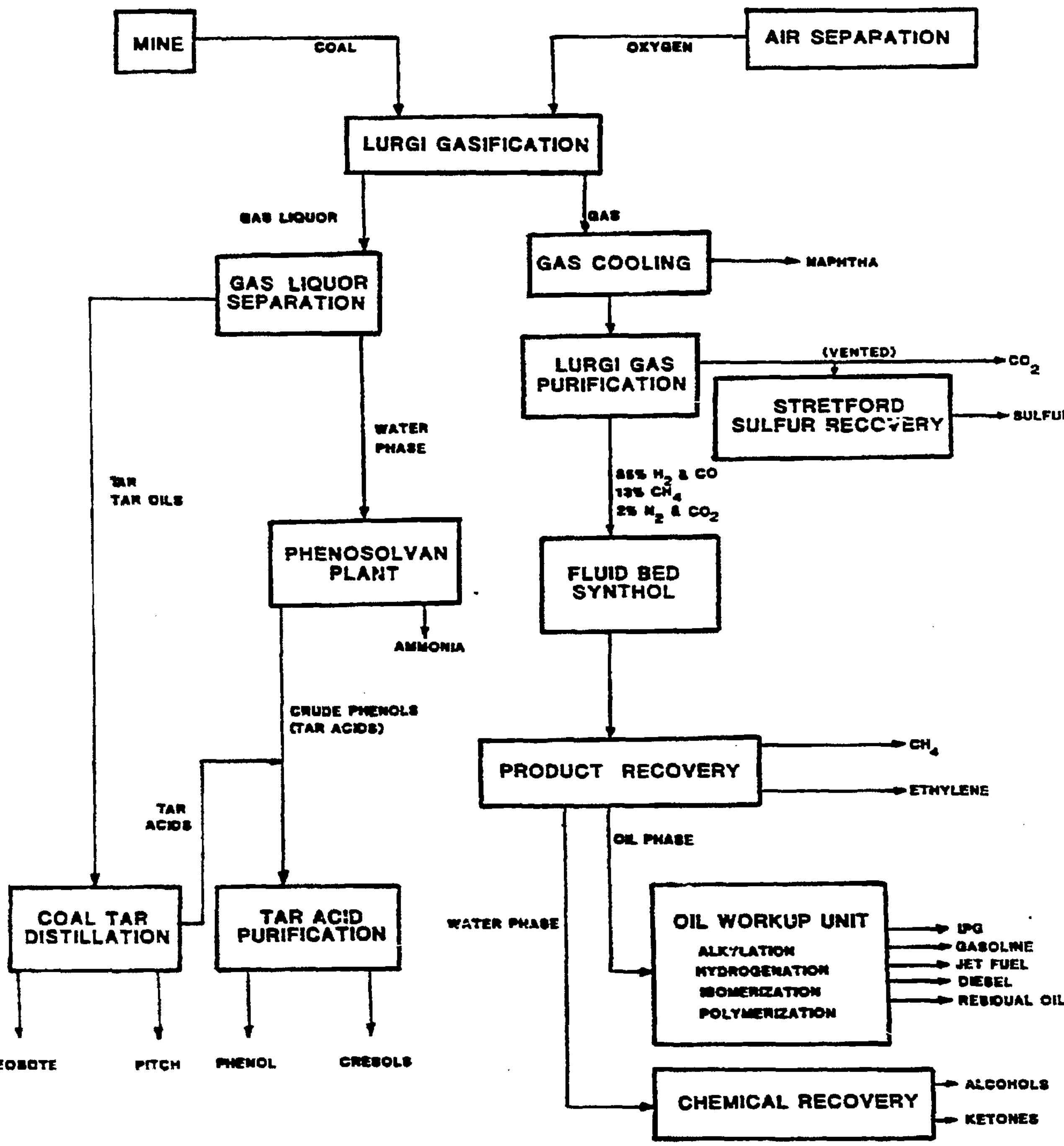
The Tri-State Synfuels Project is a coal gasification and liquefaction facility based on the commerical Lurgi and Fischer-Tropsch technologies. These technologies have some flexibility in the products that can be produced. It was within this framework that the marketability of alternative Tri-State products were analyzed.

1. Technology

In order to gain perspective on Chem Systems' recommendations of product slate, it is necessary to understand the basic flows associated with the Lurgi/ Fischer-Tropsch technologies as employed by Tri-State. Figure IV-D-1 identifies with the basic process flows as initially envisioned.

