APPENDIX A

APPENDIX A

PLANT CONSTRUCTION COST ANALYSIS

The unit-by-unit cost prepared by MITRE for the BGC/Synthol case presented in Reference 3 has been used, after escalation to 1983 dollars, as the primary basis for estimates of the construction cost of the revised indirect liquefaction plant considered in this study. The methodology used is described below.

1. Establish a flow diagram for the revised plant.

2. Determine the required capacity for each process unit which is common between the revised plant and the BGC/Synthol as a cost estimate base case. For the SFT reactor, however, the capacity and escalated cost for the Koelbel reactor in the BGC/Koelbel case were used as a reference for the estimation of the cost of the Mobil SFT reactor. Further adjustment is necessary to reflect the increased SFT reactor capacity in the all-liquid operating mode. This adjustment is achieved by multiplying the ratio of the mixed-output thermal output ratios of the Mobil and the Koelbel SFT reactors by the all-liquid output enhancement factor derived in Appendix B. These relation- ships, together with the exponential scaling factor equation in Step 3, were built into a Lotus 1-2-3 spread sheet to produce plant construction cost sheets for the various cases considered, as shown in Tables A-1 to A-5. The construction costs for the SASOL(U.S.) were calculated manually, as shown in Table A-1. In these tables, the sources for the basis of unit cost data and other pertinent details are provided in the descriptive notes to the tables, listed in Appendix C.

3. Adjust the construction cost of each unit based on unit capacity using a .7 exponential scaling factor. For example:

$$\text{Revised Cost} = \text{Base Case Cost} \quad \frac{\text{Revised Capacity}}{\text{Base Case Capacity}} \quad 0.7$$

4. Obtain best available data from the literature and/or vendor sources for units in the revised plant which are not common to the BGC/Synthol case. For example, the cost of the wax hydrotreating unit required in the Mobil high-wax case is based on the cost quoted for a hydrotreating unit in Reference 1 after adjustment to a 1983$ value. Total

construction cost for all cases considered is computed as the sum of unit costs plus certain miscellaneous items common to all cases. Capital cost is assumed to exceed construction cost by a factor of 1.59, as suggested in Reference 3.

Tables A-1 through A-6 show the detailed computation for each revised plant considered in this study. The basis of unit cost data from sources other than Reference 1, and other pert inent details are provided in descriptive notes to the tables.

TABLE A-1

SASOL (U.S.) CONSTRUCTION COST SHEET

UNIT	DESCRIPTION	CAPACITY	COST $ MM	CAPACITY	NOTE	COST $ MM
COAL AND ASH HANDLING			115.0		1	115.0
228	Coal Handling	27.8 M T/D				
229	Ash Handling	1.4 M T/D				
	Coal Dryer	N.A.				
	Slurry Preparation	N.A.				
SYNTHESIS GAS PREPARATION			533.7		1	533.7
201	Gasifiers	1,901 M lb/hr	323.0			
202	Raw Gas Shift	36 M lb moles	20.6			
203	Raw Gas Cooling	156 M lb moles	21.4			
204	Shifted Gas Cooling	36 M lb moles	9.7			
205	Gas Purification	116 M lb moles	115.4			
241	Refrigeration	(For Unit 205)	43.5			
BY-PRODUCT RECOVERY			178.0		1	178.0
206	Sulfur Recovery	35 M lb moles CO_2	95.0			
207	Gas/Liquor Separation	55 M lb moles H_2O	30.0			
208	Phenol Recovery	85 M lb moles H_2O	22.5			
209	Ammonia Recovery	85 M lb moles H_2O	30.5			
GASIFIER NAPHTHA TREATMENT			20.1		1	20.1
211	Hydrogen Recovery	1.1 M lb moles	14.0			
251	Naphtha Hydrotreating	15,922 lb/hr	6.1			
SYNTHESIS			167.6		2	252.9
250	Synthol Reactors	4,896 MMBtu/hr	123.0	10,752 MMBtu/hr	2	175.6
271	Catalyst Preparation	30 T/D	44.6	65.7 T/D	2	77.3
SNG PREPARATION OR REFORMING			39.1			65.5
212	Methanation	172.2 MM SCF/D	19.3			
213	CO_2 Removal	Total SNG	14.8			
214	Drying and Compression	Output	5.0			
116	Autothermal Reformer	N.A.			3	65.5

TABLE A-1
(Concluded)

UNIT	DESCRIPTION	Mixed Output: CAPACITY	Mixed Output: COST \$ MM	All-Liquid Output: CAPACITY	All-Liquid Output: NOTE	All-Liquid Output: COST \$ MM
F-T LIQUID PRODUCT RECOVERY AND UPGRADE		(18,093 B/D Liquid Fuels)	148.3	39,695 B/D Liquids	2	257.0
210	Hydrocarbon Recovery	534 M lb/hr Flow	31.2			
252	F-T Product Fract.	275 M lb/hr	23.3			
253	Product Hydrotreating	124 M lb/hr	10.6			
254	Hyd. Product Fract.	123 M lb/hr	6.4			
255	Catalytic Reforming	47 M lb/hr	11.8			
256	C_5/C_6 Isomerization	37 M lb/hr	8.5			
257	Cat. Polymerization	53 M lb/hr	6.6			
258	HF Alkylation	10 M lb/hr	3.5			
259	Poly Gasoline Hydro.	20 M lb/hr	3.9			
260	Light Ends Recovery	8 M lb/hr	3.5			
261	H_2 Purification	2.2 M lb/hr	4.3			
262	Alcohol Recovery	1,829 B/D	17.7			
270	Gasoline Blending	13,580 B/D	3.2			
237	Storage	to Total Liquids	13.8			
x205	Rectisol		439.7			
OFFSITES AND MISCELLANEOUS			708.0			
221	Oxygen Plant	458 M lb/hr	177.1	702 M lb/hr	2	238.3
222-223	Boiler, Main Superheater	3,111 M lb/hr steam	236.0			
225-226	Stack Precip. Cleanup		2.6			
224	LP and MP Superheater		33.2			
231	BFW Preparation		0.8			
232	CW Make-up		37.5			
233	CW Towers		4.3			
236	Blow-down Facilities					
	(Subtotal for Steam Plant)		314.4		2,4	342.8
235	Waste Water Treatment	2.1 MM lb/hr	42.3	2.53 MM lb/hr	2	248.0
234	Power Generation		17.0		1	17.0
238	Interconnecting Piping		32.8		1	32.8
	Infrastructure		74.7		1	74.7
	Other Miscellaneous		49.3		1	49.3
	TOTAL		1,909.8			

TABLE A-2

BGC/SYNTHOL CONSTRUCTION COST SHEET FOR MIXED AND ALL-LIQUID OUTPUTS

DESCRIPTION	BASE CASE: MIXED OUTPUT		CASE: BGC/SYNTHOL LIQUID	
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$415.90
GASIFIERS (MPPH)	2070.00	$161.60	2070.00	$161.60
RAW GAS SHIFT (MPPH)	159.00	$48.30	159.00	$48.30
RAW GAS COOLING (MPMPH)-estimated				
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	159.00	$21.70
GAS PURIFICATION (MPMPH)	143.50	$133.60	143.20	$133.60
REFRIGERATION	143.20	$50.60	143.20	$50.60
BY-PRODUCT RECOVERY		$150.60		$150.70
SULPHUR RECOVERY (MPMPH)	40.00	$104.30	40.00	$104.30
GAS/LIQUOR SEPERATION (MPMPH)	15.50	$9.00	15.50	$9.00
PHENOL RECOVERY (MPMPH)	15.50	$6.70	15.50	$6.80
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	15.50	$9.20
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$324.13
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	13653.00	$237.84
F-T CATALYST PREPARATION (TPD)	43.50	$57.80	77.00	$86.29
SNG PREPARATION OR REFORMING		$34.90		$58.70
METHANATION (MMSCFPD)	147.90	$17.20		
CO2 REMOVAL (MMSCFPD)	147.90	$13.20		
COAL DRYING AND COMPRESSION (MMSCFPD)	147.90	$4.50		
AUTOTHERMAL REFORMAER			48.50	$58.70
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$279.50
HYDROCARBON RECOVERY (MPPH)	737.00	$37.50		
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70		
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30		
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.70		
CATALYTIC REFORMING (MPPH)	68.00	$16.50		
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70		
CATALYTIC POLIMERIZATION (MPPH)	77.00	$8.20		
H-F ALKYLATION (MPPH)	14.00	$4.30		
POLY GASOLINE HYDROGENATION (MPPH)	29.00	$4.80		
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30		
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40		

TABLE A-2
(Continued)

DESCRIPTION	BASE CASE: MIXED OUTPUT		CASE: BGC/SYNTHOL LIQUID	
ALCOHOL AND WAX RECOVERY (BPD)	2650.00	$22.00		
GASOLINE BLENDING (BPD)	15137.00	$3.80		
STORAGE (BPD)	27847.00	$17.00		
RECTISOL (MPH)				
OFF-SITES		$652.40		$732.30
OXYGEN PLANT (MPPH)	545.00	$200.10	750.00	$250.40
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$189.00	2612.00	$209.23
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2612.00	$2.31
BFW PREPARATION (MPPH)	2264.00	$26.40	2612.00	$29.04
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2612.00	$0.66
COOLING TOWERS (MPPH)	2264.00	$30.20	2612.00	$23.11
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.50	2612.00	$3.85
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	1.26	$29.60
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.20
TOTAL PLANT COST		$1,779.10		$2,076.13