FIGURE IV-D-1

TRI-STATE SYNFUELS PROJECT



The raw gas from the Lurgi gasification process is "cleaned", producing products that are eventually upgraded to commercial specification products for direct sales. Table IV-D-1 lists the by-products produced as a result of the gasification of coal and the production of "clean" synthesis gas. The synthesis gas is fed to a Fischer-Tropsch reactor (Fluid Bed Synthol) for further conversion to other products.

TABLE IV-D-1

BY-PRODUCTS OF COAL GASIFICATION

Product	Daily Production
Carbon Dioxide	400mmscf
Gas Naphtha	350 tons
Phenol	40 tons
Cresols	50 tons
Creosotes	375 tons
Sulfur	520 tons
Ammonia	200 tons

Synthesis gas is converted into a large variety of hydrocarbons consisting of straight chain olefins and paraffins of the single carbon to as high as C_{16}^+ variety. Additionally, straight chain and branched chain alcohols and ketones of the same carbon range are produced. As illustrated in Figure IV-D-1, the output from the Synthol unit is separated into three basic streams:

- Light ends
- Oil phase
- Water phase

The composition of light ends are illustrated in Table IV-D-2.

TABLE IV-D-2

SYNTHOL LIGHT ENDS

Product	Daily Production
Methane	145mmscf
Ethane	*
Ethylene	*

The methane is separated as specification pipeline gas. The ethane stream is sent to conventional pyrolysis furnaces and converted to ethylene and combined with the primary ethylene stream.

The "water phase" contains virtually all of the soluble alcohols and ketones (i.e., chemical products). The approximate composition of these chemical components are listed in Table IV-D-3.

TABLE IV-D-3

SYNTHOL CHEMICAL PRODUCTS

Product	Daily Production
Acetone	750 tons (all products)
Methyl ethyl ketone	
Other ketones	
Methanol	
Ethanol	
n-Propanol	
Butanols	
Pentanol plus	

*included in volume of Synthol Chemical Products (Table IV-D-3)

The above products do not necessarily represent the output of specification products. Rather, they more appropriately represent the streams which are characterized by their principal component. For example, the n-propanol stream contains about 10 percent of other alcohols (e.g., sec-butanol).

The "oil phase" generally consists of all C_3+ olefinic and paraffinic straight chain hydrocarbons. This stream is sent to an "oil workup unit". This section of the plant basically refines and/or converts this stream into commercially acceptable specification transportation and heating fuels. The anticipated output from the oil workup section is illustrated in Table IV-D-4.

TABLE IV-D-4

TRANSPORTATION FUEL OUTPUT

Product	Daily Production
Propane Unleaded Gasoline Jet Fuel Diesel Fuel (1-D) Diesel Fuel (2-D)	25,000 bbl
Fuel Oil	500 bbl