TABLE A-3

BGC/KOELBEL CONSTRUCTION COST SHEET
MIXED OUTPUT CASE

DESCRIPTION	BASE CASE: MIXED OUTPUT CAPACITY	BASE CASE: MIXED OUTPUT COST ($ MM)	CASE: BGC/KOLBEL MIXED CAPACITY	CASE: BGC/KOLBEL MIXED COST ($ MM)
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$359.93
GASIFIERS (MPPH)	2070.00	$161.60	2070.00	$161.60
RAW GAS SHIFT (MPPH)	159.00	$48.30	30.60	$15.24
RAW GAS COOLING (MPMPH)-estimated			107.00	$16.37
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	30.60	$6.85
GAS PURIFICATION (MPMPH)	143.50	$133.60	106.00	$108.07
REFRIGERATION	143.20	$50.60	147.70	$51.71
BY-PRODUCT RECOVERY		$150.70		$99.32
SULPHUR RECOVERY (MPMPH)	40.00	$104.30	10.00	$39.52
GAS/LIQUOR SEPERATION (MPMPH)	15.50	$9.00	32.00	$13.39
PHENOL RECOVERY (MPMPH)	15.50	$6.80	32.00	$10.70
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	32.00	$14.30
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$250.70
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	8315.00	$213.80
F-T CATALYST PREPARATION (TPD)	43.50	$57.80	23.40	$36.90
SNG PREPARATION OR REFORMING		$34.90		$25.45
METHANATION (MMSCFPD)	147.90	$17.20	94.20	$12.54
CO2 REMOVAL (MMSCFPD)	147.90	$13.20	94.20	$9.63
COAL DRYING AND COMPRESSION (MMSCFPD)	147.90	$4.50	94.20	$3.28
AUTOTHERMAL REFORMAER				
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$240.12
HYDROCARBON RECOVERY (MPPH)	737.00	$37.50		
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70	397.00	$30.19
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30	378.00	$20.00
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.70	277.00	$10.70
CATALYTIC REFORMING (MPPH)	68.00	$16.50	129.00	$26.77
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70	102.00	$17.32
CATALYTIC POLIMERIZATION (MPPH)	77.00	$8.20	115.00	$11.26
H-F ALKYLATION (MPPH)	14.00	$4.30	26.00	$6.94

TABLE A-3
(Continued)

DESCRIPTION	BASE CASE: MIXED OUTPUT CAPACITY	BASE CASE: MIXED OUTPUT COST ($ MM)	CASE: BGC/KOLBEL MIXED CAPACITY	CASE: BGC/KOLBEL MIXED COST ($ MM)
POLY GASOLINE HYDROGENATION (MPPH)	29.00	$4.80	32.00	$9.36
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30	38.00	$10.72
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40	5.63	$8.70
ALCOHOL AND MAI RECOVERY (BPD)	2650.00	$22.00	618.00	$8.30
GASOLINE BLENDING (BPD)	19137.00	$3.80	30766.00	$5.58
STORAGE (BPD)	27847.00	$17.00	38687.00	$22.28
RECTISOL (MPH)			41755.00	$56.00
OFF-SITES		$652.40		$628.76
OXYGEN PLANT (MPPH)	545.00	$200.10	555.00	$202.66
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$189.00	2033.00	$175.28
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2033.00	$1.95
BFW PREPARATION (MPPH)	2264.00	$26.40	2033.00	$24.48
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2033.00	$0.56
COOLING TOWERS (MPPH)	2264.00	$30.20	2033.00	$28.01
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.50	2033.00	$3.25
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	0.65	$18.67
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.00
TOTAL PLANT COST		$1,778.20		$1,719.18

TABLE A-4

BGC/KOELBEL CONSTRUCTION COST SHEET

ALL-LIQUID OUTPUT CASE

DESCRIPTION	BASE CASE: MIXED OUTPUT CAPACITY	BASE CASE: MIXED OUTPUT COST ($ MM)	CASE: BGC/KOLBEL LIQUID CAPACITY	CASE: BGC/KOLBEL LIQUID COST ($ MM)
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$364.58
GASIFIERS (MPPH)	2070.00	$161.60	2070.00	$161.60
RAW GAS SHIFT (MPPH)	159.00	$48.30	30.60	$18.29
RAW GAS COOLING (MPMPH)-estimated			107.00	$16.37
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	30.60	$6.85
GAS PURIFICATION (MPMPH)	143.50	$133.60	106.00	$109.77
REFRIGERATION	143.20	$50.60	147.70	$51.71
BY-PRODUCT RECOVERY		$150.70		$99.32
SULPHUR RECOVERY (MPMPH)	40.00	$104.30	10.00	$39.52
GAS/LIQUOR SEPERATION (MPMPH)	15.50	$9.00	32.00	$13.39
PHENOL RECOVERY (MPMPH)	15.50	$6.80	32.00	$10.70
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	32.00	$14.30
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$301.88
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	6695.00	$256.94
F-T CATALYST PREPARATION (TPD)	43.50	$57.80	23.40	$44.94
SNG PREPARATION OR REFORMING		$34.90		$42.60
METHANATION (MMSCFPD)	147.90	$17.20		
CO2 REMOVAL (MMSCFPD)	147.90	$13.20		
COAL DRYING AND COMPRESSION (MMSCFPD)	147.90	$4.50		
AUTOTHERMAL REFORMAER				$42.68
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$285.90
HYDROCARBON RECOVERY (MPPH)	737.00	$37.50		
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70	397.00	
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30	378.00	
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.79	277.00	
CATALYTIC REFORMING (MPPH)	68.00	$16.50	129.00	
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70	102.00	
CATALYTIC POLIMERIZATION (MPPH)	77.00	$8.20	115.00	
H-F ALKYLATION (MPPH)	14.00	$4.30	26.00	

TABLE A-4
(Continued)