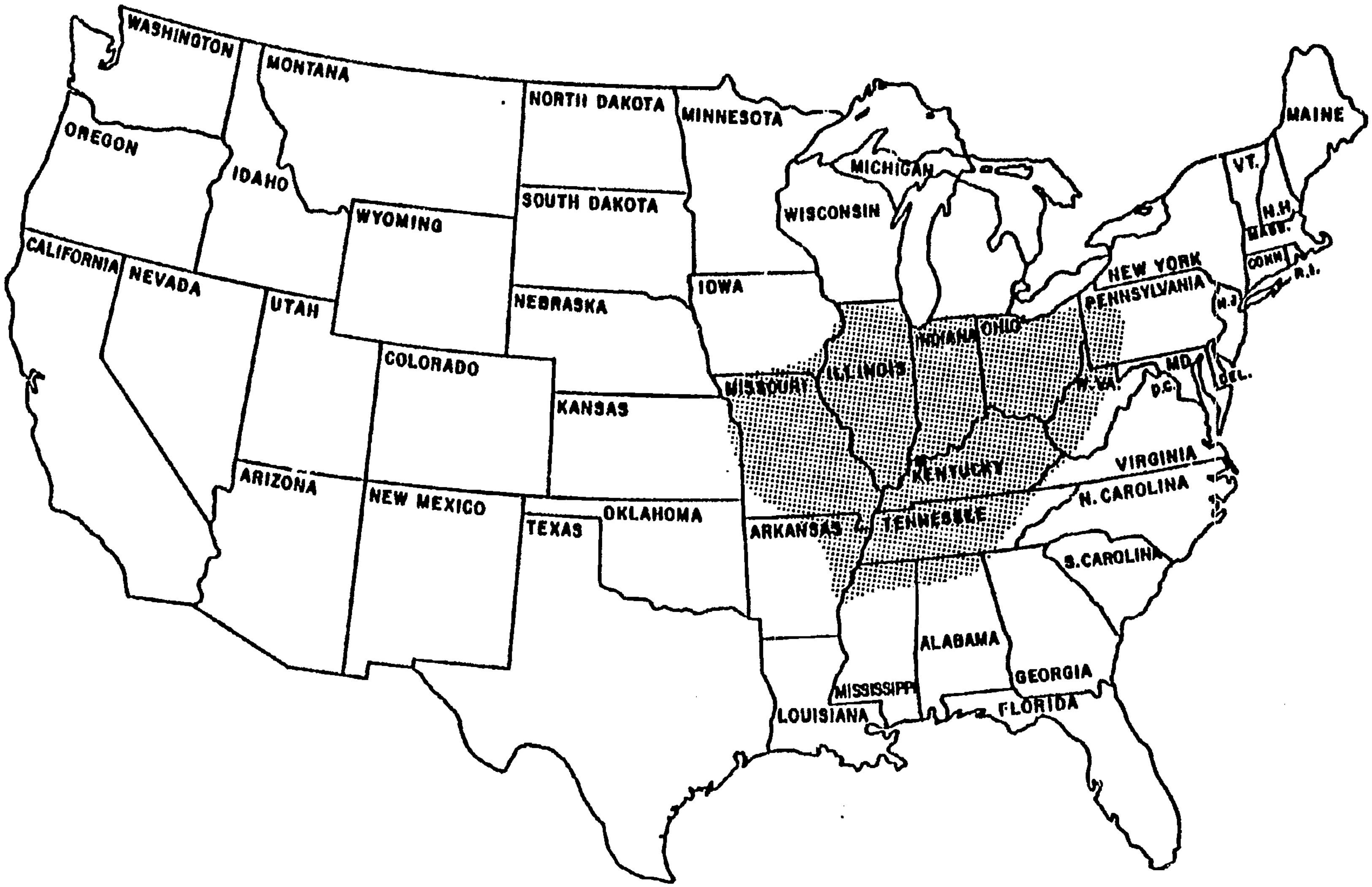
E. Tri-State Product Marketability

1. General

The prospective markets for the principle products and by-products of the Tri-State project were examined on both a national and regional basis. Prospective customers are defined within the marketing region (Figure IV-E-1) and the general requirments for market entry are defined (i.e., quality of material required, transportation and general competitive aspects). Direction is offered as to other avenues of approach to processing and/or marketing which could enhance revenue and/or profitability.

FIGURE IV-E-1

TRI-STATE MARKETING REGION



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No emphasis was placed on defining the specific marketability by potential consumers of SNG or transportation fuels. These products will be absorbed into the existing corporate markets of the Project's partners. However, the general national and regional markets as well as prices for all products are examined.

Although the product recommendations are supported by positive marketability conclusions, they must be considered preliminary until such time that additional information is developed in the area of cost estimating to allow complete economic evaluation of the alternatives.

2. Gasification Products

The Tri-State gasification products initially envisioned as being produced appear in Table IV-E-1.

TABLE IV-E-1

PRODUCTS OF COAL GASIFICATION

Product
SNG
Carbon Dioxide
Gas Naphtha
Phenol
Cresols
Creosotes
Sulfur
Ammonia

The marketability of each is summarized below. Although it is an intermediate stream, gas naphtha has also been examined since it is the source of extracted benzene. Benzene is a product recommended for direct sale.

a. SNG

The facility will produce approximately 145 MMSCFD of high BTU synthetic natural gas (SNG) of a quality indistinguishable from conventional pipeline quality natural gas. No alternative was considered to this component of production due to its high degree of marketability. There appears to be a sufficient market to absorb the plant's output within the region of the Tri-State plant, with existing transportion and distribution infrastructure in close proximity. It has been assumed that SNG pricing will approach parity with low sulfur residual fuel oil by 1990.

b. Carbon Dioxide

It is recommended that the carbon dioxide produced by the facility be sold into enhanced oil recovery and that geological/geophysical studies of crude oil producing areas amenable to miscible flooding by carbon dioxide be conducted. The alternative disposition would be to vent the carbon dioxide to the atmosphere.

The facility will produce approximately 400 MMSCFD of carbon dioxide as a direct result of gasification and as a product of the Synthol unit. The quantity available from the plant represents about twice the current United States production of carbon dioxide for the more conventional industrial and food uses. However, carbon dioxide miscible flooding for enhanced oil recovery offers a much higher volume market. The quality of the CO_2 produced will be acceptable for pipeline transportation and high pressure injection into oil fields. In the Permian Basin of West Texas, alone, it is estimated that approximately 10,000 MMSCFD of carbon dioxide can be used for enhanced oil recovery. This is approximately ten times the quantity available from current and proposed CO_2 projects.