DESCRIPTION	BASE CASE: MIXED OUTPUT CAPACITY	BASE CASE: MIXED OUTPUT COST ($ MM)	CASE: BSC/KOLBEL LIQUID CAPACITY	CASE: BSC/KOLBEL LIQUID COST ($ MM)
PDU GASOLINE HYDROGENATION (MPPH)	29.00	$4.80	32.00	
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30	38.00	
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40	5.63	
ALCOHOL AND WAX RECOVERY (BPD)	2650.00	$22.00	618.00	
GASOLINE BLENDING (BPD)	19137.00	$3.80	30766.00	
STORAGE (BPD)	27847.00	$17.00	38687.00	
RECTISOL (MPH)			41795.00	
OFF-SITES		$652.40		$691.13
OXYGEN PLANT (MPPH)	545.00	$200.10	717.00	$242.46
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$189.00	2317.00	$192.09
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2317.00	$2.13
BFW PREPARATION (MPPH)	2264.00	$26.40	2317.00	$26.83
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2317.00	$0.61
COOLING TOWERS (MPPH)	2264.00	$30.20	2317.00	$30.69
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.50	2317.00	$3.56
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	0.65	$18.67
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.20
TOTAL PLANT COST		$1,778.20		$1,900.42

TABLE A-5

BGC/MOBIL CONSTRUCTION COST SHEET
MIXED OUTPUT CASE

DESCRIPTION	BASE CASE: MIXED OUTPUT CAPACITY	BASE CASE: MIXED OUTPUT COST ($ MM)	CASE: BGC/ MOBIL MIXED CAPACITY	CASE: BGC/ MOBIL MIXED COST ($ MM)
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$364.67
GASIFIERS (MPPH)	2070.00	$161.60	2100.00	$163.24
RAW GAS SHIFT (MPPH)	159.00	$148.30	38.63	$18.00
RAW GAS COOLING (MPMPH)-estimated	159.00			
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	30.60	$6.85
GAS PURIFICATION (MPMPH)	143.50	$133.60	106.00	$124.87
REFRIGERATION	143.20	$50.60	147.70	$51.71
BY-PRODUCT RECOVERY		$150.70		$102.45
SULPHUR RECOVERY (MPMPH)	40.00	$104.30	10.00	$39.52
GAS LIQUOR SEPERATION (MPMPH)	15.50	$9.00	32.00	$14.95
PHENOL RECOVERY (MPMPH)	15.50	$6.80	32.00	$11.29
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	32.00	$15.28
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$311.55
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	7985.00	$276.05
F-T CATALYST PREPARATION (TPD)	43.50	$57.80		$35.50
SNG PREPARATION OR REFORMING		$34.90		$30.03
METHANATION (MMSCFPD)	147.90	$17.20	119.30	$14.80
CO2 REMOVAL (MMSCFPD)	147.90	$13.20	119.30	$11.36
COAL DRYING AND COMPRESSION (MMSCFPD)	147.90	$4.50	119.30	$3.87
AUTOTHERMAL REFORMAER				
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$148.70
HYDROCARBON RECOVERY (MPPH)	737.00	$37.50		
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70	318.70	$31.36
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30		
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.70		
CATALYTIC REFORMING (MPPH)	68.00	$16.50		
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70		
CATALYTIC POLIMERIZATION (MPPH)	77.00	$8.20		
H-F ALKYLATION (MPPH)	14.00	$4.30	237.50	$31.20

TABLE A-5
(Continued)

DESCRIPTION	BASE CASE: MIXED OUTPUT CAPACITY	COST ($ MM)	CASE: BSC MOBIL MIXED CAPACITY	COST ($ MM)
POLY GASOLINE HYDROGENATION (MPPH)	29.00	$4.80		
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30		
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40		
ALCOHOL AND MAI RECOVERY (BPD)	2650.00	$22.00	2421.00	$5.16
GASOLINE BLENDING (BPD)	19137.00	$3.80	28600.00	$5.03
STORAGE (BPD)	27847.00	$17.00	35000.00	$19.95
RECTISOL (MPH)			41795.00	$56.00
OFF-SITES		$652.40		$628.76
OXYGEN PLANT (MPPH)	545.00	$200.10	555.00	$202.66
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$189.00	2033.00	$175.28
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2033.00	$1.95
BFW PREPARATION (MPPH)	2264.00	$26.40	2033.00	$24.43
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2033.00	$0.56
COOLING TOWERS (MPPH)	2264.00	$30.20	2033.00	$28.01
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.50	2033.00	$3.25
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	0.65	$18.67
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.00
TOTAL PLANT COST		$1,778.20		$1,701.15

TABLE A-6

BGC/MOBIL CONSTRUCTION COST SHEET
ALL-LIQUID OUTPUT CASE

DESCRIPTION	BASE CASE MII MIXED OUTPUT CAPACITY	BASE CASE MII MIXED OUTPUT COST ($ MM)	CASE: BGC/ MOBIL LIQUID CAPACITY	CASE: BGC/ MOBIL LIQUID COST ($ MM)
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$364.59
GASIFIERS (MPPH)	2070.00	$161.60	2100.00	$161.60
RAW GAS SHIFT (MPPH)	159.00	$48.30	30.60	$18.30
RAW GAS COOLING (MPMPH)-estimated	159.00		107.00	$16.37
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	30.60	$6.85
GAS PURIFICATION (MPMPH)	143.50	$133.60	106.00	$109.77
REFRIGERATION	143.20	$50.60	147.70	$51.71
BY-PRODUCT RECOVERY		$150.70		$102.45
SULPHUR RECOVERY (MPMPH)	40.00	$104.30	10.00	$39.52
GAS/LIQUOR SEPERATION (MPMPH)	15.50	$9.00	32.00	$14.95
PHENOL RECOVERY (MPMPH)	15.50	$6.80	32.00	$11.29
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	32.00	$15.28
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$402.00
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	11347.00	$356.00
F-T CATALYST PREPARATION (TPD)	43.50	$57.80	78.00	$46.00
SNG PREPARATION OR REFORMING		$34.90		$50.88
METHANATION (MMSCFPD)	147.90	$17.20		
CO2 REMOVAL (MMSCFPD)	147.90	$13.20		
COAL DRYING AND COMPRESSION (MMSCFPD)	147.90	$4.50		
AUTOTHERMAL REFORMAER	0.00		118.70	$50.88
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$176.03
HYDROCARBON RECOVERY (MPPH)	737.00	$37.50		
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70	434.00	$40.64
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30		
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.70		
CATALYTIC REFORMING (MPPH)	68.00	$16.50		
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70		
CATALYTIC POLIMERIZATION (MPPH)	77.00	$8.20		
H-F ALKYLATION (MPPH)	14.00	$4.30	154.00	$24.15

TABLE A-6
(Continued)

DESCRIPTION	BASE CASE MIX CAPACITY	MIXED OUTPUT COST ($ MM)	CASE: BGC/ MOBIL LIQUID CAPACITY	CASE: BGC/ MOBIL LIQUID COST ($ MM)
POLY GASOLINE HYDROGENATION (MPPH)	29.00	$4.80		
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30		
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40		
ALCOHOL AND WAX RECOVERY (BPD)	2650.00	$22.00	3419.00	$6.84
GASOLINE BLENDING (BPD)	19137.00	$3.80	40000.00	$6.69
STORAGE (BPD)	27847.00	$17.00	49050.00	$26.20
RECTISOL (MPH)			48118.00	$71.40
OFF-SITES		$652.40		$691.26
OXYGEN PLANT (MPPH)	545.00	$200.10	720.00	$243.17
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$189.00	2312.00	$191.80
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2312.00	$2.13
BFW PREPARATION (MPPH)	2264.00	$26.40	2312.00	$26.79
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2312.00	$0.61
COOLING TOWERS (MPPH)	2264.00	$30.20	2312.00	$30.65
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.50	2312.00	$3.55
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	0.65	$18.67
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.00
TOTAL PLANT COST		$1,778.20		$1,902.21

TABLE A-7

BGC/MITRE-MOBIL CONSTRUCTION COST SHEET
MIXED OUTPUT CASE

DESCRIPTION	BASE CASE: MIXED OUTPUT CAPACITY	BASE CASE: MIXED OUTPUT COST ($ MM)	CASE: BGC/ MITRE-MOBIL MIXED CAPACITY	CASE: BGC/ MITRE-MOBIL MIXED COST ($ MM)
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$361.90
GASIFIERS (MPPH)	2070.00	$161.60	2100.00	$163.24
RAW GAS SHIFT (MPPH)	159.00	$48.30	30.60	$15.24
RAW GAS COOLING (MPMPH)-estimated	159.00			
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	30.60	$6.85
GAS PURIFICATION (MPMPH)	143.50	$133.60	106.00	$124.87
REFRIGERATION	143.20	$50.60	147.70	$51.71
BY-PRODUCT RECOVERY		$150.70		$102.45
SULPHUR RECOVERY (MPMPH)	40.00	$104.30	10.00	$39.52
GAS/LIQUOR SEPERATION (MPMPH)	15.50	$9.00	32.00	$14.95
PHENOL RECOVERY (MPMPH)	15.50	$6.80	32.00	$11.29
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	32.00	$15.28
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$301.07
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	7516.00	$267.07
F-T CATALYST PREPARATION (TPD)	43.50	$57.80		$34.00
SNG PREPARATION OR REFORMING		$34.90		$29.25
METHANATION (MMSCFPD)	147.90	$17.20	114.90	$14.41
CO2 REMOVAL (MMSCFPD)	147.90	$13.20	114.90	$11.06
COAL DRYING AND COMPRESSION (MMSCFPD)	147.90	$4.50	114.90	$3.77
AUTOTHERMAL REFORMAER				
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$139.37
HYDROCARBON RECOVERY (MPPH)	737.00	$37..1		
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70	289.00	$30.56
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30		
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.70		
CATALYTIC REFORMING (MPPH)	68.00	$16.50		
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70		
CATALYTIC POLIMERIZATION (MPPH)	77.00	$8.20		
H-F ALKYLATION (MPPH)	14.00	$4.30	118.00	$24.00

TABLE A-7
(Continued)

DESCRIPTION	BASE CASE: MIXED OUTPUT CAPACITY	BASE CASE: MIXED OUTPUT COST ($ MM)	CASE: 86C/ MITRE-MOBIL MIXED CAPACITY	CASE: 86C/ MITRE-MOBIL MIXED COST ($ MF)
POLY GASOLINE HYDROGENATION (MPPH)	29.00	$4.80		
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30		
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40		
ALCOHOL AND WAI RECOVERY (BPD)	2650.00	$22.00	2260.00	$4.92
GASOLINE BLENDING (BPD)	19137.00	$3.80	25283.00	$4.62
STORAGE (BPD)	27847.00	$17.00	33324.00	$19.28
RECTISOL (MPH)			41795.00	$56.00
OFF-SITES		$652.40		$628.96
OXYGEN PLANT (MPPH)	545 00	$200.10	555.00	$202.66
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$189.00	2033.00	$175.28
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2033.00	$1.95
BFW PREPARATION (MPPH)	2264.00	$26.40	2033.00	$24.48
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2033.00	$0.56
COOLING TOWERS (MPPH)	2264.00	$30.20	2033.00	$28.01
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.50	2033.00	$3.25
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	0.65	$18.67
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.20
TOTAL PLANT COST		$1,778.20		$1,678.00

TABLE A-8

BGC/MITRE-MOBIL CONSTRUCTION COST SHEET
ALL-LIQUID OUTPUT CASE

DESCRIPTION	BASE CASE MIX MIXED OUTPUT CAPACITY	BASE CASE MIX MIXED OUTPUT COST ($ MM)	CASE: BGC/ MITRE-MOBIL LIQUID CAPACITY	CASE: BGC/ MITRE-MOBIL LIQUID COST ($ MM)
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$361.63
GASIFIERS (MPPH)	2070.00	$161.60	2100.00	$163.24
RAW GAS SHIFT (MPPH)	159.00	$48.30	30.60	$15.24
RAW GAS COOLING (MPMPH)-estimated			107.00	$16.37
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	30.60	$6.85
GAS PURIFICATION (MPMPH)	143.20	$133.60	106.00	$108.23
REFRIGERATION	143.20	$50.60	147.70	$51.71
BY-PRODUCT RECOVERY		$150.70		$102.44
SULPHUR RECOVERY (MPMPH)	40.00	$104.30	10.00	$39.52
GAS/LIQUOR SEPERATION (MPMPH)	15.50	$9.00	32.00	$14.95
PHENOL RECOVERY (MPMPH)	15.50	$6.80	32.00	$11.29
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	32.00	$15.28
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$388.00
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	10785.00	$344.00
F-T CATALYST PREPARATION (TPD)	43.50	$57.80		$44.00
SNG PREPARATION OR REFORMING		$34.90		$49.46
METHANATION (MMSCFPD)	147.90	$17.20		
CO2 REMOVAL (MMSCFPD)	147.90	$13.20		
COAL DRYING AND COMPRESSION (MMSCFPD)	147.90	$4.50		
AUTOTHERMAL REFORMAER			114.00	$49.46
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$167.74
HYDROCARBON RECOVERY (MPPH)	737.00	$37.50		
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70	415.00	$39.37
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30		
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.70		
CATALYTIC REFORMING (MPPH)	68.00	$16.50		
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70		
CATALYTIC POLIMERIZATION (MPPH)	77.00	$8.20		
H-F ALKYLATION (MPPH)	14.00	$4.30	169.00	$25.73

TABLE A-8
(Continued)

DESCRIPTION	BASE CASE MIX MIXED OUTPUT CAPACITY	BASE CASE MIX MIXED OUTPUT COST ($ MM)	CASE: BSC MITRE-MOBIL LIQUID CAPACITY	CASE: BSC MITRE-MOBIL LIQUID COST ($ MM)
POLY GASOLINE HYDROGENATION (MPPH)	29.00	$4.80		
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30		
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40		
ALCOHOL AND WAX RECOVERY (BPD)	2650.00	$22.00	3223.00	$6.59
GASOLINE BLENDING (BPD)	19137.00	$3.80	35567.00	$5.17
STORAGE (BPD)	27847.00	$17.00	47112.00	$25.58
RECTISOL (MPH)			41362.00	$64.30
OFF-SITES		$652.40		$688.50
OXYGEN PLANT (MPPH)	545.00	$200.10	713.00	$241.51
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$167.00	2301.00	$191.16
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2301.00	$2.12
BFW PREPARATION (MPPH)	2264.00	$26.40	2301.00	$26.70
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2301.00	$0.61
COOLING TOWERS (MPPH)	2264.00	$30.20	2301.00	$30.44
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.30	2301.00	$3.54
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	0.65	$18.52
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.00
TOTAL PLANT COST		$1,778.20		$1,872.77

TABLE A-9

BGC/MOBIL HIGH-WAX CONSTRUCTION COST SHEET
MIXED OUTPUT CASE

DESCRIPTION	BASE CASE MIXED OUTPUT CAPACITY	BASE CASE MIXED OUTPUT COST ($ MM)	CASE: BGC/ MOBIL HIGH WAX MIXED CAPACITY	CASE: BGC/ MOBIL HIGH WAX MIXED COST ($ MM)
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$364.60
GASIFIERS (MPPH)	2070.00	$161.60	2100.00	$163.24
RAW GAS SHIFT (MPPH)	159.00	$48.30	40.00	$18.38
RAW GAS COOLING (MPMPH)-estimated	159.00			
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	30.60	$6.85
GAS PURIFICATION (MPMPH)	143.50	$133.60	106.00	$124.43
REFRIGERATION	143.20	$50.60	147.70	$51.71
BY-PRODUCT RECOVERY		$150.70		$102.45
SULFHUR RECOVERY (MPMPH)	40.00	$104.30	10.00	$39.52
GAS/LIQUOR SEPERATION (MPMPH)	15.50	$9.00	32.00	$14.95
PHENOL RECOVERY (MPMPH)	15.50	$6.80	32.00	$11.29
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	32.00	$15.28
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$315.00
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	8023.00	$279.00
F-T CATALYST PREPARATION (TPD)	43.50	$57.80		$36.00
SNG PREPARATION OR REFORMING		$34.90		$29.00
METHANATION (MMSCFPD)		$17.20		
CO2 REMOVAL (MMSCFPD)		$13.20		
COAL DRYING AND COMPRESSION (MMSCFPD)		$4.50		
AUTOTHERMAL REFORMER(MMSCFD)				
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$163.36
HYDROCARBON RECOVERY (MPPH)	737.00	$37.50	183.21	$19.00
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70		
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30		
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.70		
CATALYTIC REFORMING (MPPH)	68.00	$16.50		
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70		
CATALYTIC POLIMERIZATION (MPPH)	77.00	$8.20		
H-F ALKYLATION (MPPH)	14.00	$4.30		
POLY GASOLINE HYDROGENATION (MPPH)	29.00	$4.80	36.30	$8.38
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30		

TABLE A-9
(Continued)

DESCRIPTION	BASE CASE MIXED OUTPUT CAPACITY	BASE CASE MIXED OUTPUT COST ($ MM)	CASE: BGC/ MOBIL HIGH WAX MIXED CAPACITY	CASE: BGC/ MOBIL HIGH WAX MIXED COST ($ MM)
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40		$30.00
ALCOHOL AND WAX RECOVERY (BPD)	2650.00	$22.00	20940.00	$4.05
GASOLINE BLENDING (BPD)	19137.00	$3.80	34965.00	$19.94
STORAGE (BPD)	27847.00	$17.00	38000.00	$51.00
RECTISOL (MPH)				$31.00
WAX HYDROTREATER				
		$652.40		$628.96
OFF-SITES				
OXYGEN PLANT (MPPH)	545.00	$200.10	555.00	$202.66
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$189.90	2033.00	$175.28
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2033.00	$1.95
BFW PREPARATION (MPPH)	2264.00	$26.40	2033.00	$24.48
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2033.00	$0.56
COOLING TOWERS (MPPH)	2264.00	$30.20	2033.00	$28.01
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.50	2033.00	$3.25
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	0.65	$18.67
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.20
TOTAL COST		$1,779.20		$1,718.36

TABLE A-10

BGC/MOBIL HIGH-WAX CONSTRUCTION COST SHEET
ALL-LIQUID OUTPUT CASE

DESCRIPTION	BASE CASE: MIXED OUTPUT		CASE: BGC/MOBIL HIGH WAX LIQUID	
	CAPACITY	COST ($ MM)	CAPACITY	COST ($ MM)
COAL AND ASH HANDLING		$115.00		$115.00
COAL HANDLING (MTPD)	27.80		27.80	
ASH HANDLING (MTPD)	1.40		1.40	
SYNTHESIS GAS PREPARATION		$415.80		$364.60
GASIFIERS (MPPH)	2070.00	$161.60	2100.00	$163.24
RAW GAS SHIFT (MPPH)	159.00	$48.30	40.00	$18.38
RAW GAS COOLING (MPMPH)-estimated				
SHIFTED GAS COOLING (MPMPH)	159.00	$21.70	30.60	$6.85
GAS PURIFICATION (MPMPH)	143.50	$133.60	108.00	$124.43
REFRIGERATION	143.20	$50.60	147.70	$51.71
BY-PRODUCT RECOVERY		$150.70		$102.45
SULPHUR RECOVERY (MPMPH)	40.00	$104.30	10.00	$39.52
GAS/LIQUOR SEPERATION (MPMPH)	15.50	$9.00	32.00	$14.95
PHENOL RECOVERY (MPMPH)	15.50	$6.80	32.00	$11.29
AMMONIA RECOVERY (MPMPH)	15.50	$9.20	32.00	$15.28
GASIFIER NAPHTHA TREATMENT (BPD)	1630.00	$21.40	1630.00	$21.40
SYNTHESIS		$217.20		$397.00
SYNTHESIS REACTORS AND ZSM-5 (MMBTU PH)	7708.00	$159.40	11152.00	$352.00
F-T CATALYST PREPARATION (TPD)	43.50	$57.80		$45.00
SNG PREPARATION OR REFORMING		$34.90		$49.50
METHANATION (MMSCFPD)	147.90	$17.20		
CO2 REMOVAL (MMSCFPD)	147.90	$13.20		
COAL DRYING AND COMPRESSION (MMSCFPD)	147.90	$4.50		
AUTOTHERMAL REFORMER(MMSCFD)				$49.50
F-T LIQUID RECOVERY AND UPGRADING		$192.20		$216.30
HYDROCARBON RECOVERY (MPPH)	737.00	$37.50		
F-T PRODUCT FRACTIONATION (MPPH)	399.00	$36.70	255.40	$26.70
PRODUCT HYDROTREATING (MPPH)	180.00	$13.30		
HYD. PRODUCT FRACTIONATION (MPPH)	178.00	$7.70		
CATALYTIC REFORMING (MPPH)	68.00	$16.50		
C5-C6 ISOMERIZATION (MPPH)	54.00	$10.70		
CATALYTIC POLINEFIZATION (MPPH)	77.00	$8.20		
H-F ALKYLATION (MPPH)	14.00	$4.30	50.60	$10.60
POLY GASOLINE HYDROGENATION (MPPH)	29.00	$4.80		
LIGHT ENDS RECOVERY (MPPH)	11.00	$4.30		

TABLE A-10
(Continued)

DESCRIPTION	BASE CASE: MIXED OUTPUT		CASE: BGC/MOBIL HIGH WAX LIQUID	
	CAPACITY	COST ($ MM)	CAPACITY	COST ($ MM)
HYDROGEN PURIFICATION (MPPH)	3.00	$5.40	9431.00	$53.50
ALCOHOL AND WAX RECOVERY (BPD)	2650.00	$22.00	28525.00	$5.00
GASOLINE BLENDING (BPD)	19137.00	$3.80	48048.00	$25.00
STORAGE (BPD)	27847.00	$17.00	41795.00	$56.00
RECTISOL (MPH)				$29.50
WAX HYDROTREATER				
OFF-SITES		$652.40		$691.46
OXYGEN PLANT (MPPH)	545.00	$200.10	720.00	$243.17
BOILER & MAIN SUPERHEATER & ESP/FGD (MPPH)	2264.00	$189.00	2312.00	$191.80
LP AND MP SUPERHEATER (MPPH)	2264.00	$2.10	2312.00	$2.13
BFW PREPARATION (MPPH)	2264.00	$26.40	2312.00	$26.79
C W MAKUP PREPARATION (MPPH)	2264.00	$0.60	2312.00	$0.61
COOLING TOWERS (MPPH)	2264.00	$30.20	2312.00	$30.65
FLARE AND BLOWDOWN (MPPH)	2264.00	$3.50	2312.00	$3.55
WASTE WATER TREATMENT (MMPPH)	1.06	$26.40	0.65	$18.67
POWER GENERATION UNIT		$17.10		$17.10
INTERCONNECTING PIPEWAY		$32.80		$32.80
INFRASTRUCTURE AND MISC.		$124.20		$124.20
TOTAL COST		$1,778.20		$1,936.30

APPENDIX B

APPENDIX B

COMPUTATION OF ALL-LIQUID PRODUCT OUTPUTS

All-liquid output modes are calculated from the mixed-output product distribution as shown in the following example:

			MMBTU/HR
SNG	118.7	MMSCFD	4,474
Gasoline	28,607	BPD	5,053 (net of 318 + 210)
C_3	3,026	BPD	443
C_4	885	BPD	147
Wax	2,400	BPD	575

All-liquid factor is computed as follows, assuming 0.61 of SNG thermal value appears in liquid output:

$$\text{Factor} = (0.61 \times 4{,}474) + 6{,}218 = \frac{8{,}947}{6{,}218} = 1.439$$

Thus, all-liquid product distribution will be:

	MMBTU/hr		MMBtu/hr
Gasoline	7,271	(+ 318 Naphtha + 302 i-butane) =	7,891
C_3	637		637
C_4	212		212
Wax	827		827
	8,947		9,567

APPENDIX C

APPENDIX C

NOTES TO TABLES A-1 THROUGH A-5

1. Unchanged from Base Case.

2. Scaled on capacity using .7 scaling factor.

3. Scaled from Mobil Case 1-B (Reference 13) on which an Autothermal Reformer costing $36.5 MM was required to reform products which produced $48.5 MM SCF/D SNG in Mobil Case 1-B.

4. Capacity of all units assumed proportional to steam plant.

5. The unit cost of the BGC gasifier is assumed equal to the Lurgi Dry Bottom. Fourteen BGC units (12 operating and 2 spares) are required versus 28 Lurgi (25 operating and 2 spares) in the Base Case. Alternative costing methods using Conoco (Reference 8) or Flour (Reference 7) data would have produced much lower relative costs for BGC gasification.

6. Vendor estimate of construction cost of two-reactor unit handling 180,000 lb. mole/hr.

7. Scaled from Base Case Unit 203.

8. Unchanged from corresponding Mixed Product Case.

9. Vendor estimate.

10. Pulverization, bi-model screening, and slurry preparation are assumed to add 10 percent to coal handling costs.

11. Scaled from Flour design for EPRI (Reference 7) using .7 scale factor.

12. Capacity based on waste water in excess of slurry requirements.

13. Includes refrigeration for extra Rectisol unit used in liquid product recovery.

14. Based on a catalyst requirement for the Koelbel reactor of 0.46 times the requirement of the Synthol reactor.

15. Unit 210 unnecessary because of addition of extra Rectisol unit after the Koelbel F-T reactor.

16. Scaled on ratio of flows to catalytic reformer, since this is largest source of generated hydrogen in the refinery.

17. Scaled on base case Btu/hr to 0.7 factor with an additional 20-percent cost added as an estimate of the cost of a Koelbel reactor.

18. No shift required for this case.

19. Scaled from BGC/Koelbel all-liquids case, based on total barrels of liquids.

20. Waste water generated is insufficient to meet quench requirements. Assume that 20 percent of quench water is slipstreamed to waste to prevent contaminant build-up.

This costing methodology is believed to provide a straightforward and accurate measure of the relative costs of plants considered herein. Interpretation of results based on absolute price levels should be avoided.